Course code	Course Name	Load Distribution (L - T - P)
APH 101	FUNDAMENTALS OF HORTICULTURE	(1 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define Horticulture with its different branches and classification.
2. Explain the layout of an orchard with different systems of planting.
3. Understand the methods of propagation, training and pruning, irrigation and fertilizer application.
4. Operate garden tools to gain hands on practical knowledge and experience.
5. Exposed to commercial orchards on educational visits to identify horticultural crops and the problems in their cultivation practices.

UNIT I: **04 hrs**

Horticulture - Its definition and branches, importance and scope.

UNIT II: **04 hrs**

Horticultural and botanical classification, Climate and Soil for horticultural crops, Plant propagation -methods and propagating structures, Seed dormancy, Seed germination.

UNIT III: **04 hrs**

Principles of orchard establishment, Principles and methods of training and pruning, Juvenility and flower bud differentiation.

UNIT IV: **03 hrs**

Unfruitfulness, Pollination, Pollinizers and pollinators, Fertilization and parthenocarpy, Medicinal and aromatic plants.

UNIT V: **03 hrs**

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

Practical:

Identification of garden tools. Major states for horticultural crops in India. Principles of orchard establishment and orchard. Systems of planting. Preparation of seed bed or nursery bed. Preparation of potting mixture. Methods of training. Methods of pruning. Sexual and asexual methods of propagation. Fertilizer application. Micro-propagation. Irrigation methods. Visit to commercial nursery/orchard.

Suggested Reading:

1. Singh Jitendra 2017. Basic Horticulture. Kalyani Publisher/Lyall Book Depot.
2. Simson, S.P. and Straus, M.C. 2000. Basics of Horticuluture. Oxford Book Company, Jaipure, India.
3. Prasad, S. 1997. Principles of Horticulture. Agro-Botanics, Bikaner.
4. Edmond, J.B. 1975. Fundamentals of Horticulture. Mc Graw Hill Pub., New York.
5. Verma AK, Gupta A, Kaur Dharminder& Sharma DK 2015. Practical Manual of Horticultural crops-Pron technologies. New India Publishing Agency.
6. Misra KK 2016. Practical Manual of Horticulture. Biotech Books.

Course code	Course Name	Load Distribution (L -T - P)
ABB 101	FUNDAMENTALS OF PLANT BIOCHEMISTRY & BIOTECHNOLOGY	(2 -0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define preparation of standard solutions and buffer solutions.
2. Explain qualitative estimation of carbohydrates, proteins and amino acids.
3. Classify tissue culturing methods in plant biotechnology
4. Discuss the significance of micropropagation in agriculture.
5. Recognize recent trends in plant biotechnology for crop improvement.

UNIT I: **07 hrs**

Importance of Biochemistry, Properties of Water, pH and Buffer, Carbohydrate: Importance and classification, Structures of Monosaccharides, Reducing and oxidizing properties of Monosaccharides, Mutarotation, Structure of Disaccharides and Poly saccharides, Lipid: Importance and classification, Structures and properties of fatty acids.

UNIT II: **07 hrs**

Proteins: Importance of proteins and classification, Structures, titration and zwitterions nature of amino acids, structural organization of proteins. Enzymes: General properties, Classification, Mechanism of action. Introduction: to allosteric enzymes, Nucleic acids: Importance and classification, Structure of Nucleotides, A, B & Z DNA; RNA: Types and Secondary & Tertiary structure. Metabolism of carbohydrates: Glycolysis, TCA cycle, Glyoxylate cycle, Electron transport chain.

UNIT III: **05 hrs**

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.

UNIT IV: **05 hrs**

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 V: **06 hrs**

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

Practical:

To prepare 0.1 N NaOH solution and to determine its strength by titration against 0.1 N oxalic acid.To determine pH of HCl, NaOH and some buffer solutions by using indicators.To determine Ph of a given solution by using pH meter.To perform qualitative tests on amino acids &proteins.To estimate the total sugars by Dubois method.To estimate the strength of Glycine by formol titration.To estimate total free amino acids by ninhydrin method.Determination of Ascorbic acid using 2,6-dichlorophenolindophenol dye.To identify the end products of acid and enzymatic hydrolysis of starch by paper chromatography.Introduction and demonstration of plant tissue culture laboratory.Study of basic sterilisationtechniques.Production of synthetic seeds.Isolation of plant genomic DNA.Agarose gel electrophoresis.Polymerase Chain Reaction.

Suggested Reading:

1. Arumugam, N. Fundamentals of biochemistry. Saras Publications.
2. Boyer, R.F. 2005. Concepts in Biochemistry (3rd ed.). John Wiley & Sons, New York.
3. Elliot, W.H. and Elliot, D.C., 2009. Biochemistry and Molecular Biology (4th ed.). Oxford University Press, India.
4. Chawla H.S. 2009. Introduction to plant biotechnology. Oxford & IBH Pub Co.
5. Khanna V.K. 1999. Plant tissue culture practices. Kalyani Pub., Ludhiana.
6. Gupta P.K. 2004. Biotechnology & Genomics. Rastogi Publication, Meerut.
7. Lehninger A., Cox, M. and Nelson, D.L. 2008. Principles of Biochemistry (5th ed.). Freeman & Company, W.H.

Course code	Course Name	Load Distribution

		(L - T - P)
APS 101	**FUNDAMENTALS OF SOIL SCIENCE**	**(2 - 0 - 1)**

Learning Outcomes:
After successful completion of this course, the learner will be able to:

1. Define Paedogenesis and the factors which are responsible for soil formation.
2. Describe the various mineral and organic components of soils, including the physical and chemical properties of soil.
3. Understand water retention and movement in soils, especially as it relates to plant water availability.
4. Explain soil chemistry, including pH and CEC, especially how they relate to nutrient availability and soil colloids.
5. Analyze the organic matter content in soil and will understand the role, importance, properties of organic matter.

UNIT I: **06 hrs**
Soil as a natural body, Pedological and edaphological concepts of soil, Soil genesis: soil forming rocks and minerals, weathering, processes and factors of soil formation.

UNIT II: **06hrs**
Soil Profile, components of soil, Soil physical properties: soil-texture, structure, density and porosity, soil colour, consistence and plasticity, Elementary knowledge of soil taxonomy classification and soils of India.

UNIT III: **06 hrs**
Soil water retention, movement and availability, Soil air, composition, gaseous exchange, problem and plantgrowth, Soil temperature, source, amount and flow of heat in soil, effect on plant growth, Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability.

UNIT IV: **05 hrs**
Soil colloids - inorganic and organic; silicate clays: constitution and properties, sources of charge, ion exchange, cation exchange capacity, base saturation.

UNIT V: **07 hrs**
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 - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

P**ractical:**
Study of soil sampling tools. Collection of representative soil sample. Soil processing and storage. Study of soil forming rocks. Study of soil forming minerals. Determination of soil moisture by feel and Bouyoucos method. Determination of soil moisture by volumetric method. Determination of soil pH. Determination of electrical conductivity. Determination of Cation exchange capacity of soil. Determination of soil color. Study of soil map. Demonstration of heat transfer in soil. Estimation of organic matter content in soil.

Suggested Reading:
1. Biswas, T.D. and Mukherjee, S.K. 1994. Text book of soil science. Tata Mc Graw Hill Pub. Co. Pvt. Ltd., New Delhi.
2. Mehra RK. Text Book of Soil Science. ICAR Publication, Delhi.
3. Das DK. Introductory Soil Science. Kalyani Publishers / Lyall Bk Depot.
4. Brady N.C. and Weil, R.R. 2007. The nature and properties of soils (13^{th}ed.). Pearson Prentice Hall.
5. White, H. 1990. Introduction to principles and practices of soil science. Oxford publ., London.
6. Liv Chang, E.Jack 1996. Soil Properties –testing, measurement and evaluation. Prentice hall.

Course code	**Course Name**	**Load Distribution**

		(L - T - P)
AIF 101	**INTRODUCTION TO FORESTRY**	**(1 - 0 - 1)**

Learning Outcomes:
After successful completion of this course, the learner will be able to:

1. Memorize and define the fundamentals of forest and its pattern and processes along with various aspects of forestry.
2. Identify and classify forest and other tree species, their distribution, and associated vegetation and wildlife.
3. Utilize and execute quantitative and qualitative methods for resource analysis and problem solving.
4. Apply the fundamentals of agroforestry and its various aspects.
5. Sketch different agroforestry techniques and identify ways to classify them into relevant categories.

UNIT I:
Introduction – definitions of basic terms related to forestry, objectives of silviculture, forest classification. **02 hrs**

UNIT II: **03 hrs**
Salient features of Indian Forest Policies, 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.

UNIT III: **04 hrs**
Crown classification, Tending operations – weeding, cleaning, thinning – mechanical, ordinary, crown and advance thinning, Forest mensuration – objectives, diameter measurement, instruments used in diameter measurement.

UNIT IV: **0 3 hrs**
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 V: **03 hrs**
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 by nearby forest, farms and plantation areas. Diameter measurements using callipers. Diameter measurements using measuring tape through circumference measurement (CBH) at breast height and application of formula $2\pi r$. Diameter measurements of forked, buttressed, fluted and leaning trees using caliper and measuring tape. Height measurement of standing tree by ocular estimation using pole or pencil. Height measurement of standing trees by shadow method using similar triangle method. Height measurement of standing tree by single pole method using similar triangle method.Height measurement of standing tree by application of geometric principle of similar triangle. Height measurement of standing tree by application of trigonometric principles i.e., tangent method and sine method. Height measurement of standing tree using hypsometer and application of principle of similar triangle. Volume measurement of logs using quarter girth method. Volume measurement of logs using various formulae. Nursery lay out, seed sowing, vegetative propagation techniques. Forestplantations and their management through involvement of students in plantation activities in forest/agriculture areas and regular monitoring.

Suggested Reading:
1.Chaturvedi, A.N. and Khanna, L.S. 1982. Forest Mensuration. International Book Distributor, Dehradun.
2. Chundawat, B.S. and Gautam, S.K. 1996. Text Book of Agroforestry. Oxford & IBH Publishing Co. Pvt Ltd. New Delhi.
3. Khanna L.S. 1981. Priciples and Practices of Silviculture. Khanna Bandhu publishers, Dehradun
4. Dwivedi A.P. 1983. A text book of silviculture. International Book Distributor, Dehradun.

Course code	**Course Name**	**Load Distribution (L - T - P)**

ALE 101	COMPREHENSION AND COMMUNICATION SKILL IN ENGLISH	(1 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Remember the definitions of grammatical terms
2. Understand the basic concept of English Language and it's sentence structure
3. Apply the fundamental knowledge of grammar into writing
4. Demonstrate very good speaking skills
5. Distinguish between different forms of writing skills, like Synthesis and Transformation.

UNIT I: **05 hrs**

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

UNIT II: **01 hrs**

Reading Comprehension, Vocabulary- Antonym, Synonym, Homophones, Homonyms, often confused words.

UNIT III: **04 hrs**

Writing Skills: Paragraph writing, Precise writing, Report writing and Proposal writing. The Style: Importance of professional writing.

UNIT IV: **03 hrs**

Exercises to help the students in the enrichment of vocabulary based on TOEFL and other competitive examinations.

UNIT V: **03 hrs**

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 G.B. Shaw.

Practical:

Listening Comprehension: Listening to short talks lectures. Speeches scientific in nature. Speech commercial in nature. Speech general in nature. Oral Communication: Phonetics, stress and intonation. Conversation practice. Conversation: rate of speech, clarity of voice. Conversation: speaking and Listening.Politeness&Reading skills: reading dialogues, rapid reading, intensive reading, improving reading skills. Mock Interviews: testing initiative. Mock Interviews: team spirit. Mock Interviews: leadership ability. Mock Interviews: intellectual ability. Group Discussions.

Suggested Reading:

1. Krishna Mohan and Meera Banerjee 1990. Developing Communication Skills, Macmillan India Ltd. New Delhi.
2. Jean Naterop, B. and Rod Revell 1997. Telephoning in English Cambridge University Press, Cambridge.
3, Madress Narayanaswamy V R 1979. Strengthen your writing, Orient Longman, New Delhi.

Course code	Course Name	Load Distribution (L - T - P)
APA 101	FUNDAMENTALS OF AGRONOMY	(3 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Explain the agronomy and its scope including the principles & practices of crop production and also will able to identify the different seeds, fertilizers, pesticides and tillage implements.
2. Describe crop nutrition and classify the manure and fertilizer and also students willbe able to understandirrigation criteria and methods
3. Solve numerical exercise on fertilizer dose
4. Classify weeds and calculation on herbicide requirement
5. Analyze the irrigation requirement of the soil.

UNIT I: **08 hrs**

Agronomy and its scope, seeds and sowing, tillage and tilth, crop density and geometry.

UNIT II: **10 hrs**

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, logging.

UNIT III: **10 hrs**

Weeds- importance, classification, crop weed competition, concepts of weed management principles and methods, herbicides- classification, selectivity and resistance, allelopathy.

UNIT IV: **08 hrs**

Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles.

UNIT V: **06hrs**

Adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.

Practical:

Study of identification of the field crops. Study of different tillage implements and their uses. Study of sowing technique of wheat crop. Numerical exercises on fertilizer requirement. Numerical exercise on plant population. Numerical exercise on herbicide doses. Study of Seed germination and viability test. Identification of weeds and study of weed control measure. Identification of fertilizer and pesticides. Study of yield contributing characters and yield estimation. Study of soil moisture measuring devices. Measurement of field capacity, bulk density and infiltration rate. Measurement of irrigation water.

Suggested Reading:

1. Reddy SR 2015. Principles of Agronomy. Kalyani Publishers / Lyall Bk Depot.
2. Katyayan, A 2016. Fundamentals of Agriculture. Volume I & II. Jain Brothers.
3. Chandra De Gopal 1989. Fundamentals of Agronomy. Oxford and IBH Pub. Co. Pvt. Ltd. New Delhi.
4. Reddy, T.Y. and Reddy GHC. 1994. Principles of agronomy. The Bangalore printig and Pub. Co. Ltd. Bangalore.
5. ICAR 2011. Hand Book of Agriculture. Indian Council for Agricultural Research, New Delhi.
6. Tiwari RB & Pandey TD 2012. Practical Agronomy. Kushal Publications.
7. Bhatnagar A 2014. Mathematical Agriculture: concepts & nutrition. Kalyani Publication.

Course code	Course Name	Load Distribution (L - T - P)
ARB 101	**INTRODUCTORY BIOLOGY**	**(1 - 0 - 1)**

Learning Outcomes:
After successful completion of this course, the learner will be able to:

1. Memorize the basic concepts of the living world.
2. Describe the evolutionary patterns of lige.
3. List the plants under Binomial Nomenclature that can be valued for the future studies.
4. Describe the flowering plants and demonstrate their internal structure.
5. Classify the plants and their families and recognize the role of animals in agriculture.

UNIT I:
Introduction to the living world, diversity and characteristics of life, **03 hrs**
UNIT II: **03 hrs**
Origin of life, Evolution and Eugenics.
UNIT III: **04 hrs**
Binomial nomenclature and classification Cell and cell division.
UNIT IV: **03 hrs**
Morphology of flowing plants. Seed and seed germination.
UNIT V: **0 5 hrs**
Plant systematic- viz; Brassicaceae, Fabaceae and Poaceae.
Role of animals in agriculture.

Practical:
Identification of flowering plants. Parts of a flowering plant. Root modifications. Stem modifications. Types of leaf. Leaf modifications. Herbarium and its importance. Identification of plants in a botanical garden: Brassicaceae. Identification of plants in a botanical garden: Fabaceae. Identification of plants in a botanical garden: Poaceae. Internal structure of root. Internal structure of stem. Internal structure of leaf. Types of inflorescence.

Suggested Reading:
1. Ganguly HC, Das KS and Dutta C. College Botany. Vol. I and II. New Central Book Agency, Calcutta.
2. Trueman's Elementary Biology, Volume 1 - By K.N. Bhatia & M.P. Tyagi
3. Trueman's Elementary Biology, Volume 2 - By K.N. Bhatia & M.P. Tyagi
4. Saha LC & Sinha DK 2017. Biology Lab Manual Class 11. Bharati Bhawan Publisher.
5. Saha LC & Sinha DK 2017. Biology Lab Manual Class 12. Bharati Bhawan Publisher.
6. Sharma JP 2013. Comprehensive laboratory manual in Biology. Laxmi Publications.

Course code	Course Name	Load Distribution (L - T - P)
ARM 101	ELEMENTARY MATHEMATICS	(2 - 0 - 0)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Understand coordinate, straight line and apply methods to solve problems.
2. Understand Circle and apply methods to solve problems.
3. Apply technology tools to solve calculus problems
4. Discuss mathematical knowledge and understanding s of maxima, minima and integration
5. Understand matrices and determinant to apply them for solving matrices

UNIT I: **08 hrs**

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.

UNIT II: **05 hrs**

Circle: 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 (x1, y1) & (x2,y2).

UNIT III: **07 hrs**

Differential Calculus : Definition of function, limit and continuity, Simple problems on limit, Simple problems on continuity, Differentiation of xn , ex , sin x & cos x from first principle, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it).

UNIT IV: **05 hrs**

Maxima and Minima of the functions of the form y=f (x) (Simple problems based on it). Integral Calculus: Integration of simple functions, Integration of Product of two functions.

UNIT V: **05 hrs**

Matrices and Determinants: Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order, Properties of determinants up to 3rd order and their evaluation.

Suggested Reading:

1. Gorakh Prasad, 1985. Differential Calculus. Pothishal Private Ltd. Allahabad.
2. Gorakh Pasad, 1985. Integral Calculus, Pothishalrivate Ltd. Allahabad.
3. Loney SL 1905. Co-ordinate Geometry, Macmillian& Co.
4. Kala VN, 2009. Matrices. Laxmi publications.

Course code	Course Name	Load Distribution (L - T - P)
ARH 101	**AGRICULTURAL HERITAGE**	**(1 - 0 - 0)**

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Understand relevance of heritage to the present day agriculture
2. Understand past and present status of agriculture and farmers
3. Recognize indigenous traditional knowledge
4. Analyze importance of agriculture and agricultural resources available in India
5. Demonstrate Indian agriculture, policies and scenarios.

UNIT I: **03 hrs**

Introduction of Indian agricultural heritage; Ancient agricultural practices, Relevance of heritage to present day agriculture.

UNIT II: **02 hrs**

Past and present status of agriculture and farmers in society; Journey of Indian agriculture and its development from past to modern era.

UNIT III: **03 hrs**

Plant production and protection through indigenous traditional knowledge; Crop voyage in India and world.

UNIT IV: **05 hrs**

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

UNIT V: **02 hrs**

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

Suggested Reading:

1. Jeyaraman S, Arokiaraj A, and Manoharan ML. Agricultural Heritage of India. Department of Crop Management, AnbilDharmalingam Agricultural College and Research Institute, Tamil Nadu Agricultural University, Tiruchirapalli-620 009, Tamil Nadu
2. ICAR, 2007. Hand Book of Agriculture. Indian Council for Agricultural Research, New Delhi.

Course code	Course Name	Load Distribution (L - T - P)
ACC 101	RURAL SOCIOLOGY & EDUCATION PSYCHOLOGY	(2 - 0 - 0)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define Sociology, Rural Sociology and its clear cut demarcation with other branches of sociology.
2. State the importance of Rural Sociology in Agricultural Extension.
3. Identify different Social Groups and Institutions based on their characteristics.
4. Describe the features of Educational Psychology and discuss its behavioral features.
5. Apply room study in the midst of rural community.

UNIT I: **08 hrs**

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

UNIT II: **10 hrs**

Social Ecology, Rural society, Social Groups, Social Stratification,

UNIT III: **03 hrs**

Culture concept, Social Institution, Social Change & Development.

UNIT IV: **05 hrs**

Educational psychology: Meaning & its importance in agriculture extension.

UNIT V: **05 hrs**

Behavior: Cognitive, affective, psychomotor domain, Personality, Learning, Motivation, Theories of Motivation, Intelligence.

Suggested Reading:

1. Dahama OP & Bhatnagar OP 1987. Education and Communication for development. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Daivadeenam& Pujari 2002. Education psychology in agriculture. Agrotech Publishing Academy, Udaipur.
3. Chitamber, JB 1973. Introductory Rural Sociology, John Wiley & Sons, New York.

Course code	Course Name	Load Distribution (L - T - P)
AGP 101	FUNDAMENTALS OF GENETICS	(2 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define concepts in heredity list various theories under this field.
2. Solve Probability and Chi-square tests and memorize different gene interactions.
3. Classify mutations based on variations in chromosomes.
4. Compare qualitative and quantitative traits.
5. Discuss gene replication and protein synthesis and understand gene concept.

UNIT I: **07 hrs**

Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity. Architecture of chromosome; chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; special types of chromosomes. Chromosomal theory ofinheritance- cell cycle and cell division- mitosis and meiosis.

UNIT II: **06hrs**

Probability and Chi-square. Dominance relationships, Epistatic interactions with example. Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sexlimited and sex influenced traits, Blood group genetics, Linkage and its estimation.

UNIT III: **05hrs**

Crossing over mechanisms, chromosome mapping. Structural and numerical variations in chromosome antheir implications, Use of haploids, dihaploids and doubled haploids in Genetics. Mutation, classification, Methods of inducing mutations & CIB technique, mutagenic agents and induction of mutation.

UNIT IV: **05 hrs**

Qualitative & Quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance. Genetic disorders.

UNIT V: **07 hrs**

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 operons.

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 Reading:

1. Singh BD 2007. Fundamentals of Genetics. Kalyani Publishers.
2. Verma PS& Agarwal VK 2010. Genetics. S. Chand Publishing Co.
3. Pali Vikas 2017. Practical Handbook of genetics. Kalyani Publishers.
4. Phundan Singh 2013. Plant Genetics. Kalyani Publishers.

Course code	Course Name	Load Distribution (L - T - P)
AMB 101	AGRICULTURAL MICROBIOLOGY	(1 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. State the fundamental differences between types of microorganisms.
2. Describe the structure and biology of bacterial and fungal world.
3. Memorize microbes for fertility and crop production.
4. Discuss how microorganisms fix nitrogen in roots and rhizosphere.
5. Understand and demonstrate how microbes will be utilized in agriculture and evaluate microbial world with agricultural production.

UNIT I:

Introduction to Microbial world: Prokaryotic and eukaryotic microbes. **02 hrs**

UNIT II: **04 hrs**

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

UNIT III: **03 hrs**

Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and Sulphur cycles.

UNIT IV: **03hrs**

Biological nitrogen fixation- symbiotic, associative and asymbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere.

UNIT V: **03 hrs**

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, principlesof microscopy, resolvingpower 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 Reading:

1. Aneja KR 2017. Fundamental Agricultural Microbiology. New Age International Publishers.
2. Rangaswami &Bagyaraj 1992. Agricultural Microbiology. Prentice Hall India Learning Pvt. Ltd.
3. Pelczar MJ, Chan ECS &Kreig NR 1993 Microbiology. McGraw Hill, New York.
4. P Gunasekaran 2009. Laboratory manual in Microbiology. New Age International Publishers.
5. K R Aneja 2017. Experiments in Microbiology, plant Pathology, Tissue Culture and Microbial Biotechnology. New Age International Publishers.
6. Subhashini DV 2013. Laboratory Manual for Basic and Applied Microbiology. Kalyani Publishers.

Course code	Course Name	Load Distribution (L - T - P)
AAE 101	**SOIL & WATER CONSERVATION ENGINEERING**	**(1 - 0 - 1)**

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Identify and recommend soil and water conservation & management practices in agriculture.
2. Define soil erosion and its classification.
3. Classify contour and water harvesting techniques.
4. Evaluate water harvesting measures.
5. Design wind erosion model and demonstrate suitable conservation methods.

UNIT I: **03 hrs**

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

UNIT II: **03 hrs**

Gully classification and control measures. Soil loss estimation by universal Loss Soil Equation. Soil loss measurement techniques. Principles of erosion control.

UNIT III: **04 hrs**

Introduction to contouring, strip cropping. Contour bund. Graded bund and bench terracing. Grassed water ways and their design.

UNIT IV **03 hrs**

Water harvesting and its techniques.

UNIT V **05 hrs**

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 Reading:

1. Suresh R 2014. Soil and water Conservation Engineering. Standard publishers Distributors.
2. Das Ghanshyam 2009. Hydrology and Soil Conservation Engineering IInd Edition. Prentice Hall India Learning Pvt. Ltd.
3. Pal MS 2012. Recent Advances In Irrigation Water Management. Kalyani Publishers.
4. Gurmel Singh 1991. Manual of Soil and Water Conservation Practices. Intercept Ltd.
5. Jaiswal PC 2013. Soil, Plant and Water Analysis. Kalyani Publishers.

Course code	Course Name	Load Distribution (L - T - P)
ACP 101	FUNDAMENTALS CROP PHYSIOLOGY	(1 - 0 - 1)

Learning Outcomes:

1. After successful completion of this course, the learner will be able to:
2. Define crop physiology and its importance in Agriculture.
3. Demonstrate the organization of plants from the level of cells through tissues, tissue system and organs.
4. Memorize the developmental patterns and nutrition in plants.
5. List the various metabolic activities within a plant body and repeat their systematic functioning in detail.
6. Classify plant growth regulators with growth analysis.

UNIT I: **03 hrs**

Introduction to crop physiology and its importance in Agriculture;

UNIT II: **03 hrs**

Plant cell: an Overview; Diffusion and osmosis; Absorption of water, transpiration and Stomatal Physiology.

UNIT III: **03 hrs**

Mineral nutrition of Plants: Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms.

UNIT IV: **05 hrs**

Photosynthesis: Light and Dark reactions, C3, C4 and CAM plants; Respiration: Glycolysis, TCA cycle and electron transport chain; Fat Metabolism: Fatty acid synthesis and Breakdown.

UNIT V: **04 hrs**

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 pigmentsthrough paper chromatography, Rate of transpiration, photosynthesis, respiration, tissue testfor mineral nutrients, estimation of relative water content, Measurement of photosynthetic CO_2assimilation by Infra Red Gas Analyser (IRGA).

Suggested Reading:

1. Pandey and Sinha 2009. Plant Physiology. Vikas Publication House Pvt. Ltd.
2. Jain VK 2017. Fundamentals of Plant Physiology. S. Chand Pub. Company.
3. Kochlar& Gujral 2011. Comprehensive Practical Plant Physiology. Laxmi publications.
4. William F Ganong 2017. A Laboratory Course in Plant Physiology. Forgotten Books Publishers

Course code	Course Name	Load Distribution (L -T - P)
AEC 101	FUNDAMENTALS OF AGRICULTURAL ECONOMICS	(2 -0 - 0)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Communicate effectively in decision making on agricultural and natural resource concepts.
2. Familiarize with the economic issues related to agricultural sector and rural communities.
3. Case study in detail and locate problems and solution.
4. Execute projects on agricultural products and prepare a balance sheet for the same.
5. Classify financial institutions based on their advantages and limitations.

UNIT I: **05 hrs**

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

UNIT II: **05 hrs**

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 III: **06 hrs**

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.

UNIT IV: **08 hrs**

Production: process, creation of utility, factors of production, input output relationship. Population: Importance, Malthusian and Optimum population theories, natural and socio- economic determinants, current policies and programmes on population control.

UNIT V: **06 hrs**

National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. . Tax: meaning, direct and indirect taxes, agricultural taxation, VAT.

Suggested Reading:

1. Sandhu AN, Singh Amarjit & Singh Jasbir 2014. Fundamentals of Agricultural Economics. Himalaya Publishing House.
2. Shah CH 2013. Fundamentals of Agricultural Economics. Kalpaz publications.
3. Lekhi RK& Singh Joginder 2015. Agricultural Economics- An Indian perspective. Kalyani Publisher.

Course code	Course Name	Load Distribution (L - T - P)
APP 101	**FUNDAMENTALS OF PLANT PATHOLOGY**	**(3 - 0 - 1)**

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define various concepts in plant pathology and differentiate a disease from a disorder.
2. Memorize several disease symptoms in plants practically identify them in the field.
3. Classify the life cycle f plant pathogens and discuss their history in detail.
4. Explain the cause of disease in plants and suggest remedial measures.
5. Extraction of pathogens from soil and identify them in the lab.

UNIT I: **10 hrs**

Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Pathogenesis. Causes / factors affecting disease development: disease triangle and tetrahedron and classification of plant diseases. 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.

UNIT II: **06 hrs**

Diseases and symptoms due to abiotic causes.and extraction of nematodes from soil and plant material, preparation of nematode mounting. Study of fungicides and their formulations. Methods of pesticide application and their safe use. Calculation of fungicide sprays concentrations.

UNIT III: **12 hrs**

Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli,fungal tissues, modifications of thallus, reproduction (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions, sub-divisions, orders and classes.

Bacteria and mollicutes: general morphological characters. Basic methods of classification and reproduction.

Viruses: nature, structure, replication and transmission. Study of phanerogamic plant parasites.

Nematodes: General morphology and reproduction, classification, symptoms and nature of damage caused by plantnematodes (*Heterodera, Meloidogyne*, *Anguina*, *Radopholus* etc.)

UNIT IV: **08 hrs**

Growth and reproduction of plant pathogens. Liberation / dispersal and survival of plant pathogens. Types of parasitism and variability in plant pathogens. Pathogenesis. Role of enzymes, toxins and growth regulators in disease development. Defense mechanism in plants.

UNIT V: **06 hrs**

Epidemiology: Factors affecting disease development. Principles and methods of plant disease management. Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.

Practical:

Acquaintance with various laboratory equipments 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 phanerogamic plant parasites.

Study of morphological features and identification of plant parasitic nematodes. Sampling and extraction of nematodes from soil and plant material, preparation of nematode mounting.

Study of fungicides and their formulations. Methods of pesticide application and their safe use. Calculation of fungicide sprays concentrations.

Suggested Reading:

1. Sinha Asoke Kumar & Tripathi D P 2011. Fundamentals of Plant Pathology. Kalyani Publishers.
2. Sinha AK & Tripathi DP 2017. Introductory Plant Pathology. Kalyani Publishers.
3. Jain VK 2009. Laboratory Manual of Plant Pathology. Oxford Book Company.
4. Das PC 2014. Plant Diseases. Kalyani Publishers.

Course code	Course Name	Load Distribution (L - T - P)
APE 101	FUNDAMENTALS OF ENTOMOLOGY	(3 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. State the history of entomology and classify various crop pests.
2. Discuss biotic and abiotic factors in insect ecology.
3. Identify different crop pests and discuss the damages created by them.
4. Locate the crop pests in the actual field and demonstrate necessary control measures.
5. Demonstrate pest control measures with an integrated pest management approach.

UNIT I: **07 hrs**

History of Entomology in India. Major points related to dominance of Insecta in Animal kingdom. Classification of phylum Arthropoda upto classes. Relationship of class Insecta with other classes of Arthropoda. 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. Structure of male and female genital organ.

UNIT II: **07 hrs**

Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs like simple and compound eyes, chemoreceptor.

UNIT III: **08 hrs**

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

UNIT IV: **09 hrs**

Categories of pests. Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Chemical controlimportance, hazards and limitations. Recent methods of pest control, repellents, anti feed ants, hormones, attractants, gamma radiation. Insecticides Act 1968-Important provisions. Application techniques of spray fluids. Symptoms of poisoning, first aid and antidotes.

UNIT V: **11 hrs**

Systematics: Taxonomy –importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insectaupto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain. Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management. Storage structure and methods of grain storage and fundamental principles of grain store management.

Practical:

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

Suggested Reading:

1. Sehgal PK & Mir MA 2014. A Text Book of Agricultural Entomology. Kalyani Publishers.
2. AlamTanweer, Ali MS, Raju SVS &Raghuraman M 2015. A Text Book of Fundamental and Applied Entomolog. Kalyani Publishers.
3. Trigunayat MM 2016.AManualofPracticalEntomology.Scientificpublisher.
4. Alka Prakash 2009. Laboratory Manual of Entomology. New Age Publishers.

Course code	Course Name	Load Distribution (L - T - P)
ACC 102	FUNDAMENTALS OF AGRICULTURAL EXTENSION EDUCATION	(2 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Demonstrate understanding of agricultural extension from both historical and present contexts.
2. Describe and define the principles and functions of agricultural extension.
3. Implement successful group discussions and gain hands on experience in the use of audio-visual aids.
4. Demonstrate various teaching learning methods and discuss their merits and demerits.
5. Solve the problems of rural communities by taking guidance from KVKs and agricultural extension officers.

UNIT I: **04 hrs**

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 II: **06 hrs**

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.).

UNIT III: **07 hrs**

New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc. Rural Development: concept, meaning, definition; various rural development programmes 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.

UNIT IV: **08 hrs**

Extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes; 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.

UNIT V: **05 hrs**

Principles and Functions of Communication, models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of 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 Reading:

1. Mondal S 2015. Agricultural Extension. Kalyani Publishers.
2. Mondal S 2014. Text Book of Agricultural Extension with Global Innovations. Kalyani Publishers.
3. Burman U 2011. Fundamentals of Agricultural Extension. AGROBIOS publications.
4. Ray GL 2015. Extension Communication and Management. Kalyani Publishers.
5. Pandey AK, Srivastava RM & Pandey SN 2005. Dictionary of Extension Communication and Rural Development. Kalyani Publishers.

Course code	Course Name	Load Distribution (L - T - P)
ACC 103	COMMUNICATION SKILLS & PERSONALITY DEVELOPMENT	(1 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Memories communication skills in English.
2. Explain reading and writing skills.
3. Sketch the reports like field diary, footnote and bibliography.
4. Implement reading and comprehension ability of general and technical articles
5. Implement public speaking

UNIT I: **04 hrs**

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

UNIT II: **02 hrs**

Listening and note taking, writing skills, oral presentation skills.

UNIT III: **04 hrs**

Field diary and lab record; indexing, footnote and bibliographic procedures.

UNIT IV: **03 hrs**

Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting.

UNIT V: **03 hrs**

Individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences. Preparation of Curriculum Vitae and Job applications, Synopsis Writing, Interviews: kinds, Importance and process.

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 Reading:

1. Krishna Mohan and Meera Banerjee 1990. Developing Communication Skills, Macmillan India Ltd. New Delhi.
2. Jean Naterop, B. and Rod Revell 1997. Telephoning in English Cambridge University Press, Cambridge.
3. Madress Narayanaswamy V R 1979. Strengthen your writing, Orient Longman, New Delhi.
4. Narula SS 2013.Personality Development and Communication Skills. Taxmann's Publishers.
5. Sanjay Kumar & Pushpalata 2015. Communication Skills. Oxford University Press.

Course code	Course Name	Load Distribution (L - T - P)
APA 201	CROP PRODUCTION TECHNOLOGY – I (KHARIF CROPS)	(1 - 0 - 1)

Learning Outcomes:
After successful completion of this course, the learner will be able to:
1. Define crop production technology for Kharif crops.
2. List various package of practices.
3. Classify crops and cropping techniques.
4. Evaluate water harvesting measures.
5. Question appropriately on crop failures.

Unit I: **06 hrs**
Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops- Cereals – rice, maize, sorghum, pearl millet and finger millet.

Unit II:
Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Pulses-pigeonpea, mungbean and urdbean. **04 hrs**

Unit III:
Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Oilseeds- groundnut, and soybean. **02 hrs**

Unit IV:
Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Fibre crops- cotton & Jute. **02 hrs**

Unit V:
Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Forage crops-sorghum, cowpea, cluster bean and napier. **02 hrs**

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, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of kharif season crops, study of crop varieties and importantagronomic experiments at experimental farm. study of forage experiments, morphological description of kharif season crops, visit to research centres of related crops.

Suggested Reading:

1. Tomar, Suresh Singh and Yagya Dev Mishra. Production Technology of Kharif Crops. Astral publishers.
2. Mukund Joshi. Textbook of field crops. PHI Learning Pvt. Ltd.
3. Ahlawat,I.P.S., Om Prakash and Saini ,G.S. 1998. Scientific Crop Production in India. Rama publishing House, Meerut
4. Chidda ,S. 1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi
5. Singh. S.S. 1997. Crop management under irrigated and rainfed conditions. Kalyani Publishers, New Delhi

Course code	Course Name	Load Distribution (L - T - P)
AGP 201	FUNDAMENTALS OF PLANT BREEDING	(2 - 0 - 1)

Learning Outcomes:
After successful completion of this course, the learner will be able to:
1. State the historical developments in Plant Breeding.
2. Describe self incompatibility and male sterility and list the centres of origin.
3. Demonstrate the breeding methods in self pollinated crops.
4. Differentiate cross pollination clearly from self pollination.
5. Distinguish various breeding and hybridization techniques.

UNIT I: **04 hrs**
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.

UNIT II: **06 hrs**
Self-incompatibility and male-sterility, its genetic consequences; Domestication, acclimatization and introduction; Centers of origin/ diversity; Components of genetic variation, heritability and genetic advance.

UNIT III: **07 hrs**
Genetic basis and breeding methods in self-pollinated crops, mass and pure line selection, hybridization technique and handling of segregating population, multiline concept; Concepts of population genetics and Hardy- Weinberg law.

UNIT IV: **08 hrs**
Genetic basis and methods of breeding in 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 V: **05 hrs**
Breeding methods in asexually propagated crops, clonal selection and hybridization; Wide hybridization and pre breeding; Polyploidy in relation to plant breeding; Mutation breeding- methods and uses; Breeding for importantbiotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders and & Farmer's Rights.

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Practical:
Plant Breeder's kit, Study of germplasm of various crops. Study of floral structure ofself-pollinated and cross pollinated crops. Emasculation and hybridization techniques in self & cross pollinated crops. Consequences of inbreeding on genetic structure of resulting populations. Study of male sterility system. Handling of segregation populations. Methods of calculating mean, range, variance, standard deviation, heritability. Designs used in plant breeding experiments, analysis of Randomized Block Design. To work out the mode of pollination in a given crop and extent of natural out-crossing. Prediction of performance of double cross hybrids.

Suggested Reading:

1. Phundan Singh. Fundamentals of Plant Breeding. Kalyani Publishers.
2. B. D. Singh. Plant Breeding : Principles and Methods. Kalyani Publishers.
3. Allard, R. 1989. Principles of Plant Breeding. John Wiley and Sons, New Delhi.
4. Chaudhary, R. C. 2014. Introductory Principles of Plant Breeding. Oxford and IBH Publishing co. New Delhi.
5. Chopra, V. L. 1990. Plant Breeding - Theory and Practice. Oxford and IBH Publishing Co. Pvt. Ltd. New - Delhi.
6. Chahal, G.S. and Gosal, S.S. Principles and Procedures of Plant Breeding. Narosa Publishing House, New Delhi.
7. Chaudhary, R. C. 2014. Introductory Principles of Plant Breeding. Oxford and IBH Publishing co. New Delhi.

Course code	Course Name	Load Distribution (L - T - P)
AEC 201	AGRICULTURAL FINANCE AND COOPERATION	(2 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Understand the significance of Finance in Agricultural development.
2. Know the need of agricultural credit & various credit financing institutions.
3. Learn the meaning and concept of Agricultural Cooperation and its development in India.
4. Understand micro financing schemes.
5. Understand the finance fundamentals such as application of balance sheet, P/L account and feasibility report.

UNIT I: **06 hrs**

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. Sources of agricultural finance: institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks.

UNIT II: **06 hrs**

An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent development in agricultural credit.

UNIT III: **08 hrs**

Agro 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.

UNIT IV: **06 hrs**

Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost, role of ICA, NCUI, NCDC, NAFED.

UNIT V: **06 hrs**

Importance of capital, Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis.

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 Reading:

1. RaJ, K. Prabhakar 2008. Agricultural Finance in India: The Role of NABARD. Ist edition. New, Century Publications.
2. Roy D. 2008. Rural Banking and Agricultural Finance in India. Rajat Publications.

Course code	Course Name	Load Distribution (L - T - P)
AAI 201	AGRI-INFORMATICS	(1 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. State what Information Technology is..
2. Explain the importance of MS office.
3. Execute challenging and innovative assignments in Agricultural System built-in with effective ICT enabled
4. "Information Systems".
5. Innovate, use and adopt ICT enabled services for augmenting agriculture system through management development programs
6. Identify contemporary research areas and create enabling ecosystem through seed funding, incubating and piloting cutting edge ICT enabled interventions by engaging researchers.

UNIT I: **04 hrs**

Introduction to Computers, Operating Systems, definition and types, Applications of MS-Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions, database, concepts and types, uses of DBMS in Agriculture, World Wide Web (WWW): Concepts and components.

UNIT II: **02 hrs**

Introduction to computer programming languages, concepts and standard input/output operations-Agriculture, concepts and applications, Use of ICT in Agriculture.

UNIT III: **04 hrs**

Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management.

UNIT IV: **03 hrs**

Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc; Geospatial technology for generating valuable agri-information.

UNIT V: **03 hrs**

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 Reading:

1. Balagurusamy E. 2009. Fundamentals of Computers, McGraw Hill Education.
2. John Paul Mueller. 2012. Windows 8 for Dummies Quick Reference, Wiley.

Course code	Course Name	Load Distribution (L -T - P)
AAE 201	FARM MACHINERY AND POWER	(1 -0 - 1)

Learning Outcomes:
After successful completion of this course, the learner will be able to:

1. Memorize the principles of different engines.
2. Identify the different components of IC engines.
3. Describe the tractor and discuss on tillage operations.
4. Use of various implements in hill agriculture.
5. Differentiate plant protection, harvest and post harvest equipments.

Unit 1 **02 hrs**
Status of farm power in India, sources of farm power, IC engines, working principles of IC engines, comparison of two stroke and four stroke engines

Unit 2 **04 hrs**
Study of different components of IC engines, IC engine terminology, solved problems, air cooling, cleaning and lubrication, fuel supply and hydraulic control of a tractor

Unit 3 **03 hrs**
Tractor types, cost analysis of tractor power and attached implement familiarization with primary and secondary tillage

Unit 4 **03 hrs**
Implement of hill agriculture, implement of intellectual operations, familiarization with sowing and planting equipments, calibration of seed drills, solved problems

Unit 5 **03 hrs**
Familiarization with plant protection equipment, familiarization with harvesting equipment, familiarization with 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 seedcum-fertilizer drills their seed metering mechanism and calibration, planters and transplanter Familiarization with different types of sprayers and dusters Familiarization with different intercultivation equipment, Familiarization with harvesting and threshing machinery.

Suggested Reading:

1. Dr. R. Suresh, Sanjay Kumar. Farm Power and Machinery Engineering. Standard Publishers.
2. Shagufta. Farm Machinery and Power. Aph publishing corporation.
3. Nakra, CP. 1970. Farm Machinery and equipment, Dhanpat Rai & son.
4. Jagdishwar, S. 1992. Elements of agricultural engineering, Agro book agency.
5. Srivastava, A.C. 1990. Elements of Farm Machinery. Oxford IBH pub Co. New Delhi.

Course code	Course Name	Load Distribution (L - T - P)
APV 201	PRODUCTION TECHNOLOGY FOR VEGETABLES AND SPICES	(1 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Memorise the importance of vegetables & spices crops.
2. Discuss the package of practices for various crops.
3. Sketch a suitable flowchart for crops under vegetables and spices.
4. Compare the production technologies.
5. Discuss the technologies based on various factors.

UNIT I: **02 hrs**

Importance of vegetables and spices in human nutrition and national economy – Classification of vegetables - 1) Botanical 2) Based on Hardiness 3) Parts Used 4) Method of culture 5), Season. Botanical Name – Family – Origin – Area – Production- Improved varieties and cultivation practices such as time of Sowing – transplanting techniques - Planting distance - Fertilizer requirements - Irrigation – Weed management - Harvesting - Yield - Storage - Physiological disorders – Disease and pest control and seed production of **Tomato**, **Brinjal** and **Chilli**.

UNIT II: **04hrs**

Botanical name – Family - Origin - area - Production - Improved varieties and cultivation practices such as time of Sowing - Planting distance - Fertilizer requirements – Irrigation Weed management - Harvesting - Yield - Storage - Disease and pest control and seed production of **Okra** and Leafy vegetables (**Amaranthus**), Cucurbits – Flowering, sex expression, sex ratio - Cucumber, Ridge gourd, Bitter gourd, Bottle gourd.

UNIT III: **03hrs**

Botanical name – Family - Origin - Area - Production - Improved varieties and cultivation practices such as time of Sowing - Planting distance - Fertilizer requirements - Irrigation – Weed management - Harvesting - Yield – Production of seedless watermelons – Storage - Physiological disorders - Disease and pest control and seed production of Cole crops- **Cabbage** and **Cauliflower** - **Peas** and **beans** (French bean), Root crops (**Carrot** and **Radish**)

UNIT IV: **03 hrs**

Botanical name – Family - Origin - Area - Production - Improved varieties and cultivation practices such as time of Sowing - Planting distance - Fertilizer requirements – Irrigation-Weed management - Harvesting - Yield –Storage - Physiological disorders - Disease and pest control and seed production of **potato**, Bulb crops (**Onion** and **Garlic)**.

UNIT V: 03 hrs

Botanical name – Family - Origin - Area - Production - Improved varieties and cultivation practices such as time of Sowing - Planting distance - Fertilizer requirements – Irrigation-Weed management - Harvesting - Yield –Storage - Physiological disorders - Disease and pest control and seed production of **Ginger, Turmeric, Cinnamon,Coriander**and **Fenugreek.**

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. Economics of vegetables and spices cultivation.

Suggested Reading:

1. S Thamburaj and Narendra Singh .Textbook of Vegetables, Tubercrops& Spices. ICAR.
2. Prem Singh Arya. Vegetable Breeding and Seed Production. Kalyani Publishers.
3. Neeraj Pratap Singh, .2007; Basic Concepts of Vegetable Science; International Book Distributing Co. New Delhi. Academic Press, New Delhi.
4. Prem Singh Arya and S. Prakash, 2002. Vegetables Growing in India; . Kalyani Publishers, New Delhi
5. Shanmugavelu, K.G., N. Kumar and K.V. Peter 2005. Production Technology of Spices and Plantation Crops; Agrobios (India), Jodhpur.
6. Bose, T. K, Kabir, J., Maity T. K., Parthasarathy V. A., and Som M. G., 2002; Vegetable Crops-Vol. II & III; Naya Prokash, Kolkata.

Course code	Course Name	Load Distribution

		(L - T - P)
AES 201	**ENVIRONMENTAL STUDIES & DISASTER MANAGEMENT**	**(2 - 0 - 1)**

Learning Outcomes:
After successful completion of this course, the learner will be able to:

1. List the multi disciplines in environmental sciences.
2. Explain ecosystem and classify them based on structure and function.
3. Discuss Biodiversity and its conservation.
4. Discuss the types of environmental pollution and discuss on their effects.
5. Define disaster management and describe in detail.

UNIT I: **07 hrs**

Multidisciplinary nature of environmental studies Definition, scope and importance. Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems. Forest resources: Use and over-exploitation, deforestation, timber extraction, mining, dams and their effects on forest and tribal people. b) Use and over-utilization of Water resources, dams; Mineral resources; Food resources, world food problems; Energy resources: Growing energy needs, renewable and non-renewable energy sources; Land resources, deforestation,
desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT II: **07 hrs**

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.

UNIT III: **08 hrs**

Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and 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-sports of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. 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.

UNIT IV: **09 hrs**

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.

UNIT V: **11 hrs**

Disaster Management: Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods,drought, cyclone, earthquakes, landslides, avalanches, 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 migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community–based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

Cont.

Practical:

Pollution case studies. Case Studies- Field work: Visit to a local area to document environmentalassets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site-Urban/Rural/Industrial/ Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.

Suggested Reading:

1. Bharucha Erach 2013. Text book of Environmental studies for undergraduate courses. IInd edition. University Grant Commission, Universities Press (India) Private Limited, Delhi, India.
2. Varun Dutt Sharma, S K Pandey, Vimal Kumar Sharma. Environmental education and disasterManagement: common to all engineering and non-engineering disciplines. CBS Publishers andDistributors.
3. Alka Chauhan, Pawan Kumar Bharti. Climate Change, Disaster Management and Environment. Discovery Publishing House Pvt. Ltd.
4. Bohra, C.S. 2015, Introduction to Environmental Biology, Discovery Publication House Pvt Ltd., New Delhi.
5. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications, Meerat, India.
6. William P. Cunningham and Mary Ann Cunningham, 2007. Principles of Environmental Sciences, Tata McGraw hill Publishing company, New Delhi.

Course code	Course Name	Load Distribution (L - T - P)
ASM 201	STATISTICAL METHODS	(1 - 0 - 1)

Learning Outcomes:

1. State the fundamentals in statistical methods.
2. Describe the probability and classify their distributions.
3. Demonstrate correlation and regression with equations.
4. Compare mean, chi square and analysis of variance.
5. Experiment on sampling techniques and analysis.

UNIT I: **02 hrs**

Introduction to Statistics and its Applications in Agriculture - Graphical Representation of Data. Measures of Central Tendency- Dispersion - Skewness and Kurtosis.

UNIT II: **04 hrs**

Definition of Probability - Addition and Multiplication Theorem - Simple Problems Based on Probability Theory. Binomial - Poisson - Normal Distributions and their Properties.

UNIT III: **03 hrs**

Definition of Correlation - Scatter Diagram - Karl Pearson's Coefficient of Correlation. Linear Regression Equations. Introduction to Test of Significance - One sample -Two Sample.

UNIT IV: **03 hrs**

Test for Means. Chi-Square Test of Goodness of fit - Chi-Square Test of Independence of Attributes in 2 x 2 contingency table. Introduction to Analysis of Variance - Analysis of One Way and Two Way Classification.

UNIT V: **03 hrs**

Introduction to Sampling Methods - Sampling versus Complete Enumeration - Simple Random Sampling with and without replacement - Use of Random Number Tables for selection of Simple Random Sample.

Practical:

Graphical Representation of Data. Measures of Central Tendency (Ungrouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Central Tendency (Grouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Dispersion (Ungrouped Data).Measures of Dispersion (Grouped Data). Moments, Measures of Skewness & Kurtosis (Ungrouped Data). Moments, Measures of Skewness & Kurtosis (Grouped Data). Correlation & Regression Analysis. Application of One Sample t-test. Application of Two Sample Fisher's t-test. Chi-Square test of Goodness of Fit. Chi-Square test of Independence of Attributes for 2 ×2 contingency table. Analysis of Variance One Way Classification. Analysis of Variance Two Way Classification. Selection of random sample using Simple Random Sampling.

Suggested Reading:

1. R. Rangaswamy. A Textbook of Agricultural Statistics. NEW AGE International publishers, Hyderabad.
2. S P Gupta. Statistical Methods. Sultan Chand & Sons.
3. Nageswara Rao, G 2007. Statistics for Agricultural Sciences. B S Publications, Hyderabad.

Course code	Course Name	Load Distribution (L - T - P)
VEC 201	LIVESTOCK AND POULTRY MANAGEMENT	(3 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define livestock and its importance in Agriculture.
2. Demonstrate the management of livestock.
3. Memorize the Indian and exotic breeds of livestock.
4. Understand the need of poultry sector and its management.
5. Classify important diseases of livestock and poultry.

Unit I: **09 hrs**

Role of livestock in the national economy. Reproduction in farm animals and poultry. Housing principles, space requirements for different species of livestock and poultry.

Unit II: **11 hrs**

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

Unit III: **09 hrs**

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

Unit IV: **11 hrs**

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

Unit V: **06 hrs**

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 Reading:

1. Sastry N.S.R. Livestock Production Management, B.Sc.Kalyani Publishers.
2. Jagdish Prasad. Principles & Practices of Livestock Production Management.Kalyani Publishers.
3. Jull, M.A.2003. Successful Poultry Management Kadirvel, R., and Balakrishnan, V., 1998. Hand Book of Poultry Nutrition. Madras Veterinary College, TANUVAS., Chennai.
4. Prabakaran, R., 1998. Commercial Chicken Production. Publisher P.Saranya, 5/2, Ramalingam Street, Seven Wells, Chennai

Course code	Course Name	Load Distribution (L - T - P)
APA 202	CROP PRODUCTION TECHNOLOGY – II (RABI CROPS)	(1 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. List the concepts related to the cultivation of rabi crops.
2. Understand various crop types and its importance.
3. Classify rabi crops into cereals, pulses etc.
4. Evaluate cultivation practices for a rabi crop.
5. Design crop production schedule with respect to environmental factors.

UNIT I: **03 hrs**

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

UNIT II: **03 hrs**

Cereals – wheat and barley, Pulses- chickpea, lentil, peas;

UNIT III: **03 hrs**

Oilseeds- rapeseed, mustard and sunflower;

UNIT IV: **03 hrs**

Sugar crops- sugarcane; medicinal and aromatic crops-mentha, lemon grass and citronella

UNIT V: **03 hrs**

Forage crops- berseem, lucerne and oats.

Practical:

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

Suggested Reading:

1. Ahlawat,I.P.S., Om Prakash and Saini ,G.S. 1998. Scientific Crop Production in India. Rama publishing House, Meerut
2. Chidda ,S. 1997. Modern techniques of raising field crops. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi
3. Singh. S.S. 1997. Crop management under irrigated and rainfed conditions. Kalyani publishers, New Delhi

Course code	Course Name	Load Distribution (L - T - P)
APH 202	PRODUCTION TECHNOLOGY FOR ORNAMENTAL CROPS, MAP AND LANDSCAPING	(1 - 0 -1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define concepts in MAP and landscaping.
2. Identify various ornamental, medicinal & aromatic crops on the basis of morphological characteristics.
3. Classify medicinal, ornamental and aromatic plants based on their usage.
4. Practice the cultivation of various ornamental, medicinal & aromatic crops along with landscaping principles.
5. Understand processing and value addition concepts.

UNIT I: **02 hrs**

Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping - Landscape uses of trees, shrubs and climbers. Principles of landscaping - Initial approach – Axis – Focal Point – Mass effect – Unity – Space – Divisional Lines – Proportion and Scale – Texture – Time and Light – Tone and Colour – Mobility – Rhythm – Balance – Contract – Harmony- Vista – Style. Production technology of cut flowers under protected conditions -**Rose** – Introduction-origin and distribution- Classification- Species and varieties- Climate and soil requirements- Propagation – Rootstocks- Stock scion compatibility- Land preparation- planting- Manures and fertilizers- Cultural operations (pruning- pinching and mulching) harvesting- Post harvest management- Yield and rose bi-products.

UNIT II: **04 hrs**

Production technology of **Gerbera** - Introduction- Origin and distribution- Classification- Species and varieties- Climate and soil requirements- Propagation- Land preparation- Planting- Manures and fertilizers- Cultural operations - Defoliation- Soil loosening- Shading- use of growth regulators- Physiological disorders- Harvesting-Post harvest management and yield. Production technology of **Carnation** - Introduction- Origin and distribution-Classification- Species and varieties- Climate and soil requirements- Propagation- Land preparation- Planting-Manures and fertilizers- Cultural operations- (Pinching and disbudding) use of growth regulators- Physiological disorders- Harvesting- Post harvest management and yield. Production technology of **Lilium** - Introduction- Origin and distribution- Classification- Species and varieties- Climate and soil requirements- Propagation- Land preparation- Planting- Manures and fertilizers- Cultural operations- Use of growth regulators- Physiological disorders- Harvesting- Post harvest management and yield.

UNIT III: **03 hrs**

Production technology of cut flowers under open conditions - **Gladiolus**- Introduction- Origin and distribution- Classification of varieties- Species and varieties- Climate and soil requirements- Propagation- Land preparation- Planting- Manures and fertilizers- Cultural operations- Use of growth regulators-Physiological disorders-Harvesting- Post harvest management and yield. Production technology of **Chrysanthemum** - Introduction- Origin and distribution- Classification- Species and varieties- Climate and soil requirements- Propagation- Land preparation- Planting, Manures and fertilizers- Cultural operations- Pinching and disbudding - Use of growth regulators- Harvesting- Post harvest management and yield. Loose flowers - Marigold and Jasmine under open conditions - Introduction- Origin and distribution- Species and varieties- F1 hybrids- Climate and soil requirements-Propagation- Land preparation- Planting- Manures and fertilizers- Cultural operations- Pinching and disbudding - Use of growth regulators- Harvesting- Post harvest management and yield.

UNIT IV: **03 hrs**

Medicinal plants – Scope and Importance – Production technology of **Asparagus**, **Aloe** - Botanical name – Family - Origin - Economic part - Introduction – Climate – Soil - Varieties – Propagation – Planting - Manuring - Irrigation - Intercultural operations - Harvesting - Yield. Production technology of **Mint** and **Ocimum** - Botanical name – Family - Origin - Economic part - Introduction – Climate – Soil - Varieties – Propagation – Planting - Manuring - Irrigation - Intercultural operations - Harvesting - Yield.

UNIT V: **03 hrs**

Production technology of **Lemongrass**, **Citronella**, -Botanical name – Family - Origin – Economic part - Introduction – Climate – Soil - Varieties – Propagation – Planting – Manuring - Irrigation - Intercultural operations

Cont.

Harvesting - Yield. Production technology of **Geranium** - Botanical name – Family - Origin - Economic part –

Introduction – Climate – Soil - Varieties – Propagation – Planting - Manuring - Irrigation - Intercultural operations - Harvesting - Yield. Processing and value addition in ornamental crops and MAPs produce. Dry-flower making - Extraction methods of essential oils etc.

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 Reading:

1. Bose, T.K. 1999; Floriculture and Landscaping; Naya Prakash, Kolkatta.
2. Bose, T.K. and Yadav, L.P. 1992; Commercial Flowers; Naya Prakash, Kolkatta.
3. Randhawa, G.S. and Mukhopadhyaya, A. 1994; Floriculture in India; . Allied Publishers, Pvt. Ltd., New Delhi
4. Chattopadhyay, S.K. 2007; Commercial Floriculture; Gene-Tech Books, New Delhi.
5. Srivastava, H.C.2014; Medicinal and Aromatic Plants; ICAR, New Delhi.
6. Kumar, N., Abdul Khader, J.B.M, Rangaswamy, P and Irulappan, I. 2004; Introduction to Spices, Plantation Crops, Medicinal and Aromatic Crops; Oxford and IBH Publishing Co, New Delhi.
7. J S Arora. Introductory Ornamental Horticulture. Kalyani Publishers.
8. K L Chadha and B Chaudhary. Ornamental Horticulture in India. ICAR.

Course code	Course Name	Load Distribution (L - T - P)
AAE 202	**RENEWABLE ENERGY AND GREEN TECHNOLOGY**	**(1 - 0 - 1)**

Learning Outcomes

After successful completion of this course, the learner will be able to:

1. Understand and identify renewable energy gadgets
2. Describe production process of biodiesel
3. Recognize solar energy gadgets
4. Describe wind and nuclear energy
5. Demonstrate solid waste management system

UNIT I: **06 hrs**

Classification of energy sources: conventional and non-conventional sources of energy; contribution of these sources in agricultural sector; Biomass: utilization for biofuel production and their application; Familiarization with renewable energy gadgets; Application of geothermal energy and tidal energy/

UNIT II: **06 hrs**

Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and biooil production and their utilization as bioenergy resource. Study the production process of biodiesel.

UNIT III: **05 hrs**

Introduction of solar energy, collection and their application, Familiarization with solar energy gadgets: solar cooker, solar water heater, solar photovoltaic system, solar light, solar pumping, solar fencing, solar, drying system, solar distillation and solar pond.

UNIT IV: **05 hrs**

Introduction of wind energy and their application; Nuclear reactions: mechanism, radioactivity decay chains, reactors, characteristics of nuclear fuels, types of nulcear waste, radiation hazardous prevention.

UNIT V: **06 hrs**

Solid waste: definition, source, tupe, composition and properties; Municipal solid waste: physical, chemical and biological properties, minimization and recycling; Industrial solid waste: Composition, biodegradable and non-biodegradable hazardous, methods of detoxification, impact on environment

Practical:

Familiarization with reneawble energy gadgets. To study biogas plants, to study gasifier, to study the production process of biodiesel, to study briquetting machines, to study the production process of biofuel. 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 soalr pond.

Suggested Reading:

1. Singh Ritu, Kumar Sanjeev 2017. Green technology and environmental sustainability. Springer.
2. Kothari et al. 2011. Renewable energy sources & emerging technology. 2nd Edition. PHI Learning Pvt. Ltd-New Delhi.
3. Khan BH 2009. Non-Conventional Energy Resources 2nd Edition. Mcgraw Hill Education.

Course code	Course Name	Load Distribution (L - T - P)
APS 201	PROBLEMATIC SOILS AND THEIR MANAGEMENT	(2 - 0 - 0)

Learning Outcomes:
After successful completion of this course, the learner will be able to:
1. State soil health and quality.
2. Familiarize with the problem soils in India and their reclamation.
3. Case study in detail and locate problems and solution.
4. Understand the quality. standards and recycling of irrigation waters.
5. Apply bioremediation to treat problem soils.

UNIT I: **05 hrs**
Soil quality and health, Distribution of Waste land and problem soils in India. Their categorization based on properties.

UNIT II: **05 hrs**
Reclamation and management of Saline and sodic soils, Acid soils, Acid Sulphate soils

UNIT III: **06 hrs**
Eroded and Compacted soils, Flooded soils, Polluted soils

UNIT IV: **08 hrs**
Irrigation water – quality and standards, utilization of saline water in agriculture. Remote sensing and GIS in diagnosis and management of problem soils.

UNIT V: **06 hrs**
Multipurpose tree species, bio remediation through MPTs of soils, land capability and classification, land suitability classification. Problematic soils under different Agro-ecosystems.

Suggested Reading:
1. Arakeri, H.R.and Donahue, R.L. (1984). Principles of Soil Conservation and water management Oxford and IBH Publ. Co. Pvt. Ltd.,New Delhi.
2. Lal, P.; Chhipa, B.R. and Kumar, A. (1993). Salt affected Soils and Crop Production. Agro- Botanical Publ., Bikaner.
3. Somani, L.L. (1996). Crop Production in Acid Soils. Agro-tech. Publ. Academy, Udaipur.
4. Tripathi, R.P. and Singh, H.P. (1993). Soil Erosion and Conservation. Wiley Eastern, New Delhi.

Course code	Course Name	Load Distribution (L -T - P)
APH 203	PRODUCTION TECHNOLOGY OF FRUIT AND PLANTATION CROPS	(1 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. State the importance and scope of fruit crops.
2. Identify various fruits & plantation crops on the basis of morphological characteristics
3. Describe the production technologies of fruit crops.
4. Discuss the pests and diseases of fruit crops.
5. Understand and practice the cultivation of various fruits & plantation crops.

UNIT I: **02 hrs**

Importance and scope of fruit crops - High density planting - Canopy management- Use of rootstocks in fruit crops. Production technologies of **Mango** - Botanical name - Family – Origin – Introduction - Varieties – Climate – Soil- Propagation - Planting - Manuring- Irrigation – Inter Cultivation – Harvesting – Yield – Pests - Stem borer - Nut weevil -Fruit fly - Leaf webber - Diseases - Powdery mildew - Anthracnose - Sooty mould - Mango malformation - Physiological disorders-Fruit drop-Alternate bearing- Spongy tissue. Production technology of **Banana** - Botanical name - Family – Origin - Importance- Varieties – Climate – Soil - Propagation- Planting – Manuring - Irrigation – Inter Cultivation practices – Harvesting – Yield – Pests - Rhizome weevil - Pseudo Stem weevil- diseases - Sigatoka leaf spot - Panama wilt - Rhizome rot - Bunchy top.

UNIT II: **04 hrs**

Production technology of **Citrus** (Big Lemon & Malta)- Botanical name – Family - Origin- Introduction - Varieties – Climate – Soil - Propagation - Planting - Manuring - Irrigation – Inter Cultivation – Harvesting – Yield – Pests - Butter fly - Fruit sucking moth – Citrus leaf miner - Diseases – Gummosis – Canker - Tristeza - Physiological disorders - Fruit drop – Granulation. Production technology of **Grape**- Botanical name- Family- Origin-Introduction - Varieties – Climate – Soil - Propagation- Planting- Manuring- Irrigation – Inter Cultivation – Harvesting – Yield – Pests-Flea beetles – Mealy bug - Stem girdler Diseases- Powdery mildew - Downy Mildew – Anthracnose – Physiological disorders- Pink berries. Production technology of **Guava** and **Litchi** - Botanical name-Family- Origin- Introduction - Varieties – Climate – Soil- Propagation - Planting- Manuring- Irrigation – Inter Cultivation – Harvesting – Yield – Pests of Guava - Tea mosquito bug - Mealybug - Diseases of Guava – Wilt.

UNIT III: **03 hrs**

Production technology of **Papaya** - Botanical name - Family- Origin- Introduction- Varieties – Climate – Soil – Propagation – Planting – Manuring - Irrigation – Inter Cultivation – Harvesting – Yield – Pests – Nematodes - diseases - Powdery mildew - Foot rot – Mosaic. Production technology of **Apple, Pear, Peach** - Botanical name – Family – Origin –Importance – Varieties – Climate – Soil – Propagation - Planting- Manuring- Irrigation – Inter Cultivation – Harvesting – Yield – Pests of Apple - Wooly aphid, Codling moth - Pests of Peach - Fruit Fly - Diseases of Apple- Scab – Powdery mildew- Physiological disorder in apple - Bitterpit - Diseases of Pear- Fruit spot - Diseases of Peach- Leaf curl. Production technology of Minor fruits-, **Pomegranate** - Botanical name- Family-Origin- Importance- Varieties – Climate – Soil- Propagation- Planting- Manuring- Irrigation – Inter cultivation – Harvesting – Yield, Pests of pomegranate- Butterfly -Fruit sucking moth; Diseases of pomegranate - Anthracnose and bacterial leaf spot - Physiological disorders of pomegranate - Fruit cracking.

UNIT IV: **03 hrs**

Production technology of **Jackfruit**, **Strawberry**, Nut crops (**Almond**&**Walnut**) - Botanical name- Family- Origin- Importance- Varieties – Climate – Soil- Propagation- Planting- Manuring- Irrigation – Inter cultivation – Harvesting – Yield – Pests of Jackfruit - Spittle bug - Fruit borer – Diseases of Jackfruit - Rhizopus rot - Die back.

UNIT V: **03 hrs**

Plantation crops- Scope and Importance; Production technology of **Tea** - Botanical name- Family- Origin-Importance- Varieties – Climate – Soil- Propagation- Planting- Manuring- Irrigation – Inter cultivation – Harvesting – Yield - Processing- Pests of Tea - Tea mosquito bug- Red spider mite - Diseases of Tea - Algal leaf spot- Blister blight.

Cont.

Practical:

Seed propagation. Scarification and stratification of seeds. Propagation methods for fruit and plantation crops. Description and identification of fruit. 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 Reading:

1. Bose, T.K. and Mitra, S.K. 1990; Fruits – Tropical and Sub-tropical; Naya Prakashan, Calcutta.
2. Chattopadhya, P. K. Year; Text Book on Pomology (Fundamentals of Fruit Growing). Kalyani Publishers, Ludhiana.
3. Parthasarathy, V. A., P.K.Chattopadhyay and Bose, T.K. 2006; Plantation Crops-Vol I and II. Parthasankarbasu Naya Udyog, Kolkata.
4. Kumar, N., Abdul Khader, J.B.M, Rangaswamy, P. and Irulappan, I. 2004; Introduction to Spices, Plantationcrops' Medicinal and Aromatic Crops; Oxford and IBH Publishing Co, New Delhi.

Course code	Course Name	Load Distribution (L - T - P)
AGP 202	PRINCIPLES OF SEED TECHNOLOGY	(1 - 0 - 2)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. State the importance of seed technology.
2. Discuss the seed production technology in various crops.
3. Identify the seed certification procedures.
4. Understand Seeds Act and Seed Act enforcement.
5. List seed testing steps and role of WTO and OECD in seed marketing.

UNIT I: **08 hrs**

Seed and seed technology: introduction, definition and importance, Deterioration of crop varieties, causes of seed deterioration and their control, maintenance of genetic purity during seed production, seed quality and different classes of seed, principles of seed production.

UNIT II: **04 hrs**

Seed production of Wheat, Rice, Maize and Ragi; Seed Production in major pulses: Urd, Pigeonpea, Lentil and Field pea

UNIT III: **04 hrs**

Seed production in major oilseeds: Soybean and Mustard, and Seed production of oat and sugarcane.

UNIT IV: **08 hrs**

Seed certification, phases of certification, procedure for seed certification, field inspection, Seeds Act and Seed Act enforcement, Duties and powers of seed inspector, offences and penalties, Varietal genetic purity determination through grow-out test and molecular markers, PPV and FR Act.

UNIT V: **06 hrs**

Seed drying, testing, processing and packaging. Seed storage, general principles, stages and factors affecting seed longevity during storage. Seed marketing, Role of WTO and OECD in seed marketing.

Practical:

Seed production in major cereals: Wheat, Rice, Maize, Sorghum, Bajra and Ragi. Seed production in major pulses: Urd, Mung, Pigeonpea, 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. Seed certification: Procedure, Field inspection, Preparation of field inspection report. Visit to seed production farms, seed testing laboratories and seed processing plant.

Suggested Reading:

1. Agarwal, P.K. Seed Technology. ICAR.
2. Subir Sen and Nabinanda Ghosh. Seed Science and Technology. Kalyani Publishers.

Course code	Course Name	Load Distribution (L - T - P)
APA 203	FARMING SYSTEM AND SUSTAINABLE AGRICULTURE	(1 - 0 - 0)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Describe the importance of farming system in India.
2. Classify the types and systems of farming.
3. Differentiate farming system with cropping system.
4. Understand the importance of sustainable agriculture.
5. Schedule resource use efficiency and optimisation techniques for effective farming.

UNIT I: **02 hrs**

Farming System-scope, importance, and concept.

UNIT II: **04 hrs**

Types and systems of farming and factors affecting types of farming. Farming system components and their maintenance.

UNIT III: **04 hrs**

Cropping system and pattern, multiple cropping systems. Efficient cropping system and their evaluation.

UNIT IV: **04 hrs**

Allied enterprises and their importance. Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation.

UNIT V: **04 hrs**

Resource use efficiency and optimization techniques. Resource cycling and flow of energy in different farming system, farming system and environment.

Suggested Reading:

1. Rangasamy, A.; Annadurai, K., Subbian, P. and Chinnusamy, J. 2015. Farming systems in the tropics. Kalyani Publishers.
2. Jayantha et al., 2008. Farming system Principles and Practices. Satish Serial Publishing House. Joshi, M. and ParbhakaraSetty, T.K. 2005. Sustainability through organic farming, Kalyani Publishers.

Course code	Course Name	Load Distribution (L - T - P)
AEC 202	AGRICULTURAL MARKETING, TRADE AND PRICES	(2 - 0 - 1)

Learning Outcomes:
After successful completion of this course, the learner will be able to:
1. Define various concepts in Agricultural Marketing.
2. Understand the terms like consumer, producer, market demand, market surplus etc.
3. Recognize what agricultural promotions are with their merits & demerits.
4. Explain the market functionaries and marketing channels.
5. Demonstrate the role of government in Agricultural Marketing.

UNIT I: **06 hrs**
Introduction: 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 II: **06 hrs**
Product life cycle and pricing: 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; Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing;

UNIT III: **08 hrs**
Agro promotion and various functions: Market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits & demerits; marketing process and functions: Marketing process-concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (Agmark);

UNIT IV: **06 hrs**
Market functionaries and marketing channels: 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 V: **06 hrs**
Govt. cooperative marketing and trade issues: 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; 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 over time for some selected commodities; Construction of index numbers; Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class; Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning; Application of principles of comparative advantage of international trade.

Suggested Reading:

1. Acharya SS & Aggarwal NL. Agricultural Marketing in India. Oxford and IBH.
2. Joginder Singh, Lekhi R.K. Agricultural Marketing Trade & Prices an Indian Perspective. Kalyani Publishers.

Course code	Course Name	Load Distribution (L - T - P)

APA 204	INTRODUCTORY AGROMETEOROLOGY AND CLIMATE CHANGE	(1 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define agricultural meteorology and its concepts.
2. Demonstrate the solar radiation principles.
3. Memorize the atmospheric concepts in relation to plant growth.
4. List the Weather hazards and weather forecasting types.
5. Describe the effect of monsoon on crop growth.

UNIT I: **03 hrs**

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 II: **03 hrs**

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 III: **03 hrs**

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

UNIT IV: **05 hrs**

Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave. Agriculture and weather relations; Modifications of crop microclimate, climatic normals for crop and livestock production. Weather forecasting- types of weather forecast and their uses.

UNIT V: **04 hrs**

Monsoon- mechanism and importance in Indian agriculture 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 Reading:

1. Mavi, H.S. 1986. Introduction to Agro-meteorology (2nd Ed.). Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
2. Murthy, V.R.K. 1993. Practical Manual in Agricultural Meteorology. Kalyani, Pub., New Delhi.
3. Prasad Rao, G.S.L.H.V. 2003. Agricultural Meteorology. Published by A.I. Jose, Director, 4. Extension, Kerala University, Mannuth- 680651, Trissur, Kerala, India.
4. Reddy, S.R. and Reddy, D.S. 2007. Agrometeorology. Kalyani Publishers, 4779, Ansari Road, 23 Daryaganj, New Delhi- 110002, India.

Course code	Course Name	Load Distribution (L -T - P)

AAC 201	AGROCHEMICALS	(2 -0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Describe merits and demerits of agrochemicals.
2. Classify the types of herbicides and fungicides.
3. Differentiate natural and synthetic agrochemicals.
4. Understand the application of fertilizers in agriculture.
5. Optimize techniques for effective farming.

UNIT I: **06 hrs**

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

UNIT II : **08 hrs**

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- Bordaeux mixture and copper oxychloride. Organic fungicides-mode of action-dithiocarbamates-characteristics, preparation and use.

UNIT III: **06 hrs**

Systemic fungicides-Benomyl, carboxin, oxycarboxin, metalaxyl, carbendazim, characteristics and use. Introduction and classification of insecticides: inorganic and organic insecticides: organochlorines, organophosphates, carbamates, synthetic pyrethroids, neonicotinoids, biorationals, insecticide act and rules, insecticides banned, withdrawn and restricted rules, fate of insecticides in soil and plant.

UNIT IV: **06 hrs**

Fertilizers and their importance. Nitrogenous fertilizers, feedstock and manufacturinf of ammonium pjosphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of singlr superphosphate.

UNIT V: **04 hrs**

Mixed and complex fertilizers: sources and compatibility-preparation of major, secondary and micronutrient mixtures. Complex fertilizers: manufacturing of ammonium phosphates, nitrophosphates and NPK complexes., Bioinsect 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 anionand cation in fertilizer. Calculation of doses of insecticides to be used. To study and identify variousformulations of insecticide available kin market. Estimation of nitrogen in Urea. Estimation ofwater soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate. Estimation of potassium in Muraite 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.

Suggested Reading:

1. Heaton, CA 2012. An Introduction to Industrial Chemistry 3rd Edition, Kindle Edition. Springer.
2. Muller F 2000. Agrochemicals: Composition, Production, Toxicology, Applications. Wiley VCH.
3. Panda H 2003. The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides withFormulae& Processes. National Institute of Industrial Research.
4. NIIR Board 2012. The Complete Technology Book on Biofertilizer and Organic Farming. NIIR project consultancy services.

Course code	Course Name	Load Distribution (L - T - P)
APP 301	Principles of Integrated Pest and Disease Management	(2 - 0 - 1)

Learning Outcomes:
After successful completion of this course, the learner will be able to:

1. Classify insect pests and diseases.
2. Define IPM and explain its components.
3. Weigh the ETL and EIL and derive control methods.
4. Use of surveillance and forecasting to understand IPM module.
5. Examine case history on IPM practices.

UNIT I: 6 hrs
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.

UNIT II: 6 hrs
Methods of detection and diagnosis of insect pest and diseases. Calculation and dynamics of economic injury level and importance of Economic threshold level.

UNIT III: 8 hrs
Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment. Introduction to conventional pesticides for the insect pests and disease management.

UNIT IV: 6 hrs
Survey surveillance and forecasting of Insect pest and diseases. Development and validation of IPM module. Implementation and impact of IPM (IPM module for Insect pest and disease.

Unit V: 6 hrs
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 (agro-ecosystem) 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 Reading:

1. Handbook of Integrated Pest Management, ICAR, New Delhi 2018.
2. Dhaliwal G.S., Arora Ramesh. 2017. Integrated Pest Management Concepts and Approaches.Kalyani Pub., Ludhiana.
3. Gopi R., Kapoor C. 2013. Organic Plant Disease Management.Kalyani Pub., Ludhiana.
4. R. C. Sharma and J. N. Sharma. 2005. Integrated Plant Disease Management. Scientific Publishers Journals Dept.

Course code	Course Name	Load Distribution (L - T - P)
APS 301	Manures, Fertilizers and Soil Fertility Management	(2 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. List the different aspects of organic farming.
2. Identify the importance of integrated nutrient management.
3. Classify chemical fertilizers and understand their composition and properties.
4. Differentiate the critical levels of various nutrients in soil.
5. Use nutrient use efficiency to explain fertilizer recommendations to crops.

UNIT I: 5 hrs

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 II: 8 hrs

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

UNIT III: 6 hrs

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

UNIT IV: 8 hrs

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.

Unit V: 5 hrs

Indicator plants. 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 Reading:

1. Das P.C. 2018. Manures and Fertilizers. Kalyani Pub., Ludhiana.
2. Singh Avdhesh Pratap. 2016. Soil Fertility, Fertilizers & Integrated Nutrient Management. Kalyani Pub., Ludhiana.
3. 3. Sivamurugan A.P., Gethara Gauri Y, Jagathambal P, M. Soil Fertility Management**.** 2015. Kalyani Pub., Ludhiana.

Course code	Course Name	Load Distribution (L - T - P)
APE 301	**Pests of Crops and Stored Grain and their Management**	**(2 - 0 - 1)**

Learning Outcomes:
After successful completion of this course, the learner will be able to:
1. Identify nature and type of damage by different arthropods pests.
2. Understand the hierarchy of classification of insect pests.
3. List storage pest of various field and horticultural crops.
4. Locate the factors responsible for deterioration of grains.
5. Demonstrate grain storage management techniques.

UNIT I: **5 hrs**
General account on nature and type of damage by different arthropods pests.

Unit II: **6 hrs**
Scientific name, order, family, host range, distribution, biology and bionomics. Nature of damage, and management of major pests and scientific name.

Unit III : **8 hrs**
Order, family, host range, distribution, nature of damage and control practice other important arthropod pests of various field crop, vegetable crop, fruit crop, plantation crops, ornamental crops, spices and condiments.

UNIT IV: **8 hrs**
Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain. Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management.

Unit V: **5 hrs**
Storage structure and methods of grain storage and fundamental principles of grain store management.

Practical:
Identification of different types of damage. Identification and study of life cycle and seasonal history of various insect pests attacking crops and their produce: (a) Field Crops; (b) Vegetable Crops; (c) Fruit Crops; (d) Plantation, gardens, Narcotics, spices & condiments. Identification of insect pests and Mites associated with stored grain. Determination of insect infestation by different methods. Assessment of losses due to insects. Calculations on the doses of insecticides application technique. Fumigation of grain store / godown. Identification of rodents and rodent control operations in godowns. Identification of birds and bird control operations in godowns. Determination of moisture content of grain. Methods of grain sampling under storage condition. Visit to Indian Storage Management and Research Institute, Hapur and Quality Laboratory, Department of Food., Delhi. Visit to nearest FCI godowns.

Suggested Reading:
1. Khare D P. 2015. Stored Grain Pests and their Management.Kalyani Pub., Ludhiana.
2. Bhargava MC. 2009. Pests Of Stored Grains And Their Management. New India Publishing Agency.

Course code	Course Name	Load Distribution (L - T - P)
APP 302	Diseases of Field and Horticultural Crops and their Management -I	(2 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Identify symptoms of field and horticultural crop diseases.
2. Understand cause of disease.
3. Discuss the disease cycle based on etiology.
4. Execute management practices for major diseases in field and horticultural crops.
5. Compare and contrast the disease symptoms.

UNIT I: 6 hrs

Symptoms, etiology, disease cycle and management of major diseases of following crops: Field Crops: Rice: blast, brown spot, bacterial blight, sheath blight, false smut, khaira and tungro;Maize: stalk rots, downy mildew, leaf spots.

Unit II: 6 hrs

Sorghum: smuts, grain mold and anthracnose, Bajra :downy mildew and ergot; Groundnut: early and late leaf spots, wilt Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic.

UNIT III: 7 hrs

Pigeonpea: Phytophthora blight, wilt and sterility mosaic; Finger millet: Blast and leaf spot; black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic; Castor: Phytophthora blight;Tobacco: black shank, black root rot and mosaic.

UNIT IV: 8 hrs

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; Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic.

UNIT V : 5 hrs

Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot; Colocasia: Phytophthora blight; Coconut: wilt and bud rot; 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 Reading:

1. Thind T S. 1998. Diseases of field crops and their management. NATIC.
2. Ahamad Shahid, Ali Anwar and P K Sharma.2013. Plant Diseases Mangament in Horticultural Crops. Daya *Publishing* House.
3. Kalita M K. 2014. Diseases of Field Crops and their Management. Kalyani Pub., Ludhiana
4. Gopi R., Kapoor C. 2013. Organic Plant Disease Management.Kalyani Pub., Ludhiana.

Course code	Course Name	Load Distribution (L - T - P)
AGP 301	Crop Improvement-I (Kharif Crops)	(1 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Locate the origin and history of kharif crops.
2. Discuss the concept of plant genetic resources and its conservation.
3. Differentiate breeding of self pollinated, cross pollinated and vegetatively propagated crops.
4. List the breeding objectives including conventional and modern innovative approaches.
5. Understand hybrid seed production technology in major kharif crops.

UNIT I: 3 hrs

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

UNIT II: 2 hrs

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

UNIT III: 3 hrs

Important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops.

UNIT IV: 5 hrs

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 V: 3 hrs

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, Urdbean, Mungbean, Soybean, Groundnut, Seasame, Caster, Cotton, Cowpea, Tobacco, Brinjal, Okra and Cucurbitaceous crops. Maintenance breeding of different kharif crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid 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 Reading:

1. Arya R. L., Arya Keshav. 2016. Kharif Crop-Production.Kalyani Pub., Ludhiana.
2. Mukund Joshi. 2015.Textbook of field crops. Prentice Hall India Learning Private Limited.

3. Dr. S.K. Taunk , Dr. J.L. Choudhary Dr. G.S. Tomar . 2011. Science of Crop Production Vol 1: Kharif Crops Paperback . Kushal Publications and Distributors.

Course code	Course Name	Load Distribution (L - T - P)
ACC 301	**Entrepreneurship Development and Business Communication**	**(1 - 0 - 1)**

Learning Outcomes:
After successful completion of this course, the learner will be able to:
1. Define an entrepreneur with his characteristics.
2. Dicuss the government policy and programs and institutions for entrepreneurship development.
3. Understand the importance of developing organizational skills like controlling, supervising, problemsolving, monitoring and evaluation.
4. Report the managerial, problem solving and leadership skills required to be a successful entrepreneur.
5. Examine the entrepreneurial opportunities for agri-entrepreneurship and rural enterprise.

UNIT I: **2 hrs**
Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs; SWOT Analysis& achievement motivation.

UNIT II: **3 hrs**
Government policy and programs and institutions for entrepreneurship development. Impact of economic reforms on Agribusiness/Agrienterprises.

UNIT III: **3 hrs**
Entrepreneurial Development Process, Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation).

Unit IV: **4 hrs**
Developing Managerial skills, Business Leadership Skills (Communication, direction and motivation Skills), Problem solving skill, Supply chain management and Total quality management.

UNIT V: **4 hrs**
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 Reading:

1. Desai & Rai. 2013. Entrepreneurship Development And Business Communication. Himalaya Pub.House-New Delhi.
2. Arvind Kumar Bhatt. 2016. Innovation and Entrepreneurship. Laxmi Publications Pvt. Ltd.
3. Ranganadha Chary A.V., Rudra Sai Baba, Girija Sastri. 2016.Business Economics & Entrepreneurship Development BBA 1st year Osmania Uni**.** Kalyani Pub., Ludhiana.
4. Kalita J C. 2009. Entrepreneurship Development B.Com. Gauhati and Dibrugarh.Kalyani Pub., Ludhiana.

Course code	Course Name	Load Distribution (L - T - P)
APA 301	**Geoinformatics and Nano-technology and Precision Farming**	**(1 - 0 - 1)**

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define precision farming and its objectives for Indian agriculture.
2. List the geoinformatics tools used in agriculture.
3. Understand Remote sensing concepts and application in agriculture.
4. Sketch crop simulation models in precision agriculture.
5. Distinguish nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors and their uses.

UNIT I: **2 hrs**

Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture.

UNIT II: **3 hrs**

Geo-informatics- definition, concepts, tool and techniques; their use in Precision Agriculture. Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies.

Unit III : **4 hrs**

Spatial data and their management in GIS; Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), components and its functions.

Unit IV: **3 hrs**

Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs; STCR approach for precision agriculture.

UNIT V: **4 hrs**

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.

Practical:

Introduction to GIS software, spatial data creation and editing. Introduction to image processing software. Visual and digital interpretation of remote sensing images. Generation of spectral profiles of different objects. Supervised and unsupervised classification and acreage estimation. Multispectral remote sensing for soil mapping. Creation of thematic layers of soil fertility based on GIS. Creation of productivity and management zones. 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 Reading:

1. Reddy S.R. 2017. Geoinformatics and Nanotechnology for Precision Farming B.Sc. 6th Sem. Kalyani Pub., Ludhiana.
2. Premjit Sharma. 2007. Precision Farming. Gene-Tech Books.
3. AK Singh and UK Chopra 2007. Geoinformatics Applications in Agriculture. New India Publishing Agency.

Course code	Course Name	Load Distribution (L - T - P)
APA 302	**Practical Crop Production – I (Kharif crops) Lab**	**(0 - 0 - 2)**

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Demonstrate the steps in crop production.
2. Organize a cropping plan for local crops.
3. Solve insect pests and disease problems in crop plants.
4. Execute harvest and post harvest operations in the field.
5. Design a balance sheet including the net returns.

Practical:

Crop planning, raising field crops in multiple cropping systems. Field preparation techniques considering local crops. Seed treatment management and methods-I. Seed treatment management and methods-II. Nursery raising practices. Sowing, nutrient, water and weed management. Management of insect-pests of crops. Management of diseases of crops.Harvesting and threshing.Drying and winnowing.Storage of produce. Marketing of produce.Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.Visit to nearby farm/seed units.

Suggested Reading:

1. Dr. S.K. Taunk , Dr. J.L. Choudhary Dr. G.S. Tomar . 2011. Science of Crop Production Vol 1: Kharif Crops Paperback . Kushal Publications and Distributors.
2. Arya R. L., Arya Keshav, Dev Karan, Jatav A. L. 2016. Kharif Crop-Production. Kalyani Pub., Ludhiana.

Course code	Course Name	Load Distribution (L - T - P)
AIP 301	Intellectual Property Rights	(1 - 0 - 0)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define IPR and understand various concepts in IPR.
2. Distinguish different types of IPR.
3. Question the concept and principles in patenting.
4. Relate plant variety protection with breeders rights.
5. State the salient features in biodiversity convention.

UNIT I:

2hrs

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 II: 3 hrs

Types of Intellectual Property and legislations covering IPR in India:-Patents, Copyrights,Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets.

Unit III: 4 hrs

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 IV: 4 hrs

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 V: 3 hrs

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 Reading:

1. Yadav Rajendra Kumar and Shweta. 2018.Intellectual Property Rights P.G. B.Sc. (Ag)**.**Kalyani Pub., Ludhiana.
2. Yadav Rajendra Kumar, Shweta. 2018**.**Intellectual Property Rights and Entrepreneurship B.Sc. Biotech. 6th Sem. GNDU.Kalyani Pub., Ludhiana.

Course code	Course Name	Load Distribution (L - T - P)
ALS 301	*Landscaping	(2 - 0 - 1)

Learning Outcomes:
After successful completion of this course, the learner will be able to:
1. Define landscaping concepts inclusive of all the components.
2. Identify trees for propagation, planting, canopy based on the requirement.
3. Discuss the propagation of annuals for garden designing.
4. Distinguish the landscaping pattern in urban and rural areas.
5. Examine a bonsai and use of Computer aided design in landscaping

UNIT I: **5 hrs**
Importance and scope of landscaping. Principles of landscaping, garden styles and types, terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery, water gardens, walk-paths, bridges, other constructed features etc. garden for special purposes.

UNIT II: **5 hrs**
Trees: selection, propagation, planting schemes, canopy management, shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture. Climber and creepers: importance, selection, propagation, planting.

Unit III : **8 hrs**
Annuals: selection, propagation, planting schemes. Other garden plants: palms, ferns, grasses and cacti succulents. Pot plants: selection, arrangement, management.

UNIT IV: **8 hrs**
Bio-aesthetic planning: definition, need, planting. Landscaping or urban and rural areas. Peri-urban landscaping. Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, and industries.

UNIT V: **6 hrs**
Bonsai: principles and management, lawn: establishment and maintenance. CAD applications.

Practical:
Identification of trees, shrubs, annuals, pot plants. Concepts of landscaping, botanical gardens, parks etc. 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 types of gardens (sunken garden, terrace garden, rock garden). Layout of informal gardens. Layout of special types of gardens (sunken garden, terrace garden, rock garden). Designing of conservatory and lathe house. Use of computer software in designing. Visit of important garden/parks/institutes.

Suggested Reading:

1. Rachel Mathews . 2014. Garden Design and Landscaping - The Beginner's Guide to the Processes Involved with Successfully Landscaping a Garden. Successful Garden Design.
2. HS Grewal &Parminder Singh. Landscape Designing and Ornamental Plants. Kajal Books.
3. Anil K Singh, Anjana Sisodia. Textbook of Floriculture and Landscaping. Hellmart publication.

Course code	Course Name	Load Distribution (L - T - P)
APA 303	RAINFED AGRICULTURE & WATERSHED MANAGEMNET	(1 - 0 - 1)

Learning Outcomes:
After successful completion of this course, the learner will be able to:

1. Discuss the problems and prospects of rainfed agriculture in India.
2. Explain the edaphic and climatic conditions responsible for rainfed farming.
3. Examine the importance of water use by understanding the water harvesting techniques.
4. Relate the crop suitability to rainfed areas.
5. Distinguish the components in watershed management.

UNIT I: **2 hrs**

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

UNIT II: **4 hrs**

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 III: **3 hrs**

Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices.

UNIT IV: **3 hrs**

Management of crops in rainfed areas, Contingent crop planning for aberrant weather conditions,

UNIT V: **4 hrs**

Concept, objective, principles and components of watershed management. Factors affecting watershed management.

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 Reading:

1. Reddy S.R., Reddy G. Prabhakaran. 2018.Rainfed Agriculture & Watershed Management.Kalyani Pub., Ludhiana.
2. Thomas C. 2018. George Land Husbandry & Watershed Management.Kalyani Pub., Ludhiana.
3. Dr Rayees Ahmad Shah. 2017. Rainfed Agriculture And Watershed Management. Kushal Publications and Distributors.
4. G.P. Verma, Y.P. Singh. 2017. Rainfed Farming Development in Central India. Scientific Publishers (India).

Course code	Course Name	Load Distribution (L - T - P)
AAE 301	PROTECTED CULTIVATION AND SECONDARY AGRICULTURE	(1 - 0 - 1)

Learning Outcomes:
After successful completion of this course, the learner will be able to:

1. Define green house technology.
2. Sketch a design for green house with control panel.
3. Understand the types of green houses according to their principles.
4. Relate the engineering parameters essential in the construction of green house.
5. Differentiate the drying and dehydration techniques on the basis of its principle and working.

UNIT I: 2 hrs

Green house technology: Introduction, Types of Green Houses; Plant response to Green house environment, Planning and design of greenhouses.

UNIT II: 4 hrs

Design criteria of green house for cooling and heating purposes. Green house equipments, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, typical applications.

UNIT III: 3 hrs

Passive solar green house, hot air green house heating systems, green house drying. Cost estimation and economic analysis.

UNIT IV: 3 hrs

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 V: 4 hrs

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, recirculatory dryer and solar dryer). Material handling equipment; conveyer and elevators, their principle, working and selection.

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Practical:

Study of different type of green houses based on shape. Determine 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 houseequipments. 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 Reading:

1. Brahma Singh and Balraj Singh. 2014. Advances in Protected Cultivation. New India Publishing Agency.
2. Pushpendra K. karhana. 2014. Agriculture Science.Arihant Publications.
3. D. K. Singh and K. V. Peter. 2014. Protected Cultivation of Horticultural Crops. New India Publishing Agency.

Course code	Course Name	Load Distribution (L - T - P)
APP 303	DISEASES OF FIELD AND HORTICULTURAL CROPS AND THEIR MANAGEMENT-II	(2 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Identify the disease symptoms in field and horticultural crop plants.
2. Discuss etiology and disease cycle for each disease pathogen.
3. Classify the management practices followed for diseases.
4. Organise disease symptoms based on season and sporulation.
5. Differentiate symptoms of major pathogens causing leaf spot, wilt, rust, smut etc.

UNIT I: 4 hrs

Symptoms, etiology, disease cycle and management of major diseases of field crops: Wheat-rust, loose smut, karnal bunt, powdery mildew, alternaria blight, ear cockle. Sugercane: red rot, smut, wilt, grassy shoot, ratoon stunting, PokkahBoeng.

UNIT II: 6 hrs

Symptoms, etiology, disease cycle and management of major diseases of Sunflower: Sclerotinia stem rot and alternaria blight. Mustard: alternaria blight, white rust, downy mildew and sclerotinia stem rot.

UNIT III: 6 hrs

Symptoms, etiology, disease cycle and management of major diseases of Gram: wilt, grey mould and ascochyta blight. Lentil: rust and wilt. Cotton: anthracnose, vascular wilt, black arm. Pea: downy mildew, powdery mildew and rust.

UNIT IV: 8 hrs

Symptoms, etiology, disease cycle and management of major diseases of Horticultural crops: Mango-anthracnose, malformation, bacterial blight and powdery mildew. Citrus- canker and gummosis, grape wine, 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, black scurf, leaf roll and mosaic.

UNIT V: 8 hrs

Symptoms, etiology, disease cycle and management of major diseases of Cucurbits: downy mildew, powdery mildew, wilt. Onion and garlic: purple blotch and stem phylium blight. Chillies: anthracnose and fruit rot, wilt and leaf curl. Turmeric-leaf spot. Coriander: stem gall. Marigold: botrytis blight. Rose: dieback, powdery mildew and leaf curl spot.

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 preservationof plant diseased specimens for herbarium.

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

Suggested Reading:

1. Parvathy Reddy 2008. Diseases of Horticultural Crops. Scientific Publishers Journals Dept.
2. Kalita M.K. 2014. Diseases of Field Crops and their Management. Kalyani Publishers.
3. Robert F Nyvall.1979. Field crop diseases. AVI Publishing Company.
4. Rangaswami . 1998. Diseases of Crop Plants in India Paperback. Prentice Hall India Learning Private Limited.

Course code	Course Name	Load Distribution (L - T - P)
APH 301	POST-HARVEST MANAGEMENT AND VALUE ADDITION OF FRUITS AND VEGETABLES	(1 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define post-harvest processing of fruits and vegetables.
2. Relate the pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening.
3. Understand the major role played by respiration in PHT.
4. List the value addition concepts their principles and methods of preservation.
5. Use tomato as a yard stick to explain the PHT technology.

UNIT I: 2 hrs

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

UNIT II: 4 hrs

Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening.

UNIT III: 3 hrs

Respiration and factors affecting respiration rate; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric).

UNIT IV: 3 hrs

Value addition concept; Principles and methods of preservation; Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards; Fermented and non-fermented beverages.

UNIT V: 4 hrs

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 oftemperature on shelf life and quality of produce. Demonstration of chilling and freezing injury invegetables 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, cannedproducts. Quality evaluation of products -- physico-chemical and sensory. Visit to processingunit/ industry.

Suggested Reading:

1. A. Chakraverty. 2018. Post Harvest Technology of Cereals, Pulses and Oilseeds. Paperback.
2. Adel Kader. 2002. Postharvest Technology of Horticultural Crops. Univ. of California Agriculture & Natural Resources.
3. Misra K.K..2018. Post Harvest Management of Fruit Crops. Scientific Publishers India.
4. Amit Baran Sharangi and Suchand Datta. 2015. Value Addition of Horticultural Crops: Recent Trends and Future Directions. Springer India.

Course code	Course Name	Load Distribution (L - T - P)
APE 302	MANAGEMENT OF BENEFICIAL INSECTS	(1 - 0 - 1)

Learning Outcomes:
After successful completion of this course, the learner will be able to:

1. Explain the importance of beneficial insects.
2. Examine the role of bees as pollinators in cross pollinated plants.
3. Differentiate silk worms as per their biology and life cycle.
4. Identify the importance of lac production in agriculture sector.
5. Investigate the insect orders used in pest control.

UNIT I: **2 hrs**

Importance of beneficial Insects, Beekeeping and pollinators, bee biology, commercial methods of rearing, equipment used, seasonal management.

UNIT II: **4 hrs**

Bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee. Role of pollinators in cross pollinated plants.

UNIT III: **3 hrs**

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 IV: **3 hrs**

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 V: **4 hrs**

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, bee enemies and disease. Bee pasturage, bee foraging and communication. Types of silkworm, voltinismand biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvestingand preservation of leaves. Species of lac insect, host plant identification. Identification of otherimportant pollinators, weed killers and scavengers. Visit to research and training institutionsdevoted to beekeeping, sericulture, lac culture and natural enemies. Identification and techniquesfor mass multiplication of natural enemies.

Suggested Reading:

1. Thomas K Sabu. 2012. Selected Beneficial and Harmful Insects of Indian Subcontinent. LAP Lambert Academic Publishing.
2. Ministry of Agriculture and Fisheries.2018. Beneficial Insects (Classic Reprint). Forgotten Books.
3. The Xerces Society. 2014. Farming with Native Beneficial Insects: Ecological Pest Control Solutions Kindle Edition. Storey Publishing, LLC.

Course code	Course Name	Load Distribution (L - T - P)
AGP 302	CROP IMPROVEMENT-II (RABI CROPS)	(1 - 0 - 1)

Learning Outcomes:
After successful completion of this course, the learner will be able to:

1. Locate the centers of origin, distribution of species and wild relatives in different rabi crops.
2. Repeat the study on plant genetic resources and utilization as in kharif crops.
3. Distinguish conventional and modern breeding methods.
4. Assess yield, adaptability, stability, abiotic and biotic stress tolerance and quality.
5. Schedule hybrid seed production technology of rabi crops.

UNIT I: **2 hrs**
Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds.
UNIT II: **4 hrs**
Wild relatives in fodder crops and cash crops; vegetable and horticultural crops.
UNIT III: **3 hrs**
Plant genetic resources, its utilization and conservation; study of genetics of qualitative and quantitative characters.
UNIT IV: **3 hrs**
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 V : **4 hrs**
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 namelyWheat, Oat, Barley, Chickpea, Lentil, Field pea, Rajma, Horse gram, Rapeseed Mustard,Sunflower, Safflower, Potato, Berseem. Sugarcane, Tomato, Chilli, Onion; Handling of germplasmand segregating populations by different methods like pedigree, bulk and single seed decentmethods; 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; Studyof quality characters, study of donor parents for different characters; Visit to seed productionplots; Visit to AICRP plots of different field crops.

Suggested Reading:

1. R C Setia, N Setia and H Nayyar. 2008. Crop Improvement. I K International Publishing House Pvt. Ltd.
2. Dr. G.S. Tomar, Dr. S.P.S. Tomar, Dr. S.N. Khajanji. 2011. Science Of Crop Production PART-2 (Rabi Crops). Kushal Publications and Distributors.
3. K R Hakeem, P Ahmad and M Ozturk. Crop Improvement. 2013. Springer-Verlag New York Inc.
4. U. S. Gupta. 2000. Crop Improvement. Science Pub Inc.

Course code	Course Name	Load Distribution (L - T - P)
APA 304	**PRACTICAL CROP PRODUCTION-II (RABI CROPS)**	**(0 - 0 - 2)**

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define the concepts in multiple cropping systems.
2. List the steps from field preparation to post harvesting.
3. Understand the due importance to be given to inter cultural operations.
4. Manage insect-pests and diseases of crops.
5. Prepare a balance sheet for net returns per student and per team of 8-10 students.

Practical:

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

Suggested Reading:

1. Manual on agricultural production technology rabi 2007-08. Directorate of agriculture & food.
2. R N Meena and R K Singh. 2013 . A Practical Manual on Field Crop-II (Rabi). Ert Publications Pvt. Ltd.

Course code	Course Name	Load Distribution (L - T - P)
APA 305	PRINCIPLES OF ORGANIC FARMING	(1 - 0 - 1)

Learning Outcomes:
After successful completion of this course, the learner will be able to:

1. After successful completion of this course, the learner will be able to:
2. Define organic farming and its principles.
3. Discuss the initiatives taken by Government (central/ state), NGOs and other organizations for promotion of organic agriculture.
4. Understand the organic ecosystem and their concepts, Organic nutrient resources and its fortification and restrictions to nutrient use in organic farming.
5. Examine the complete cropping mode from choice of crop to all intercultural practices.
6. List the certification process and standards of organic farming.

UNIT I: **2 hrs**
Organic farming, principles and its scope in India.

UNIT II: **4 hrs**
Initiatives taken by Government (central/ state), NGOs and other organizations for promotion of organic agriculture.

UNIT III: **3 hrs**
Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming.

UNIT IV: **3 hrs**
Choice of crops and varieties in organic farming; Fundamentals of insect, pest, disease and weed management under organic mode of production; Operational structure of NPOP.

UNIT V: **4 hrs**
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, packagingand handling.

Suggested Reading:

1. Ann Larkin Hansen. 2010. The organic farming manual: A comprehensive guide to starting and running a certified organic farm. Storey publishing.
2. Peter V Fossel. 2014. Organic Farming: How to Raise, Certify, and Market Organic Crops and Livestock. Voyager press
3. Dr. H. Panda. 2013. Integrated Organic Farming Handbook. Asia Pacific Business Press Inc.

Course code	Course Name	Load Distribution (L - T - P)
AEC 301	FARM MANAGEMENT, PRODUCITON AND RESOURCE ECONOMICS	(1 - 0 - 1)

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Define the meaning and concept of farm management.
2. Distinguish -product, factor-factor and product-product relationship in farm management.
3. Schedule the importance of cost in managing farm business and estimation of gross farm income, net farm income, family labour income and farm business income.
4. Explain the importance of documentation for 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.
5. Understand important issues in economics and management of common property resources of land, water, pasture and forest resources etc.

UNIT I: 2 hrs

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.

UNIT II: 4 hrs

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 III: 3 hrs

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 IV: 3 hrs

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 V: 4 hrs

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 principlein allocation of farm resources. Determination of most profitable level of inputs use in a farmproduction process. Determination of least cost combination of inputs. Selection of most profitableenterprise combination. Application of cost principles including CACP concepts in the estimationof cost of crop and livestock enterprises. Preparation of farm plan and budget, farm records andaccounts and profit & loss accounts. Collection and analysis of data on various resources in India.

Suggested Reading:

1. V T Raju. 2017.Economics of Farm Production and Management. Oxford & IBH Publishing Co Pvt. Ltd.
2. S Subba Reddy. 1996. Agricultural Finance And Management. Vijay Nicole publishers.
3. SS Joshi and TR Kapur 2015. Fundamentals of farm business management. Kalyani publishers, Ludhiyana.
4. SC Panda 2013. Farm management and Agricultural marketing. Kalyani publishers, Ludhiyana.

Course code	Course Name	Load Distribution (L - T - P)
FST 301	**PRINCIPLES OF FOOD SCIENCE AND NUTRITION**	**(2 - 0 - 0)**

Learning Outcomes:
After successful completion of this course, the learner will be able to:
1. Define the basic concepts in food science.
2. Explain the chemistry and composition of food.
3. Discuss the microbiological aspect of food that contributes to spoilage and fermentation.
4. Understand the principles and methods of food processing and preservation.
5. Report new trends in food science and nutrition.

UNIT I: **5 hrs**
Concepts of Food Science (definitions, measurements, density, phase change, pH, osmosis, surface tension, colloidal systems etc.

UNIT II: **6 hrs**
Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives, important reactions.

UNIT III: **8 hrs**
Food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods, Production of fermented foods.

UNIT IV: **6 hrs**
Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying etc.

UNIT V: **7 hrs**
Food and nutrition, Malnutrition (over and under nutrition), nutritional disorders; Energy metabolism (carbohydrate, fat, proteins); Balanced/ modified diets, Menu planning, New trends in food science and nutrition.

Suggested Reading:

1. Sunetra Roday. 2018. Food Science and Nutrition. Oxford University Press.
2. B Srilakshmi. 2018. Food Science. New Age International Publishers.

Course code	Course Name	Load Distribution (L - T - P)
ABM 301	**AGRIBUSINESS MANAGEMENT**	**(2 - 0 - 1)**

Learning Outcomes:
After successful completion of this course, the learner will be able to:

1. State the transformation of agriculture into agribusiness for raising Indian economy and new agricultural policy.
2. Discuss the importance and needs of agro-based industries for development.
3. Understand management functions, their roles and activities, organization culture.
4. Examine the components in a business plan and list the steps in implementation.
5. Question the marketing aspects like trade, policy, consumers, financial statements and so on.

UNIT I: **5 hrs**

Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Importance of agribusiness in Indian economy and new agricultural policy.

UNIT II: **6 hrs**

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 setup agro based industries. Constraints in establishing agro based industries.

UNIT III: **8 hrs**

Business environment: PEST and SWOT analysis. Management functions: roles and activities, organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, strategies, polices procedures, rules, programs and budget. Components of a business plan, steps in planning and implementation.

UNIT IV: **8 hrs**

Organization stuffing, directing and motivation. Ordering, leading, supervision, communication, control. Capital management and financial management of agribusiness. Financial statements and their importance. Marketing management: segmentation, targeting & positioning. Marketing mix and marketing strategies. Consumer behaviour analysis, product life cycle (PLC).

UNIT V: 5 hrs

Sales & distribution management. Pricing policy, various pricing methods. Project management definition, project cycle, identification, formulation, and 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 addedproducts. Study of financing institutions- Cooperative, Commercial banks, RRBs, AgribusinessFinance Limited, NABARD. Preparations of projects and Feasibility reports for agribusinessentrepreneur. Appraisal/evaluation techniques of identifying viable project- Non-discountingtechniques. Case study of agro-based industries. Trend and growth rate of prices of agriculturalcommodities. Net present worth technique for selection of viable project. Internal rate of return.

Suggested Reading:

1. James G. Beierlein, Kenneth C. Schneeberger and Donald D. Osbum. 2013. Principles of Agribusiness Management. Waveland Press, Inc.
2. L.M. Prasad. 2013. Principles and Practice of Management.Sultan Chand & Sons.
3. F L Barnard, J T Akridge and F J Dooley. Agribusiness management. 2012.Rutledge publishers.
4. A C Broadway and A A Broadway. 2004. Textbook Of Agri-Business Management. Kalyani publishers

Rural Agricultural Work Experience (RAWE)

The Rural Agricultural Work Experience (RAWE) helps the students primarily to understand the rural situations, status of agricultural technologies adopted by the farmers to prioritize the farmers' problems and to develop skills & attitude of working with farm families for overall development in rural area. The timings for RAWE can be flexible for specific regions to coincide with the main cropping season.

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Understand the rural setting in relation to agriculture and allied activities.
2. Discuss socio-economic conditions of the farmers and their problems.
3. Explain the real field situations through practical training and awareness.
4. Deliver extension and rural development programmes.
5. Solve local/regional agricultural problems using extension teaching methods.

Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE &AIA)			
Code	Activities	No. of weeks	Credit hours
RAWE 401	General orientation & On campus training by different faculties	1	14
RAWE 402	Village attachment	8	
RAWE 403	Unit attachment in Univ./ College. KVK/ Research Station Attachment	5	
RAWE 404	Plant clinic	2	02
RAWE 405	Agro-Industrial Attachment	3	04
RAWE 406	Project Report Preparation, Presentation and Evaluation	1	
Total weeks for RAWE & AIA		**20**	**20**

RAWE Component-I

Village Attachment

Sl. 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 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.

S.No.	Activities and Tasks during Agro-Industrial Attachment Programme
1	Acquaintance with industry and staff
2	Study of structure, functioning, objective and mandates of the industry
3	Study of various processing units and hands-on trainings under supervision of industry staff
4	Ethics of industry
5	Employment generated by the industry
6	Contribution of the industry promoting environment
7	Learning business network including outlets of the industry Skill development in all crucial tasks of the industry
8	Documentation of the activities and task performed by the students
9	Performance evaluation, appraisal and ranking of students

Experiential Learning Programme (ELP)

Experiential Learning (EL) provides the students an excellent opportunity to develop analytical and entrepreneurial skills, and knowledge through meaningful hands on experience, confidence in their ability to design and execute project work. The main objectives of EL are:

Learning Outcomes:

After successful completion of this course, the learner will be able to:

1. Understand the network system that connects agriculture to market.
2. Discuss the different entrepreneurship opportunities linked with agriculture based systems.
3. Develop self dependent entrepreneurship programme using enterprise management capabilities.
4. Deliver hands on experience to promote professional skills and knowledge.
5. Work in project mode.

Modules for Skill Development and Entrepreneurship: A student has to register 20 credits opting for any two modules of (0+10) credits each (total 20 credits) from the package of modules in the VIII semester Experiential Learning Programme (ELP).

S. no.	Subject Code	Title of the module	Credits
1	READY-401	Production Technology for Bioagents and Biofertilizer	0+10
2	READY-402	Seed Production and Technology	0+10
3	READY -403	Mushroom Cultivation Technology	0+10
4	READY -404	Soil, Plant, Water and Seed Testing	0+10
5	READY -405	Commercial Beekeeping	0+10
6	READY -406	Poultry Production Technology	0+10
7	READY -407	Commercial Horticulture	0+10
8	READY -408	Floriculture and Landscaping	0+10
9	READY -409	Food Processing	0+10
10	READY -410	Agriculture Waste Management	0+10
11	READY -411	Organic Production Technology	0+10
12	READY -412	Commercial Sericulture	0+10

*__READY__= Rural Entrepreneurship Awareness Development Yojana