

Under Graduate Degree Program in Natural Farming

4 Years B.Sc. (Hons.) Natural Farming

Eligibility Criteria: The minimum eligibility requirement for admission in undergraduate programme on Natural Farming will be the same as in case of B.Sc.(Hons.) Agriculture and allied subject

Semester Wise Course Distribution

Course Number	Course Title	Credit Hours
First Year		
Semester I		
FCC-111	Vidyarambh[#]	CNC
NF-111	Indian Heritage of Natural Farming	3(2+1)
NF-112	Principles and Practices of Natural Farming	4(2+2)
NF-113	Bhumi Suposhan (Soil Nutrition)	3(2+1)
NF-114	Biodiversity Conservation	3(2+1)
AGRON 113	Farming based Livelihood System	3(2+1)
SEC-I	Skill Enhancement Course	2(0+2)
SEC-II	Skill Enhancement Course	2(0+2)
	National Services Scheme/NCC/NSO	1(0+1)
	Physical Education, First Aid and Yoga Practice [#]	CNC
	Total	21(10+11)
Semester II		
NF-121	Cow- based Natural Farming	3(1+2)
NF-122	Soil Biology in Natural Farming	3(2+1)
NF-123	Integration of Horticulture Crops under Natural Farming	2(1+1)
NF-124	Insect Ecology, Nematodes and Pest Management	3(2+1)
EE- 122 (A)	Introductory English, Communication Skills and Personality Development	2(1+1)
Ag Met- 123	Environmental Studies and Disaster Management	3(2+1)
SEC-III	Skill Enhancement Course	2(0+2)
SEC-IV	Skill Enhancement Course	2(0+2)
	National Services Scheme/NCC/NSO	1(0+1)
	Total	21(9+12)
Second Year		
Semester III		
NF-211	Crop Management in Natural farming	3(2+1)
NF-212	Production of Bio-inputs	2(1+1)
NF-213	Farm Power and Machinery	3(1+2)
NF-214	Livestock and Poultry Production	3(2+1)
NF-215	Management of Plant Diseases	2(1+1)

Course Number	Course Title	Credit Hours
Ag. Stat-213	Agri- Informatics and Database Management	3(2+1)
SEC-V	Skill Enhancement Course	2(0+2)
SEC-VI	Skill Enhancement Course	2(0+2)
	Total	20(9+11)
Semester IV		
NF-221	Elements, Characteristics and Design of Natural Farming Systems	3(2+1)
NF-222	Improvement of Traditional and Under-utilized Crops	3(2+1)
NF-223	Agro-Ecosystem Analysis for Natural Farming	2(1+1)
NF-224	Beneficial Insects	3(2+1)
NF-225	Quantification and Valuation of Ecosystem Services	3(2+1)
EE -222	Entrepreneurship Development and Business Communication	3(2+1)
SEC-VII	Skill Enhancement Course	2(0+2)
SEC-VIII	Skill Enhancement Course	2(0+2)
	Seminar-I	1(0+1)
	Total	22(11+11)
Third Year		
Semester V		
NF-311	Post-Harvest Management –I	3(2+1)
NF-312	Bio- resources and Agricultural Waste Management	3(2+1)
NF-313	Medicinal and Aromatic Plants	2(1+1)
NF-314	Seed Production Technology	3(2+1)
NF-315	Value Chain Management in Natural Farming	2(1+1)
NF-316	Renewable Energy Sources	2(1+1)
NF-317	Natural Farming and Human Health	2(1+1)
ENTO	Fundamentals of Entomology	3(2+1)
	Educational Tour	CNC
	Total	20(12+8)
Semester VI		
NF-321	Indian Traditional Knowledge	3(2+1)
NF-322	Post-harvest Management-II	3(2+1)
NF-323	Standards and Certification for Natural Farming	2(2+0)
NF-324	Aqua-based Natural Farming	3(2+1)
NF-325	Marketing of Natural Farming Produce	3(2+1)
NF-326	Agronomic Practices	2(1+1)
Ag IPR-	Intellectual Property Rights	1(1+0)

Course Number	Course Title	Credit Hours
ECON	Principles of Agricultural Economics and Farm Management	2(2+0)
	Seminar-II (Case studies)	1(0+1)
	Total	20(14+6)

Fourth Year		
Semester VII		
NF-411	Community Mobilization for Natural Farming	2(1+1)
NF-412	Water Management	2(1+1)
NF-413	Research Methodology and Ethics	2(1+1)
NF-414	Weather Forecasting	3(2+1)
STAT	Basic and Applied Agricultural Statistics	3(2+1)
	Elective Course-I	3(2+1)
	Elective Course-II	3(2+1)
	Elective Course-III	3(2+1)
	Total	21(13+8)
Semester VIII		
Project Work/Experiential Learning/Internship	For Student opting for 4 Year B.Sc. (Hons.) Natural Farming Degree Student READY (RAWE/Industrial Attachment/Experiential Learning/Hands on Training/Project Work)/ Internship	20 credits (Minimum 20 weeks)
	For Student opting for 4 Year B.Sc. Natural Farming (Research) Research work	20 credits
	Total	20(0+20)

Vidyaramh: At the start of 1st Semester, there will be a three weeks Foundation Course (FC) with 0+4 credits (Non-gradual), common to all the students

* Educational (Study) Tour: It will be compulsory non-gradual of 2 credit for 10-12 days during after 5th semester.

CNC – Compulsory Non-Credit Course.

Details of the Course

SEMESTER-I

S. No.	Course Title	Course No.	Credit load
1.	Vidyarambh	FCC-111	CNC
2.	Skill Enhancement Course	-	2(0+2)
3.	Skill Enhancement Course	-	2(0+2)
4.	Indian Heritage of Natural Farming	NF 111	3(2+1)
5.	Natural Farming: Principles and Practices	NF 112	3(2+1)
6.	Soil Nutrition (Bhumi Suposhan)	NF 116	2(1+1)
7.	Biodiversity Conservation	NF 117	3(2+1)
8.	Farming based Livelihood System	AGRON113A	3(2+1)
9.	National Services Scheme/NCC/NSO	CC- 111(B)	1(0+1)
10.	#Physical Education, First Aid and Yoga Practice		CNC
	Total		20 (9+11)

* Course work credit requirements of I and II semesters

** Internship extra 2 months for those students who wish to exit after one year and get eligible for Certificate

CNC-Compulsory Non-credit Course

*** From Basket of Skill Development course modules available

Semester I

Course Title : **Vidyarambh**
Course Code : **FC-111 Credit Hours** :
CNC 4(0+4)

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

- (i) Discussions on operational framework of academic process in university, as well as interactions with academic & research managers of the University.
- (ii) Interaction with alumni, business leaders, scientists and prospective employers
- (iii) Group activities to identify the strength and weakness of students (with expert advice for their improvement), streaming of the students as per their aptitude for research entrepreneurship or others through psychometric test as well as to create a platform for students to learn from each other's life experiences
- (iv) To identify the student's having difficulty in mathematics and enrolling them for 1 non-gradual remedial course on mathematics of one credit
- (v) Activities to enhance cultural integration of students from different backgrounds.
- (vi) Classes on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, Knowing and Being etc.) and communication skills

Course Title: Indian Heritage of Natural Farming Course Code NF111 Credits Hours: 3(2+1)

General objective: To acquaint the students about the ancient *Vedic* Krishi, Indian heritage, principle and importance of natural farming.

Specific objectives:

- i) To impart knowledge on the heritage of natural farming in ancient India and various techniques of *Vedic Krishi*.
- ii) To develop skills on *Vedic Krishi* practices for practicing natural farming.

Theory

The heritage of natural farming, pPioneers and scholars of natural farming and their contribution to the heritage of natural farming, Ancient methods of livestock management, health, nutrition, soil fertility and plant protection, Description on ancient methods of rainfall prediction, Importance of seed and their collection, storage ,

removal of weed seeds and seed uniformity, Discussions on important rare documents like *Krishi-Parashar*, *Sitadhyaksha* chapter in *Kautilya Arthashastra* (Acharya Kautilya-321 BC), *Kashyapiya Krishi Sukti* (by sage Kashyap-c.800 CE), *Vrikshayurveda* (by Vaidya Surapala), *Upavanavinod* (Nalini, 2011), *Vishwavallabha* (by Chakrapani Mishra-1577 CE), *Brihat Samhita* (by Varahamihir-600 AD), *Lokopakara* (1000-year-old manuscript), *Nuskha Dar Fanni-Falahat-The Art of Agriculture* (by Prince Dara Shikoh-1650 CE), *Krishi Gita -Agricultural Versus* (15th century by Vidwan C Govinda Warriar), etc. Measurement of wealth on natural resources, '*Gau-dhan*' (Cows), '*Ashwa-dhan*' (Horses), '*Gaj-dhan*' (Elephants) etc. as all different forms of wealth. '*Vidya-dhan*'. The most important wealth '*dhanya*' or rice/crops, Mode of the transactions in the society through '*dhanya*'. Broad tradition of 'natural farming', propounded by advocates such as Dr. Y.L Nene, (Asian Agri History Foundation), Narayana Reddy (Karnataka), Shripad Dabholkar (Maharashtra), G Nammalvar (Tamil Nadu), Partap C Aggarwal (Madhya Pradesh) and Bhaskar Hiroji Save (Gujarat). Rich heritage of plant protection in natural farming, Identification of disorders; Surapala's *Vrikshayurveda* describes various plant diseases based on Tridosha (Vata, Pitta, Kapha) Siddhanta of Ayurveda along with symptoms and remedial measures. Plant protection practices, Kunapajala, Herbal Kunapajala other indigenous liquid concoctions.

Practicals

Visit of natural farms to understand the concept, components and management practices. Identification of plant and animal-based products used in *Vrikshayurveda* for plant nutrition and crop protection. Preparation of *Vrikshayurveda* based on-farm inputs for nutrient, pest and disease management. Documentation of *vrikshayurveda* technology knowledge-base for resource conservation, soil health and plant protection.

Course Title : Principles and Practices of Natural Farming Course Code : NF- 112

Credits Hours : 4 (2+2)

Theory

Natural farming: Concept and importance. Modern agriculture and need for new strategies, Origin of concept of natural farming, Agroecology: Concept and Principles, and history of development in agro-ecology, Natural farming: principles, philosophy and components, Merits and demerits of natural farming, Principles of Fukuoka and other methods of natural farming, Practices of Natural Farming - case studies, Types of natural farming systems (Community based natural farming, Palekar's Natural Farming, Bio-dynamic, homa farming, natu- eco farming, rishi Krishi, panchagavya Krishi, Yogic farming etc., Scope of natural farming in modern time, Laws of nature, Indian philosophy /Bhartiya Chintan of Pancha Mahabhoot and their role in human life and development, Important management practices for crops, fruits, vegetables and animals in natural farming, comparison of conventional, organic and natural farming production systems, Scientific aspects of ecological and natural farming for supporting food, nutritional and livelihood security - food sovereignty, livelihood of farmers and rural communities, biodiversity and conservation of biodiversity, Sustainable soil health and clean water, Ecological pest protection, Climate resilient food production, Indigenous farming systems prevalent in India and other countries. Government schemes supporting natural farming (PKVY, BPKP, National Mission on Natural Farming), Start-Ups in chemical free agriculture, Digital India.

Practicals

Identification of indigenous crops and practices, Study of different farming systems and their characterization, Students' visit to natural farms to study the various components and practices of natural farming, Development of natural farm inventory, Analysis of ancient Indian & modern natural farming Bio-dynamics, homa farming, natu-eco farming, rishi Krishi, panchagavya Krishi, Yogic farming and practical field application of these practices, Design of natural farm based on locally available resources, Preparation of on-farm inputs for nutrients, pest and disease management. Documentation of indigenous technology knowledge (ITK) for nutrient, insect, pest disease and weed management, Development of documentary on management of natural farm.

Course Title : Bhumi Suposhan (Soil Nutrition) Course Code NF-113 Credits Hours 3 (2+1)

Theory

Soil as a natural medium for plant growth, Status of soil degradation; Weathering of rocks and minerals, Soil genesis and classification; Concept of essential, beneficial, functional and trace elements in soils; Role of essential nutrients in plants, their deficiency and toxicity symptoms and diagnosis, Nutrient movement in soils and mechanisms of nutrients uptake by plants, Cycling of nutrients in soils (C, N, P, S, secondary and micronutrients), Importance of physical, chemical, and biological properties of soil, Factors affecting soil fertility, Methods of soil fertility evaluation: physical, chemical and biological, Origin, formation, extent of distribution and characteristics of acid soils, acid sulfate soils, alkali soils, saline soils and their management, Formation of soil organic matter and its management in agroecosystem, carbon sequestration, soil carbon and nitrogen management indices, Soil quality and health, soil quality indicators, characteristics of a healthy soil, Principles of supporting healthy rhizosphere interactions for improved soil fertility, Best management practices (BMPs) for promoting soil health and monitoring of soil-health: minimum tillage, mulching, organic residue incorporation, cover crops, green manuring, crop rotation, conducive environment for beneficial microbes, mixed cropping, intercropping, composts, FYM, biochar, bio-culture formulations, Sing Khad, (Horn measure), *Kunapajal*, Samadhi Khada, biogas manures (liquid and solid), etc., Principles and methods of production of various organic manures, Sources of contamination in soil and reclamation by bioremediation processes (Phytoremediation, phytoextraction, phytostabilization and microbial bioremediation), Ancient classification of soil based on soil fertility, irrigation, physical characteristics, and crop suitability; Ancient practices for soil enrichment under natural farming, Traditional festivals of the region with respect to soil health, Schemes promoting soil health in India.

Practicals

Soil sampling methods, processing, and storage, Determination of soil texture (feel method, hydrometer method and international pipette method), Determination of soil bulk density, particle density, porosity, and water holding capacity, Determination of soil pH and EC, Determination of soil organic carbon, Determination of available nitrogen, Determination of available phosphorus, Determination of available potassium, Determination of available secondary plant nutrients (Ca, Mg, S,), Determination of available micronutrients (Zn, Fe, Cu, Mn, B, Mo), Plant sample digestion procedure, Analysis of important nutrient elements in plant, Studies on important ITKs for selection of crop-soil combination, Quantification of carbon-natural farming practices.

Course Title : Biodiversity Conservation Course Code : NF-114 Credits Hours : 3 (2+1)

Theory

Definition, Genetic diversity, Species diversity, Ecosystem diversity: structural and functional aspects. Agro ecological zones in India with a brief understanding of diversity in soil types, temperature, rainfall, watershed atlas of India, Seasons and season cycle in India, Festivals and seasons, Importance of local biodiversity, Bio-geographic classification of India, The value of biodiversity and conservation, India as a mega diversity nation, Hotspots of biodiversity: criteria for determining hot spots, Threats to biodiversity- habitat loss, pollution, species introduction, global climate change, overexploitation, poaching, Rare species, Extinction: mass extinction, extinction processes, Human factors: social, economic, political and remedial actions, Endangered and endemic species of India, common plant species, common animal species, Conservation of biodiversity- strategies for conservation: *in-situ* and *ex-situ* conservation, Conservation practices in India and world- Organizations involved in resource conservation: IUCN, WWF, UNEP, UNESCO, Biodiversity International, IPGRI, FAO, BSI, ZSI. General account on activities of DBT, BSI, NBPGR, ZSI, FSI, NBFGR and NBAGR NFPTCR, Sacred groves, Biodiversity register, Conservation of biodiversity, Salient provisions of Biological Diversity Act, 2002, Role of Gramsabha in biodiversity conservation, Ancient Indian culture in biodiversity conservation, Role of biodiversity in SDGs, Ecological economics and mission life style environment (Life)

Practicals

Field survey for studying plant species diversity in a village/region, Study of the morphology and reproductive structures of the types of micro-flora and micro- fauna, Staining of fungal filaments by Cotton Blue, Methylene Blue, Preparation of sterilization media, principles of isolation, pure culturing, Collection, identification and submission of non-wood forest products, Visit to forest to study genus/species distribution, Notes on pest and diseases of forest plants (any four), Study of ITKs on biodiversity conservation and documentation of tangible & non-tangible benefit of biodiversity conservation, Orientation about biodiversity register and its activities.

Course Title : Farming based Livelihood Systems Course Code AGRON 113 Credits Hours : 3 (2+1)

Theory

Concept of farming system and integrated farming system- Definition, goal and advantages, Classification of farming systems, Components of farming systems- Crops and cropping systems, Livestock and poultry, Fishery and Secondary enterprises, Integration of components in farming system, Factors affecting integration of components in IFS, Selection of crops and cropping systems for various enterprises, Feasibility of different cropping systems for different agro- climatic zones, Horticultural crops and cropping systems feasible for different farming systems, Livestock and poultry as a component of integrated farming systems, Study of different livestock components feasible for IFS (Dairy, Piggery, goatry, poultry, duckry etc.), Aqua culture as a component of IFS, Duck/Poultry cum Fish, Dairy cum fish, Piggery cum fish etc. Problems, profitability and prospects, Sericulture as a component of IFS: Scope and potentiality of sericulture for small and marginal farmers of states, Some suitable module of IFS for different agro-ecological situations, Commercial livestock production- problems and prospects, Design for livestock shed and their maintenance, Importance of feed processing unit for livestock production, Silage and hay production, Marketing, Concept of sustainable farming system and their indicators.

Practicals

Study of IFS models for different agroclimatic zones, Preparation of IFS model in groups, Recycling of organic waste in IFS, Study of production and profitability of IFS, Market survey for IFS products, Preparation of organic manure in IFS, Study of crops and cropping systems for diversification in IFS, Visit to farmers field for feasibility study for scientific intervention in IFS, Study of Integrated Organic Farming Systems

Semester II	
Cow- based Natural Farming	3(1+2)
Soil Biology in Natural Farming	3(2+1)
Integration of Horticulture Crops under Natural Farming	2(1+1)
Insect Ecology, Nematodes and Pest Management	3(2+1)
Introductory English, Communication Skills and Personality Development	2(1+1)
Environmental Studies and Disaster Management	3(2+1)
Skill Enhancement Course	2(0+2)
Skill Enhancement Course	2(0+2)
National Services Scheme/NCC/NSO	1(0+1)
Total	21(9+12)

Course Title: Cow Based Natural Farming Course Code: NF-121 3 (1+2)

Theory

Sociology of natural farming, Indian Livestock scenario, Indigenous breeds of cattle, Differentiating features of indigenous, crossbred and exotic cattle, Traditional livestock farming practices, Draft animal power in natural farming, Feeding cattle at various phases, Forage production, Hay making, Preventive health care practices, Bio

efficacy of cow urine on crop production, Effect of different natural inputs on yield, quality and soil properties, Effects of cow urine and its major constituents on pasture properties, Cow based rearing systems: land, feed and water requirement of traditional farming method, Advantages of cow based natural farming methods, Economics of cultivation and comparison with currently adopted practices, Role of cow based farming system in utilising the available cattle (Desi cow) as valuable resource, Cost of cultivation under cow based natural farming, Composition and constituents of desi cow milk vs cross breeds; role of tryptophan precursor of serotonin in relaxing human mind and better sleep, role of A2 Milk in controlling blood sugar level. Sustainable agriculture and fodder business, Natural farming business and entrepreneurship development, Supply chain management, Application of bio gas in agriculture, Traditional therapies for various ailments, ITKs in cow based natural farming.

Practicals

Identification and characteristics of various cattle breeds, fodder varieties and feeding ingredients; Visit to dairy farm to study the various components and their utilization, Visit to gau-shala, Visit to an institute involved in cow based natural farming, Design and development of cow based natural farm, Identification of herbal plants used for livestock treatment, Ethno veterinary medicines,; Feed and fodder conservation practices-Silage and Hay making, Concentrate making techniques including ration balancing for cow based farms, Calf management under natural Farm, Value addition of milk from dairy, Grassland management, Value addition of by-products from cow based natural farm, Bio-inputs preparation for natural farms, Traditional practices followed in cow-based natural farms, Record keeping and economics of cow based natural farming, Preparation of inputs for cow based natural farming, Demonstration of renewable energy sources in cow based natural farms.

Course Title : Soil Biology in Natural Farming Course Code : NF-122 3 (2+1)

Theory

Soil as a habitat for life, concept of soil biome & its components, Soil organic matter: Definition and its characterization, Biochemical processes of formation of soil organic matter, SOM as carbon source for soil biota, Decomposition processes, reaction order and its dynamics, Soil biodiversity and its methods of evaluation, Soil microbiota: its distribution and abundance, metabolism and physiology, classification of soil microorganisms and their importance in soil processes, Soil fauna (microfauna, mesofauna, macrofauna and megafauna): distribution, abundance, diversity and interactions; Factors affecting soil biodiversity, Significance of biota in soil development, Soil biological interactions: Functions and processes, Above-ground and below-ground biotic linkages, Rhizosphere, spermosphere, phyllosphere and their use in crop growth and development, Habitat adaptive fitness benefits to host crops in terms of tolerance to abiotic and biotic stresses, Biological nitrogen fixation: Symbiotic (*Rhizobium*-legume, Actinorhizal, *Azolla-Anabaena*), Associative (*Azotobacter*, *Azospirillum*, *Gluconacetobacter*, etc.), Free-living (BGA, *Klebsiella*, etc.), Microbiological methods of composting: various composting techniques, biofortification of various organic manures, *In-situ* decomposition techniques of crop residues using decomposers, Mechanisms of Biological Nitrogen Fixers (BNF), factor affecting BNF, Microbial mediated nutrient availability and exchange in soil, Nutrient mobilization, Arbuscular mycorrhizal symbiosis: its types, biochemical basis of interactions and benefits to host crops, Soil enzymes -characterization and mode of action, Agricultural management impacts on soil enzyme activities, Soil health, soil sickness, soil resistance concept, indicators and evaluation criteria, ITKs on soil health management through enriching soil microbiome.

Practicals

Hands on microscopy and examination of microbes, Microbiological media and methods of sterilization, Isolation and purification of microbial cultures, Enumeration of microbial population in soil- bacteria, fungi, actinomycetes, Isolation of *Azospirillum*, *Azotobacter*, BGA, *Rhizobium*, Determination of microbial biomass C and N, Assay for soil enzyme activities, Assay for carbon substrate utilization, Determination of earthworm population and biomass, Estimation of soil carbon active pool (CO₂ evolution, SMBC), Estimation of different carbon fractions of soil, Estimation of soil carbon stock.

Theory

Importance and scope of horticulture crops in natural farming, Soil management in relation to nutrient and water uptake and their effect on soil environment, Intercrops- types and its role in nutrient management, Biological efficiency of cropping systems in horticulture, Planting of fruit plants in combination with annual crops – principles and strategies, Types of planting system for fruit plants in natural farming, Competitive and complimentary effect of root and shoot systems, Type of mulches - sod mulch and organic mulches for soil moisture and nutrients management, Irrigation – defined systems of irrigation for natural farming in fruit crops, Soil microbes and their role for sustainable horticultural crop production system, Canopy management, Training and pruning, Methods of training and training of important fruit trees, High density planting (HDP) and meadow orchards and their management, Rejuvenation of old orchards - top working and frame working, Integrated pest and disease management (IPDM), Integrated nutrient management (INM), Crop regulation in relation in fruit crops, Management of resources constraints in existing systems, Climate aberrations and mitigation measures of horticultural crops, Management of fruit plants of important tropical, sub-tropical and temperate fruit crops under natural farming, Mulching of fruit crops and Whapasa management, ITK for management of fruit plants under natural farming system,

Practicals

Selection of site for farm system design for establishment of natural farming of horticulture crops, different planting systems and its layout – triangular system, contour lines, double row system, rectangular and square, Preparation of pit and procedures for filling, Soil depth and slope for fruit tree plantation, Irrigation methods and application of water to fruit crops, Growing of intercrops ginger, turmeric, colocasia, cowpea, cabbage and green manuring, Filler crops – definition and their use in young orchard, Training and pruning methods of important tropical, sub-tropical and temperate fruit crops, Weed management in orchards, Use of plant-based products and microbes for plant protection of tropical, sub-tropical and temperate fruit crops, Mulching of fruit crops and Whapasa management.

Theory

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, Categories of pests, Storage pests. Solutions for insect pest control in Natural Farming: surveillance, perimeter weeding, conventional land preparation, host plant resistance, interaction of plant resistance traits and biocontrol agents, crop rotation and planting practices (date of sowing), intercropping/ mixed cropping, trap crops, border crops, sanitation, conserving natural enemies via habitat enrichment, Physical control strategies to reduce pest incidence, Mechanical control, Behavioral control (repellents and anti-feed ants plants, Biological control (Importation, Conservation, Augmentation; Parasitoids predators & Pathogens), Factors affecting success of biological control: Narrow host range/ Climatic adaptability/ Synchrony with host life cycle / High reproductive potential / Efficient search ability/ Short handling time / Survival at low host density, Botanicals (Plant extracts), Plant bioformulations: agniaster, brahmaster, neemaster, dasparni ark etc. Management of stored grain pests by non-chemical methods.

History and economic importance of nematodes: General characters of plant parasitic nematodes, their morphology, symptomatology and control of important plant parasitic nematodes of field and fruits by non-chemical methods, Use of various plant bioformulations like agniaster, brahmaster, neemaster, dasparni ark etc. for nematodes and pest management.

Practicals

Sampling techniques for estimation of insect-pests and nematodes populations, Collection of insect-pests, nematodes, natural enemies and their identification, Diversity of insect pests, nematodes, Calculation of diversity indices, Preparation of different bioformulations and their application methods.

Course Title: Introductory English, Communication Skills and Personality Development EE- 122(A)2 (1 + 1)

Theory

Grammar-Parts of speech, Subject/verb agreement, Tenses; Sentence construction-Transformation of sentences, Synthesis of sentences, Direct and Indirect speech; Vocabulary-Homophones/ Homonyms, Commonly confused words; Paragraph Writing-Principles of paragraph construction, Orders of paragraph development (chronological, spatial, compare and contrast), Inductive and deductive paragraphs;; Introduction to communication skills-Communication and its types, Communication barriers, Effective communication, Speaking skills-Public speaking, Presentation skills, Reading skills- Skimming and Scanning, Local comprehension (Factual comprehension, Inferential comprehension, Evaluative comprehension), Understanding discourse markers, Writing skills: Introduction to technical writing, Letter writing, Summarizing and Abstracting, Note-taking, Listening skills-Hearing, Understanding, Remembering, Evaluating, Responding, Introduction to personality development- Personality and its determinants, Developing positive attitude, Raising self-esteem, Etiquettes and Manners, Ethics and Values, Stress management, Time management, Group dynamics, Body language-Components of body language, Importance of body language, Body language in specific situations, Career and interviews-Attending interviews, Self- introduction, Preparing resume, SWOT Analysis-Elements of SWOT Analysis, Analysing strengths, weaknesses, opportunities and threats, Usage of SWOT analysis, Importance of SWOT Analysis

Practicals

Grammar- Function of different parts of speech, Subject/verb agreement, Correct usage of tenses; Sentence construction-Transformation of sentences, Synthesis of sentences, Direct and Indirect speech, Vocabulary-Correct usage of different Homophones/ Homonyms, Correct usage of commonly confused words, Paragraph Writing-Application of principles of paragraph construction, Chronological, Spatial, Compare and contrast paragraphs, Inductive and deductive paragraphs; Speaking skills-Public speaking, Presentation skills, Reading skills- Skimming and Scanning, Local comprehension (Factual comprehension, Inferential comprehension, Evaluative comprehension), Understanding discourse markers, Writing skills-Letter writing, Summarizing and Abstracting, Note-taking, Listening skills Hearing, Understanding, Remembering, Evaluating, Responding, Career and interviews: Self-introduction, Preparing resume, SWOT Analysis- Analysing strengths, weaknesses, opportunities and threats

Course Title: Environmental Studies and Disaster Management Course Code Ag Met-123 3(2+1)

Theory

Multidisciplinary nature of environmental studies: Definition, scope and importance.

Natural Resources : Renewable and non-renewable resources, Natural resources and associated problems, a) Forest resources: Use and over- exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forest and tribal people, b) water Resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems c) Mining Resources: Use and exploitation, environmental effects extraction and using mineral resources, case studies, d) Food resources: World food problem, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies, e) Energy resources: Growing energy needs, renewable and non-renewable energy resources, use of alternate energy sources. Case studies, f) Land resources: Land as resources, land degradation, man induced landslides, soil erosion and desertification, Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.

Ecosystem: Concept of 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, characteristics features, structure and function of the following ecosystems: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)

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 level, India as a mega –diversity nation, Hot-spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-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 e.g. nuclear hazards. Solid Waste Management: causes, effects, and control measures of urban and industrial wastes, Role of an individual in prevention of pollution.

Social issues and the environment: From Unsustainable to Sustainable development, urban problem 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 Dies, Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation, public awareness.

Human Population and the Environment: population growth, variation among nations, population explosion, Family welfare Programme, Environment and human health: Human Rights, Value Education, HIV/AIDS, Women and Child welfare, Role of Information Technology in Environment and human health.

Disaster Management: Natural Disaster- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, climatic changes: 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, rail, air and 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 arrangement, role of NGOs, community-based organization and media, Central, state, district and local administration, Armed forces in disaster response, Disaster response, Police and other organizations.

Semester III		
NF-211	Crop Management in Natural farming	3(2+1)
NF-212	Production of Bio-inputs	2(1+1)
NF-213	Farm Power and Machinery	3(1+2)
NF-214	Livestock and Poultry Production	3(2+1)
NF-215	Management of Plant Diseases	2(1+1)
Ag. Stat-213	Agri- Informatics and Database Management	3(2+1)
SEC-V	Skill Enhancement Course	2(0+2)
SEC-VI	Skill Enhancement Course	2(0+2)
	Total	20(9+11)

Course Title : Crop Management in Natural Farming

Course Code : NF-211

Credits Hours : 3(2+1)

Theory

Selection of crop and variety– criteria for selection of crops in natural farming, Traditional and indigenous variety - Advantages and disadvantages -Classification of crops - factors affecting selection of crops and variety,

Importance of pulses of legumes in natural farming, Weather management- Concept of weather and climate, Factors affecting crop production:- climatic factors, edaphic, biotic, physiographic etc., micro-climate management techniques, Windbreaks and shelter belts, Management of weather in natural farms, Seed, sowing and Irrigation- Importance and concept of seed selection, seed treatment, Seed rate- Factors affecting seed rate and seed germination, sowing- time, method and depth, indigenous methods and animal drawn techniques, time and method of irrigation, management of irrigation, ITKs in seed, sowing and water management, Crop Geometry- d Definition of crop geometry and crop density, types of crop geometry, importance of crop geometry, thinning, gap filling, optimum plant population, factor affecting plant population, relation of crop geometry and growth, relation of crop geometry and yield, Weed management: classification of weeds and their importance, methods of weed management, practices of weed management in natural farming, Nutrient management: sources of nutrient application and their management in natural farming and modern agriculture, maintenance of soil health and plant health, under natural farming, Package of practices of crops under natural farming.

Practicals

Selection of crops for natural farming according to agro-ecological zones, Know how on agro-met observatory and data interpretations, Calculation of seed rate for sowing, Plant geometry and population calculation, Traditional seed treatment methods, Preparation of traditional nutrient supply concoctions and their uses, Traditional knowledge techniques in crop management and on-farm waste management, Study of methods of crop residue management, Study of important methods of plant protection, Irrigation efficiency, Preparation of crop calendar for different sowing seasons under various micro-climates, Preparation of contingency crop plan for natural farming, Yield estimation in naturally grown crops, Field visit to natural farm, Documentation of sustainable natural farming practices

Course Title : Production of Bio-inputs Course

Code : NF-212

Credits Hours : 2 (1+1)

Theory

Definition and types of bioinputs, Importance of bioinputs, Mechanism of action of bioinputs, Quality standards of bioinputs, Methods of production and application doses of bioinputs, Factors affecting the product quality, Green manures, *Achhadana*, Cow-based bioproducts (*Beejamrutha*, *Jeevamrutha*, *Ghanajeevamrutha* and other inputs (*agniaster*, *brahmasteer*, *neemasteer*, *sonthasteer*, *Khatti lassi dasparni ark*, *Kanupajala* and *saptdhanyaankur*) for pest, disease and nutrient management, compositions/ingredients of various bioinputs and their relative merits, Effects of bioinputs on soil biological components, their activities, soil enzymes and overall soil fertility, Impact of bioinputs on plant physiological activities and physiological stress indicators, Influence of bioinputs on plant-microbe and plant-faunal interactions, Initiatives taken by government (central/state), NGOs and other organizations in India for promotion of bioinputs under natural farming perspectives, Economic considerations, viability, marketing and export potential of different bioinputs, Quality aspects, grading, packaging, handling, and establishment of internal control system for bioinputs, Project formulation of bioinputs in natural farming.

Practicals

Definition and types of bioinputs: compositional analysis (nutritional and microbiological), Assay on mode of action of bioinputs, Preparation of animal manure-based bioinputs and their uses, Preparation of *Beejamrutha*, *Jeevamrutha*, *Ghana Jeevamrutha*, soil microbes based improved bioinputs, mass production

and its uses; Preparation of *Bramhaster* and their uses, Preparation of *Agniaster*, *Neemaster* and *Dashparni ark*, their mass production and uses, Preparation of plant-extract based bioinputs, Ginger- Garlic- Chilli extract and their use, Preparation of fermented butter milk and their uses, Preparation of herbal *kunapajala* and Neem -based concoctions and their specific uses, Study of physical, Chemical and biological characteristics of important bioinputs, Determination of plant physiological stresses upon application of bioinputs,

Course Title : Farm Power and Machinery Course Code : NF-213

Credits Hours : 3 (1+2)

Theory

Mechanization in agriculture: its potential and prospects, . Sources of Farm Power, Draught animal power and its relevance to Indian Agriculture, Familiarization with different engine systems, Familiarization with different systems of I.C. engines, working principles of I C engines, Components of IC engine, Use of bio- diesel/bio-ethanol as alternative fuel for engines, Familiarization with tractor, Introduction to primary and secondary tillage equipment, Energy efficient improved tools and equipment's in natural farming: Introduction to rotavator, planter, vegetable transplanter, bed former, disk harrow, mulch laying equipment, Ergonomically improved hand tools for intercultural operations: wheel hoe, long handle hoe, garden tools, labour saving/drudgery reducing tools, Plant protection equipment: knapsack sprayer, power sprayer, threshing and shelling machinery, Animal drawn farm equipment/tools: Animal drawn bund former, Seed drill, Planters, cultivator, ITK in farm machinery, ITKs on farm tools.

Practicals

Study of different engine systems, Study of the different components of IC engines, Familiarization with tractor, Familiarization with tools and equipment for input production in field, Familiarization with tractor drawn primary and secondary tillage implements, Familiarization with animal drawn primary and secondary tillage implements, Familiarization with tractor drawn seed-cum- fertilizer drills their seed metering mechanism and calibration, Familiarization with animal drawn seed-cum-fertilizer drills their seed metering mechanism and calibration, Familiarization with planters, Familiarization with transplanters. Familiarization with different inter-cultivation equipment, Familiarization with different types of sprayers, Familiarization with different types of dusters, Familiarization with harvesting machinery, Familiarization with threshing machinery.

Course Title : Livestock and Poultry Production Course Code NF 214 3 (2+1)

Theory

Historical account of livestock rearing in vedic, medieval and modern era in India including free range, semi-intensive and intensive systems and major pastoral systems in India, Demographic distribution and characteristics of livestock (Cattle, buffalo, sheep, goat, and poultry) and economy, Common farm management practices of livestock and poultry including housing, feeding, watering, sanitation, pest and disease management, Common vices of animals (Cattle, Buffalo, Sheep, Goat), their prevention and care. General principles of sewage disposal and purification, Solid and liquid manure management, Compost making,. Ventilation requirements, Presumptive standards for permissible air pollution in buildings, Respiratory exchange in domestic animals, Importance and method of ventilation, Livestock and poultry rearing and carbon foot prints, Breeding strategies and biotechnological tools for the improvement of dairy cattle, buffalo, sheep, goat, swine and poultry, Natural Breeding for livestock and poultry, Methods of conservation - livestock and poultry conservation programmes in the state and the country, Fodder production and conservation - Importance of grasslands and fodder in livestock production and their management, Structures for storage of feeds and fodders, Scarcity fodders and preservation of green fodder, Recycling of animal shed washings and wastes in fodder production and use of recycle waste., Disposal, utilization and recycling of waste, etc. Sheep, goat, rabbit farming and swine farming: role and importance in natural farming, Classification of poultry with respect to production characters, age and standards, Production characters of other avian species, Description of indigenous fowls and their value in rural farming,

Livestock production management - Housing systems, layout and design of different buildings for animals, Selection of site: General principles affecting the design and construction of building for housing for various livestock species. Scavenging system of management – Low input technology – Backyard and semi- intensive units; their management and economic achievements.

Deep litter management – Control of litter-borne diseases and recycling of litter. Cage management – Different types; Advantages and disadvantages. Management of growers, layers, broilers and breeders. Stress management.

General management and feeding practices of calves, heifers, pregnant, lactating and dry animals, bulls and working animals. Systems of feeding, restricted feeding, phase feeding. Unconventional feed ingredients -Herbal Bio enhancers.

Protection and welfare of livestock, poultry and working animals. Draught ability of cattle and buffaloes; Routine animal farm operations and labour management, Animal farm accounts and records.

Indigenous technical knowledge related to livestock rearing and veterinary practices, Indigenous technical knowledge pertaining to health and management of livestock.

Classification of poultry with respect to production characters, age and standards; Description of indigenous fowls and their value in rural farming, Specific strains developed for rural poultry production their acceptability and importance in rural eco-system.

Brooding management – Types of brooders – preparation of shed – Importance of environmental factors; Housing – Types of poultry, houses – space requirements. Feeding management– Classification of nutrients, Nutrient requirements and feed formulations, Feeding systems; Water management.

Sheep and goat farming: Introduction and scope in the country, Important breeds (exotic and indigenous) & their characteristics, Housing and feeding. Management of sheep and goat for optimal production.

Principles of disease and pest prevention management, Ayurvedic, homeopathic, ethno-medicines, General principles of medication for livestock and poultry in natural farming.

Candling, sexing, grading, packing and disposal of hatchery waste. Troubleshooting hatchery failures, Poultry waste management, pollution and environmental issues, mixed and integrated poultry farming under natural landscape. Vertical & horizontal integration in poultry production, Management of ducks, turkeys, Japanese quails and guinea fowls.

Practicals

Identification of indigenous breeds of livestock, small ruminants and poultry and other avians. Acquaintance with natural livestock farms (dairy and small ruminant), backyard poultry and other avians, Layout plans for different livestock houses and poultry, Fodder production and conservation: Visit to the fodder farm, Familiarization with various types of fodders in the states and India. Livestock waste utilization and recycling/ Familiarization with various fertilizers and manures. Human handling and restraining of cattle, buffalo, sheep and Goat: clipping, shearing, dipping, spraying and spotting sick animals, Determination of body weight using different measurements, Training of breeding males: detection of heat, Identification and care of pregnant animals, Care of neonatal and young stock, Diagnosis, prevention and treatment of important diseases and pest of livestock, small ruminants and poultry and other avians, Economic traits of broilers, egg-type chicken and breeders, Poultry farm and hatchery equipment, Brooding arrangement in broiler farms, ITKs related to livestock management, Vaccination, deworming and Medication of birds, Keeping records and their maintenance, Feed ingredients and its quality assessment, Fundamentals in poultry post-mortem examination for sample collection and dispatch. Economics and preparation of project report for establishing livestock, fodder and poultry farms/festivals related to animals, Participation and documentation of the region- specific festivals related to animals.

Course Title : Management of Plant Diseases Course Code : NF 215 Credits Hours : 2 (1+1)

Theory

Plant disease management under natural farming: 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, Pathogenesis, Koch's postulates, Role of enzymes, toxins and growth regulators in disease development, Defense mechanism in plants, Epidemiology: Factors affecting disease development, Survey, surveillance and vigilance, Crop loss assessment and models, Principles and prerequisites of forecasting of diseases, Principles and methods of plant disease management, Symptoms, etiology, disease cycle and management of major diseases of field crops and horticulture crops, Methods of plant disease control: Host plant resistance, cultural, mechanical, physical, legislative, biological control, Ecological management of crop environment, Role of soil microbiome in disease management, Suppressive soils, concepts and potentialities for managing soil borne pathogens, Application of khatti lassi, jungle ki Kandi, sontha aster for the management of various types of diseases, Plant growth promoting rhizobacteria (PGPR) and their use in plant protection, Heritage perspective of plant protection (Drumraksha), Plant Protection through Botanicals, ITKs related to management of plant diseases.

Practicals

Acquaintance with various laboratory equipments and microscopy, Collection and preservation of disease specimens, 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, Preparation of extracts of natural plant products as fungicides, Field visit for the diagnosis of field problems, Collection and preservation of plant diseased specimens for Herbarium, Preparation of pressed and well mounted specimens, Preparation and methods of application of Khattilassi, Jungle ki Kandi, Sontha aster for disease management, Bio-surfactants and their use.

Course Title : Agri Informatics and Database Management Course Code : Ag Stat- 213 3(2+1)

Theory

Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System, definition and types, Applications of MS-Office for creating, Editing and Formatting a document, Data presentation, Tabulation and graph creation, Statistical analysis, Mathematical expressions, Database, concepts and types, Creating database, Uses of DBMS in Agriculture, Internet and World Wide Web (WWW), Concepts and components. Computer programming, General concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc. concepts and standard input/output operations. e-Agriculture, concepts, design and development, Application of innovative ways to use information and communication technologies (IT) in Agriculture, Computer Models in Agriculture: statistical, weather analysis and crop simulation models, concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation, IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone mobile apps in Agriculture for farm advice: market price, postharvest management etc., Geospatial technology: concepts, techniques, components and uses for generating valuable agri-information, Decision support systems: concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting farm decisions. Preparation of contingent crop-planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India.

Practicals

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 documents, MS- EXCEL - Creating a spreadsheet, Use of statistical tools, Writing expressions, Creating graphs, Analysis of scientific data, Handling macros. MS-ACCESS: Creating Database, preparing queries and reports, Demonstration of Agri- information system, Introduction to World Wide Web (WWW) and its components, Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++, Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/CropSyst/ Wofost, Preparation of inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools, Use of smart phones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial Technology, Hands on practice on preparation of Decision Support System, Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA).

Semester IV		
NF-221	Elements, Characteristics and Design of Natural Farming Systems	3(2+1)
NF-222	Improvement of Traditional and Under-utilized Crops	3(2+1)
NF-223	Agro-Ecosystem Analysis for Natural Farming	2(1+1)
NF-224	Beneficial Insects	3(2+1)
NF-225	Quantification and Valuation of Ecosystem Services	3(2+1)
EE -222	Entrepreneurship Development and Business Communication	3(2+1)
SEC-VII	Skill Enhancement Course	2(0+2)
SEC-VIII	Skill Enhancement Course	2(0+2)
	Seminar-I	1(0+1)
	Total	22(11+11)

Course Title : **Elements, Characteristics and Design of Natural Farming Systems**

Course Code : **NF-221**

Credits Hours : **3 (2+1)**

Theory

Natural Farming Systems: Concept, importance, approaches, determinants and characteristics, Strength and weakness of natural farming systems, Ecosystems: concept and components, System approach and concept for farming systems, natural farming systems and ecosystem analysis, The water cycle, nutrient cycle and energy cycle, Types of ecosystems: Natural ecosystems and agri-ecosystems, concept and classification of ecosystem services, Concept and elements of natural systems, Classification of farming types (based on geographical condition, levels of technology and external input use, labour, demand of produce, etc.), Subsistence farming: Intensive subsistence and primitive subsistence, Traditional farming, intensive conventional farming, integrated farming, conservation agriculture, eco-agriculture, ecologically intensive agriculture (sustainable intensifications) biodynamic farming, permaculture, cow based farming, cosmic energy farming, praktikshaswat yogic farming, natural farming, agnihoter farming (homa farming), astrology and astronomy in agriculture, vastu practices,

Important agri-based, horti-based, animal based, agro forestry, aqua farming system models, The prairie model, Natural system models at the basis of mimicry (the rain forest model, the dry forest model, Concept of ecosystem based integration of crops, livestock, horticulture and fish farming as complimentary activities, Traditional integrated farming system models based on natural farming principles, Comparison of natural ecosystems, traditional farming system and modern agriculture, Production syndrome in natural farming, Hypotheses and concepts in designing the natural farming system models (Biodiversity and the mimicry hypothesis, productivity, resilience, equilibrium and stability, Levels of organization for nature mimicry in agro-ecosystems), Principles for cropping and farming system design based on natural ecosystem mimicry, Steps for development of agricultural systems based on mimicking natural ecosystems, Economic evaluation and comparative analysis of different farming systems and natural systems, Optimization methodology: a potential approach for system, natural farming system and ecosystem analysis and design.

Practicals

Identification and characterization of different natural and agro-ecosystems in the rainfed, hill and mountain, arid, coastal and irrigated regions, Study on characterization of natural eco-systems and intensive farming system, Study on characteristics of elements of water cycle in natural ecosystem and farming system, Study on characteristics of elements of nutrient cycle in natural ecosystem and farming system, Study on characteristics of elements of energy cycle in natural farming, Comparative biodiversity analysis in natural and conventional farming systems, Calculation of bio-diversity index for different farming systems, Designing of cropping/farming and natural farming systems, Study and representation of resource flow and recycling in different farming systems, Budgeting: Farm records and farm book keeping in natural farming system, Cost and profit analysis of different components and whole system, Designing of natural farming systems models in different Agro-ecosystems, Designing Farming systems/Natural farming systems using mathematical tools/optimization methodology.

Course Title Improvement of Traditional and Underutilized Crops Course Code NF-2223 (2+1)

Theory

Importance of traditional and underutilized crops, Genetic basis of crop Improvement: Laws of inheritance; qualitative and quantitative traits, multiple factor hypothesis, pureline theory, components of phenotypic variance, GXE interaction, heritability, breeder's equation, populations/ landraces/ farmers' varieties/ cultivars, Hardy Weinberg equilibrium and factors affecting it, Assortative and disassortative mating, Difference between self-pollinated, cross pollinated and clonal populations, Important physiological parameters for crop improvement- photosynthesis, transpiration, water and mineral regulation, Breeding objectives under natural farming systems- Nutrient Use Efficiency, Tolerance to micronutrients, mineral deficiencies and toxicities, Weed competitiveness, Enhanced Interaction with Rhizospheric microorganisms, Multiple disease and insect resistance, Quality, Earliness/ crop duration to suit multiple cropping system and agro-ecologies, Wider adaptability and stability, Broad genetic base / population heterogeneity, High yield, Multipurpose crops- stay green, food, feed, fiber and fuel. Plant breeding techniques: Domestication, introduction, Selection, hybridization; Breeding self-pollinated crops- Pureline selection, mass selection, pedigree selection, mass selection, SSD, backcross breeding, Breeding cross pollinated crops- Population improvement, recurrent selection, composite and synthetic varieties, Improving clonally propagated crops- clonal selection, Farmer participatory plant breeding. Molecular markers, Marker Assisted Selection (MAS), comparison of MAS vs. Phenotypic selection.

Practicals

Study of floral biology of different crops, Hybridization techniques, DUS characterization important land races and traditional varieties of crops, Breeding methods for natural farming, Study of root characteristics of crops grown under natural and other production systems, Learning of techniques of participatory plant breeding, Techniques of conservation of plant genetic resources, PRA for mapping indigenous crops & their characteristics, Seed identification & collection for natural farming systems, Identification of important land races and traditional varieties of crops, Identification of important land races and traditional varieties of fruit crops.

Course Title : **Agro-Eco System Analysis for Natural Farming** **Course Code NF-2 2 (1+1)**

Theory

Definition of system, system hierarchy, Introduction, and concept of agro- ecosystem, Properties of agro-ecosystem, Types of agro ecosystem analysis, Tools and techniques used in agro-ecosystem analysis, agro-ecosystem analysis and sustainable agriculture, Steps involved in agro-ecosystem analysis, Methodology of agro-ecosystem analysis, Energy flow of agro-eco system analysis, Participatory rural appraisal related terms – RRA, PRA, PLA, PLAM, and philosophy of PRM, Participatory planning frame work, Importance of participation, Principles of participatory extension, Participatory technology development process

Practical

Simulated exercise on space related methods, Time related methods, Flow related methods, Documentation of participatory technology development process, conducting agro-ecosystem analysis using PRA tools and techniques in village situation, Learn the techniques of action plan development.

Course Title : **Beneficial Insects NF-224 3 (2+1)**

Theory

Ecological understanding of insects in natural farming, Study of their life cycle, population dynamics and interaction with other abiotic and biotic components in a natural farming ecosystem, Decomposers (insects) in natural farming system, Pollinators in natural farming systems: their kinds, types, diversity, conservation and profitable use for enhancing productivity in terms of quality and quantity, Natural enemies of poriferous insect's generalist predators, specific predators, parasitoids (egg, larval, pupal & intermediary), Insects in ecological communities, Insects as food, soil builders and insects of aesthetic value, Promotion of required habitat for friendly insects, Pollinators: Honey -bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and diseases, Bee pasturage, bee foraging and communication, Insect pests and diseases of honey bee, Role of pollinators in cross pollinated plants, Types of silkworms, voltinism and biology of silkworm, Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves, Rearing, mounting and harvesting of cocoons, Pests and diseases of silkworm, management, rearing appliances of mulberry silkworm and methods of disinfection, Species of lac insect, morphology, biology, host plant, lac production – seed lac, button lac, shellac, lac-products, Indigenous technical knowledge on management of insect pests, Knowledge and importance of beneficial insects in ancient India.

Practicals

Rearing dung beetles for decomposing organic wastes as manure, Pollinators- diversity, Species richness and their use in enhancing productivity of crops, Natural enemies- diversity, species richness, their conservation in *in-situ* and wherever possible, artificial rearing for using pest management. Collection of beneficial insects, study of life cycle & habitats of beneficial insects, crop wise applications of beneficial insects for pest control.

Course Title Quantification and Valuation of Ecosystem Services NF-225 3 (2+1)

Theory

Ecosystem Services (ES)-Meaning, Concept and its importance, Classification of Ecosystem Services - Provisioning, Regulating, Supporting and Cultural services, Basics of natural capital, Quantification of ecosystem services-Direct and Indirect approaches, Valuation of Ecosystem Services and its need, Ecosystem valuation methods-Revealed preference methods: Market pricing, Production function, Hedonic pricing methods, Travel cost method and Random utility models, Stated preference methods-Contingent valuation method and choice modelling, Cost based approaches of Ecosystem Valuation- Opportunity cost, Cost of alternatives or substitute

goods, Replacement cost method, Methods for Obtaining Non- economic Values-Focus groups, Citizens' Juries, Health-based valuation , Q- methodology and Delphi surveys, Payment for ecosystem services (PES), Governance and policy issues in ecosystem services, Challenges in valuation of ecosystem services.

Practicals

Ecosystem Valuation methods- direct and indirect methods of calculation, An Overview-Millennium Ecosystem Services (MEA) Assessment, Case studies on Payment for ecosystem services (PES), Case studies in Ecosystem Services in India and abroad, Study on Environmental Impact Analysis,. Visits to the ecosystem areas (Agro ecosystem, Forest Ecosystem and Aquatic ecosystem).

Course Title Entrepreneurship Development and Business CommunicationEE-222 3 (2+1)

Theory

Concept of entrepreneur, Entrepreneurship development, Characteristics of entrepreneurs; SWOT Analysis & achievement motivation, Government policy and programs on MSMEs/SSI , export and import policy relevant in agriculture sector and institutions for entrepreneurship development, Impact of economic reforms on agribusiness/agri-enterprises, Entrepreneurial development process; Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation), Developing managerial skills, Business Leadership Skills (Communication, direction and motivation Skills), Problem solving skill, Supply chain management and Total quality management, Project planning, formulation and report preparation; Financing of enterprise, Opportunities for agri-entrepreneurship and rural enterprise.

Practicals

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.

Semester V		
NF-311	Post-Harvest Management –I	3(2+1)
NF-312	Bio- resources and Agricultural Waste Management	3(2+1)
NF-313	Medicinal and Aromatic Plants	2(1+1)
NF-314	Seed Production Technology	3(2+1)
NF-315	Value Chain Management in Natural Farming	2(1+1)
NF-316	Renewable Energy Sources	2(1+1)
NF-317	Natural Farming and Human Health	2(1+1)
ENTO	Fundamentals of Entomology	3(2+1)
	Educational Tour	CNC
	Total	20(12+8)

Course Title : **Post-Harvest Management –I NF-311 3 (2+1)**

Theory

Post-harvest management: Importance of fruits and vegetables, Introduction to postharvest physiology of fruits and vegetables; Post-harvest losses, Maturity indices, Harvesting methods and collection devices, Unit operations in packaging with emphasis on use of natural products like bee wax, gum Arabic, shellac, xantham gum etc., Environment friendly and safe ripening methods, Post-harvest diseases, Disorders and their management.

Storage techniques: Traditional and modern storage structures: On farm and off farm storage, refrigerated storage, evaporative cool chambers, refrigerated vehicles, Storage techniques for local cultivars seeds.

Value addition: Principles and methods of preservation, natural preservatives, indigenous and traditional preservation techniques, phytochemicals for preservation, FSSAI, BIS, and Codex standards for major processed products from fruits and vegetables

Value addition in fruits and vegetables through drying, pickling, jam, jelly, marmalade, preserve (murabba), candy, juice, ready-to-serve, squash, nectar, crystallized products, etc.; minimal processing, Eco-friendly handling and packaging: Use of essential oils and ecofriendly phytochemicals in postharvest handling; Edible films and coating, eco or bio-based polymeric films used for packaging.

Modified atmosphere packaging, Vacuum packaging, Smart packaging, Active packaging using natural or bio-colours, ITKs for handling and packaging; neem- based products for fruit and vegetable handling.

Practicals

Demonstration and use of different harvesting tools, Practical demonstration on packhouse operations, Study of different preservation methods for fruits, and vegetable, Study of weight loss of produce in eco-friendly packaging, Determination of TSS and acidity in fresh and processed products, Determination of ascorbic acid, Determination of sugars, Study of different types of dryers, Study of evaporative cooling system/low cost cooling system/Zero Energy Cool Chamber, Preparation of traditional value-added products from fruits and vegetables, Preparation of jam, Preparation of jelly, Preparation of fruit-based beverages, Preparation of pickles, Study of different packaging materials, Visit to industry/processing unit.

Course Title : Bio-resources and Agricultural Waste Management Course Code : NF-312

Credits Hours : 3 (2+1)

General Objective

- i) To acquaint students with the knowledge and skills on management of bioresources and agricultural wastes into wealth for enhancing productivity and quality of agroecosystems.

Specific objectives

- i) To impart knowledge on various aspects of biowastes and agricultural wastes for managing as organic amendments in agricultural production system.
- ii) To develop skills on various methods of conversion of decomposable wastes into organic manures.

Theory

Introduction to bio-resources and agricultural biomass waste, Classification and characterization of agri and livestock biomass waste Principles of agricultural waste management: 4R's approach, Potential of recyclable crop residues and its management, In-situ management of agricultural waste, Role of soil and plants in waste management, Impact of agro-waste on soil and plant quality and the environment, Pre-treatment (Jeevamrutha) of agricultural wastes, Pre-treatment methods: biological treatment, biological-processes of waste management, Bio- conversion/bio-decomposition through native microflora biogas generation, operation and management of biogas plants, utilization of biogas and spent slurry, landfill, Farm waste management machinery, Environmental benefit of waste

management, ITK information on waste management,. Life style for Environment(LiFE) and Govt. schemes to promote agriculture waste into wealth.

Practicals

Visit to various agri-farms, Collection and preparation of agricultural waste samples, Characterization of agricultural waste, Determination of ash content of agricultural wastes and determination of un-burnt carbon in ash, Determination of pH, EC and CEC, Determination of BOD and COD, Nutrient status (N, P, K, and micronutrients) analysis of agricultural waste, Survey of different agri -waste from livestock, dairy, food processing, fruit & vegetable and agri-chemicals, Study of biogas production process and Study briquetting of agricultural residues and important commercial agri-waste management methods in public and private sector.

Course Title : **Medicinal and Aromatic Plants****Course Code**

: **NF-313**

Credits Hours : **2 (1+1)**

Theory

General aspects of Medicinal Plants, Definition, history, present and future needs, Introduction of plant parts (fruit, leaves, roots, stem, seeds and their modification), Cultivation and harvesting practices, Processing and storage practices, Marketing of medicinal products, Important Indian medicinal plants, Plant parts used as powder: Identification and utilization of Amla (*Embelica officinalis*), Behra (*Terminalia bellerica*), Harad (*Terminalia chebula*), Turmeric (*Curcuma longa*), Garlic (*Allium sativum*), Bitter guard (*Momordica charantia*), Black plum (*Syzygium cumini*), Fenugreek (*Trigonella foenumgraecum*), Cinnamon (*Cinnamomum verum*), Sarpagandha (*Rauvolfia serpentina*), Black pepper (*Piper nigrum*), Ashwagandha (*Withania somnifera*), Psyllium husk (*Plantago ovata*). Plant parts used as juice/ decoction: Identification and utilization of Amla (*Embelica officinalis*), Ginger (*Zingiber officinalis*), Onion (*Allium cepa*), Bottle guard (*Lagenaria siceraria*), Basil (*Oscimum santum*), Arjun (*Terminalia arjuna*), Neem (*Azadirachta indica*), Gwarpatha (*Aloe vera*), Brahmi (*Bacopa monnieri*), Giloy (*Tinospora cordifolia*), Shankpushpi (*Convolvulus prostrata*), Bael (*Aegle marmelos*). Plant Parts Used as Lotion and Ointments: Identification and utilization of Gwarpatha (*Aloe vera*), Fenugreek (*Trigonella foenumgraecum*), Pot marigold (*Calendula officinalis*), Neem (*Azadirachta indica*) Plant Parts Used as Oil: Clove (*Syzygium aromaticum*), Neem (*Azadirachta indica*), Coconut (*Coccus nucifera*), Nilgiri (*Eucalyptus* sp.). Plant Parts Used as Surgical Fibres, Sutures and Dressings: Identification and utilization of cotton (*Gossypium* sp.), Jute (*Corchorus capsularis*), Banana (*Musa* sp.). Plant Parts Used as Poultice: Identification and utilization of Turmeric (*Curcuma longa*), Nilgiri (*Eucalyptus* sp.), Ginger (*Zingiber officinalis*), Garlic (*Allium sativum*), Onion (*Allium cepa*), Dhatura (*Datura* sp.), Aak (*Calotropis* sp.), Arandi (*Ricinus communis*).

Practicals

Identification of locally available common medicinal plants, Basic preparation of herbal products as kadha, powder (Ex. Neem leaf, moringa leaf, tulsi leaf, giloy, arandana), Juice (Ex. Amla, Aloe vera), Trifala, Chyavanprash, Amla candy, herbal tea, etc. Study and documentation of commercial production of at least five medicinal plants, (Using website/ You Tube). Submission of digital photo album of at least ten medicinal plants with brief description, Cultivation maintenance and reporting of at least five medicinal plants within college campus.

Course Title : **Seed Production Technology Course**
Code : **NF-314**
Credits Hours : **3 (2+1)**

Theory

Seed quality: definition and concept of seed quality, Classification of seeds, Use of biodiversity for seed production, Formal and informal seed production systems. Principles of seed production of important cereals, pulses, oilseeds, fodder crops vegetables, Seed Physiology: Seed germination, viability, seed dormancy, types and requirements of seed germination, Seed health, quality seed collection from natural farming, Seed legislation, Seed testing, Varietal identification through Grow Out Test and electrophoresis, Biochemical tests and molecular tools, Minimum Seed Certification standards, field standards and seed standards, Seed drying and processing, Orthodox seed and recalcitrant seeds, General principles, stages and factors affecting seed longevity during storage and handling, Seed Village Concepts (seed self reliance), types and significance of indigenous seed conservation, community seed banks, Seed marketing, Role of WTO and OECD in seed marketing, Seed production, collection, storage and quality control in context with Natural farming, Technology of Seed Health during ancient time, Materials recommended (plant based, animal based) in ancient time for seed treatments, Sample case study of a few farmers initiative on conservation of seed in different states of India, PPVFR act (2001) and Suo generis plant variety law approach, ITKs in seed storage and seed health as compiled by ICAR.

Practicals

Seed production in major self-pollinated crops, Seed production in major cross pollinated crops, Seed production in selected vegetable crops, Seed sampling procedures, Seed testing: Physical purity, moisture test, varietal purity. RPL, germination, viability, Grow out test and electrophoresis, etc. Seedling vigour tests, Seed health tests, Genetic purity test: moisture tests, heterogeneity, Seed certification: Procedure, field inspection, taking of field counts, Preparation of field inspection and seed testing reports, Seed collection and rural improved storages, Visits to seed production farms, seed testing laboratories and seed processing plants.

Course Title : Value Chain Management in Natural Farming Course Code : NF-315

Credits Hours : 2 (1+1)

Theory

Concept of agriculture value chain, characteristics of value chain management in natural farming, types of value chains, role and importance of value chains; dynamics of renewable and non-renewable resources, resource scarcity, pricing and valuation of natural resources; good agriculture practices, good manufacturing and good processing practices, Value chain models- Producer driven, buyer driven, facilitated models.

Role of farmer producer organization in value chains of natural farming products; Market initiation and strategies, organization of value chains, roles and responsibilities of stakeholders of value chain, transportation, logistics and infrastructure, cold chain components, dispute resolutions and arbitration, physical asset collateralization, Quality certification like HACCP and FSSAI standards, Postharvest, quality, and value-added aspects for domestic and export market special economic zones, Theory of storage and Warehouses – Types, classification, advantages and disadvantages.

Practicals

Case studies and success stories on natural farming value chains in India and abroad, environmental resource accounting techniques, visit to special economic zones, identification of value chains for commodities, identification of nichemarkets for natural farming produces; post-harvest loss assessment.

Course Title : **Renewable Energy Sources Course**
Code : **NF-316**
Credits Hours : **2 (1+1)**

Theory

Introduction to energy, Forms of energy, Conservation of Energy, Sources of energy and their classification, Energy consumption patterns in India, Concept of renewable energy sources, Potential of renewable energy sources, Classification of renewable energy sources, Ecological footprint, Carbon footprint. Role of renewable energy in natural farming and its impact on food system, Environment and economy, Solar Energy: Introduction of solar energy, solar thermal energy systems: solar cooker, solar distillation, solar water heater, solar dryer, solar photovoltaic systems and their different types & uses, soil solarization, Biomass Energy: Introduction of biomass, biogas–biogas generation process, types of biogas plants, application of biogas, usage of biogas spent slurry, Biomass Gasification- types of gasifiers, producer gas production and utilization, Introduction to ethanol, biodiesel and hydrogen production process. Wind Energy: Introduction, Traditional practices of wind energy, Wind mills and their applications, Role of renewable energy in carbon mitigation, Energy balance in natural farming, Programmes and policies for promotion of renewable energy in India.

Practicals

Visit to farms to study different source of energy and their consumption, Study of solar cooker, Study of solar dryer, Study of solar water heater, Study of solar distillation, Study of solar photovoltaic system, Study of biogas plant, Study of biomass gasifier, Study the production process of biodiesel, Study of improved biomass cookstove, Traditional practices of wind energy, Determination of energy balance in natural farming.

Course Title : **Natural Farming and Human Health Course Code**
: **NF-317**
Credits Hours : **2 (1+1)**

Theory

Changing lifestyles and food habits of the people over the years, Health and disease statistics of world and India, Food production and requirement vis-à-vis growth in human population in India and World, Need of healthy food, Concept of healthy food, safe food, organic food, greenfood, pesticide free food, fast food, slow food, Dietary guidelines, Traditional food vis-a-vis modern food and its potential health impact, Food Chain contamination and human health hazards, Deficiency in micro-nutrients by the human and livestock population, Malnutrition, Concept of one health, Traditional food of Indian population: Food and its nutrient content, Traditional diets in Indian and their adequacy- Nutritional value of traditional food, Concept of nutrition and health per acre, Interrelationship between natural farming and human health, Health and nutrition disconnect in the agriculture policy of India, Effect of Natural farming on animal reproduction, Nutrients, taste, Safety, immune system, antibiotic resistance, antioxidant value and protection of environment, Dietary requirement for Indian population: Current diet and nutrition scenario, Recommended Dietary Allowances (RDA): food exchange list, food composition database, food composition and food groups, bio- fortification of crops, Criteria for classification of quality and safe food, Human health – definition and philosophy, concept of health- biomedical, ecological, psychological and holistic, Criteria & qualities of organic and natural food, Comparison of natural and conventionally grown foods: Nutritional and non-nutritional components, bioactive components, their impact on human health, effect of processing on nutritional components, conservation of nutrients in processed foods, Food standards, food laws and labelling of natural foods, Concept of nutritional garden, homestead kitchen garden and nutri smart village. ITKs in human food and nutrition and health, Life Style for Environment (LiFE Mission)

Practicals

Physical examination of food, determination of gluten, bulk density, hydration capacity and index, oil absorption capacity, Sensory evaluation and organoleptic evaluation of natural and conventional foods, Analysis of proximate composition in conventional foods and natural farming produce/foods based on available secondary data.

Determination of pesticide residues and heavy metal contamination in foods, Market survey and listing of natural farming foods available in the market, Preparation of nutri-thali, Composition of nutrient in different crop plants,

Effect of processing on nutritive value of food, Determination of pesticides load in the food stuffs, Glycemic index of common food, Macro – nutrient and micro – nutrient and their sources, Calorie requirement among different class of population, Balance diet for different class of people, Drinking water standard - limits of heavy metal content.

Course Title : Fundamentals of Entomology Course Code : ENTO

Credits Hours : 3 (2+1)

Theory

Entomology in ancient India, Historical classics of modern entomology, Classification of phylum Arthropoda up to classes, Relationship of class Insecta with other classes of Arthropoda, Major points related to dominance of Insecta in animal kingdom. Morphology: Structure and functions of insect cuticle and moulting, 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 and modifications of abdominal appendages, Anatomy of insect systems - digestive, excretory, respiratory, circulatory, nervous, reproductive and glandular systems, sense organs and tropism and bio-communication in insects, Metamorphosis in insects, Taxonomy – importance, history and development and binomial nomenclature, Definitions of Bio-types, Sub-species, Species, Genus, Family and Order, Classification of class Insecta up to Orders, basic groups of present days insects with special emphasis to orders and families of economic importance and their distinguishing characters.

Practicals

External features of Grasshopper/Blister beetle, Methods of collection and preservation of insects including immature stages, Types of insect antennae, mouthparts, legs, wings, wing venation and wing coupling apparatus, Types of insect larvae and pupae, Dissection of digestive system in insects, Dissection of male and female reproductive systems in insects, Study on characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Coleoptera, Diptera, Hymenoptera, Neuroptera, and their families of agricultural importance, Identification of major pests of crops.

Semester VI		
NF-321	Indian Traditional Knowledge	3(2+1)
NF-322	Post-harvest Management-II	3(2+1)
NF-323	Standards and Certification for Natural Farming	2(2+0)
NF-324	Aqua-based Natural Farming	3(2+1)
NF-325	Marketing of Natural Farming Produce	3(2+1)
NF-326	Agronomic Practices	2(1+1)
Ag IPR-	Intellectual Property Rights	1(1+0)
ECON	Principles of Agricultural Economics and Farm Management	2(2+0)
	Seminar-II (Case studies)	1(0+1)
	Total	20(14+6)

Course Title : Indian Traditional Knowledge

Course Code : NF-321

Credits Hours : 3 (2+1)

Theory

Introduction and importance of Indian Traditional Knowledge in agriculture and allied sciences: Definition, Difference between Traditional Knowledge System and Western Science System, Protection of Traditional Knowledge, IPR and other provisions, Indian Traditional Knowledge in Agriculture covering Veterinary and Animal Husbandry, Pest and Disease Management, Grain/ Seed storage, Horticultural Crops, Crops and Cropping system, Farm implements, Weather forecasting, Soil and water conservation, Soil fertility Management, Rainwater management, Tillage practices, Fisheries, Post Harvest Technology, Garbage disposal and management, Wind erosion, Waste water management.

Practicals

Case studies on validation of ITK's, Need to revive traditional technologies relevant to the contemporary agricultural scenario, Geographical indications of plant species involved in various ITK's (Pest and disease management, Grain/ Seed Storage, Veterinary and Animal Husbandry and Weather forecasting).

Course Title : Post-Harvest Management -II Course Code : NF-322

Credits Hours : 3 (2+1)

Theory

Physico-chemical and nutritive properties of cereals, pulses and oilseeds, causes of postharvest losses, traditional and modern storage structures, on farm and off farm storage, bulk and bag storage (especially eco/bio-based bags), Primary processing of cereals, pulses and oilseeds: Cleaning, grading, curing/tempering/conditioning, pretreatments including parboiling, Secondary processing: Drying, size reduction (milling), Oil seed milling: Ghanis, hydraulic presses, expellers, extrusion processing and different types of extruded products (snack, breakfast cereals and weaning foods), bakery and confectionary products, Traditional value-added products (regional products like nuggets/wadi/badi, papad, vermicelli/sevai, etc.),

Storage Pest Management: Use of ITKs like oil treatment, ash treatment, bio- control practices for storage pest control of cereals, pulses and oilseeds, Primary processing operations in poultry: Preslaughter operations and slaughtering operations for poultry: stunning, icing, grading, blanching, washing, evisceration, beheading, scaling, cutting off fins and belly flaps, steaking, filleting, skinning, deboning (meat-bone separator), mincing of skinned fillets, peeling, deveining, shucking, knobbing, Preservation methods for fish: Preservation of meat and fish by canning, chilling, freezing, marination (pickling), curing, cooking and smoking, dehydration, and biological preservatives (fermentation), etc. Value- added products from fish and meat, Hygienic handling and storage of fish: chilling or icing, refrigeration, pest infestations in stored fishery products, natural means to control pests infestation, Food-grade coatings as processing aids, Integrated pest management.

Practicals

Study of physicochemical properties of cereals, pulses and oils seeds, Determination of gluten content in wheat flour, Study of conditioning of wheat, Milling of wheat and rice by laboratory mill, Study of pre-treatment and milling of pulses, Study of oil expression equipment, Manufacture of value- added products, millets, guar gum and other minor crops, Study of primary processing of fish or meat, Study of preservation methods for fish/meat, Preparation of traditional value-added products from fish/meat, Preservation of meat/fish by freezing, Preservation of meat/fish by curing and pickling, Preservation of meat/fish by dehydration, Preparation of value-added poultry meat products, Quality evaluation and grading of eggs, Visit to processing facilities.

Course Title : **Standards and Certification for Natural Farming** **Course Code** :
NF-323

Credits Hours : **2 (2+0)**

Theory

Scope and procedure of Natural Farming Certification System (NFCS), definitions, Crop Production, habitat care, conversion, landscape, seeds and planting materials, diversity in crop production, inputs for soil and fertility management, Insect, pest and weed management, Contamination control, Transition / conversion Period and requirements for transition, Soil and water conservation, collection of non-cultivated material of plant origin/forest produces, Livestock production, General requirements, Feed and fodder, Health care, Processing and handling, General requirement: , Ingredients, Processing Methods, Packaging, Labelling, *Processed Products*, Storage and Transport, Marketing, Practices for use in soil preparation, Soil enrichment, practices for seed treatment, pest and disease management, procedure to evaluate natural farming input, Ethical Aspects — Animal welfare and socio economic aspects, practices to be followed for livestock reared in natural farm, International and national regulations on quality assurance and certification for non-chemical farming systems, ICT enabled certification process.

Course Title : **Aqua-based Natural Farming** **Course Code**
: **NF-324**

Credits Hours : **3 (2+1)**

Theory

Physical, biological and components of aquatic ecosystem, Ecological structure and function of aquatic ecosystem, Organic matter recycling and nutrient cycles, Food web and food chain, Heterotrophic activities, Energy and matter flow in the ecosystem, Eutrophication and pollution. Definition and scope of aquaculture, Global and national scenario, Trends and constraints, Different aquaculture systems and utilization of natural food, pond, pen, enhanced fisheries, Pre- stocking, stocking and post-stocking interventions for primary fish survival and growth, Aquaculture and climate change, Natural productivity and carrying capacity, Secondary and tertiary production, Carrying capacity of aquaculture system and associated factors, Natural food and feeding behavior of fishes and shellfishes: Concept of ecosystem based aquaculture, Integration of crop, live- stock, horticulture and fish farming as complimentary activities, Comparative nutritional value and decomposition of different types of organic wastes on organic productivity, Nutrient values of common animal waste and agro residues as potential manures, Biofertilizer, Definition of reservoirs in India: nature and extent of reservoirs, pen and cage culture in reservoir, Health management in aquaculture, Traditional techniques for curing fish diseases and pond management, Probiotics and bioremediation, Renewable and eco-friendly bio- inputs in aquaculture, Management and conservation natural aquatic ecosystems.

Practicals

Identification of important cultivable species, Estimation of carrying capacity, Practices on pre-stocking, Stocking and post stocking management, Growth studies in aquaculture system, Study on waste accumulation in aquaculture system (NH₃, Organic matter, CO₂), Analysis of certified manure/natural aquaculture inputs, Measurement of important soil and water quality parameters and their correction measures with certified standard materials/inputs, Preparation of artificial feeds using locally available permitted feed ingredients, Identification of different live food organisms and their rearing/culture with standard methods, Case studies on cage and pen culture.

Course Title : **Bio-resources and Agricultural Waste Management****Course Code** :
NF-325

Credits Hours : **3 (2+1)**

Theory

Concepts and definition of market, Agricultural marketing, Marketing of natural farming products, Market structure, Marketing mix and market segmentation, Demand, supply and producer's surplus of agricultural commodities marketable and marketed surplus, Pricing consideration and approaches cost based and competition based pricing, Market promotion and publicity, Marketing management-segmentation, Targeting & positioning, Marketing function-physical function, facilitating functions, Market functionaries and marketing channels, Marketing efficiency, Marketing costs, Market margin and price spread, Role of government in marketing of natural farming products, Public sector institutions – CWC, SWC, FCI, CACP, APEDA, Risks in marketing-types of risks involved speculation and hedging, Forward market and Future markets.

Practical

Study of relationship between market arrival and prices, Demand and supply curves, Calculation of marketable and marketed surplus, Identification of market channels for selected commodities, Computation of market margin, Price spread, visit to marketing institutions to study their organization and functioning.

Course Title : **Agronomic Practices****Course NF-326 2 (1+1)**

Theory

Classification of crops- Field crops – Origin, distribution, economic importance, soil and climatic requirements, varieties, cropping systems: definition, principles and its importance, physical resources, soil and water management in cropping systems, Importance of mixed cropping in natural farming, multiple cropping, alley cropping, sequential cropping and intercropping, cropping system indices - mechanism of yield advantage in intercropping systems, Complementary and competition relations, multi storied cropping and yield stability in intercropping, Types of crops - trap, cover, catch and restorative crops, ITK related to crops and cropping systems, Seeds- Traditional and recent varieties, classification of seeds, seed dormancy, nursery management, main field preparation, types of tillage, Seasons of India, Pre-monsoon sowing, Sowing techniques, Optimum time of sowing for different crops-ITK for seed treatment and seed selection, Methods of planting of crops, Time of planting of different crops & intercrops, Row spacing for different crops, Irrigation –Definition, irrigation types, water saving techniques and management, ITKs in irrigation and water management, Green manures and green leaf manures – Types of green manures, Ideal plant types for green manures, Nutrient content and biomass contribution, time and method of incorporation, decomposition pattern, Advantages and limitations, Weeds-Classification, habitat management of weeds, crop weed interaction, critical periods of weed competition, non-chemical weed management, weed mulch, trap crop, biological and herbal measures, Mulching – Types, cover crops – advantages and disadvantages, Soil moisture conservation approaches and Water Harvesting, ITKs on soil and water conservation. Alternate land use system – Definitions and types.

Practicals

Identification different growth stages in crops, manures and seeds, agriculture tools and implements, nursery and main field preparation, animal drawn, seed treatment and seed dormancy, methods of sowing, input requirement, water requirement and water use efficiency (WUE), weeds in wetland, irrigated up land, dryland system, low cost technology, indices for cropping systems, mulching practices, green manuring practices - alternate land use system - wind break and shelter belt - – ITKs in crops and agronomic practices.

Course Title : Intellectual Property Rights Course Code : Ag. IPR-210

Credits Hours : 1 (1+0)

Theory

Introduction, importance and meaning of intellectual property, changing scenario of agriculture in India, brief introduction to GATT, WTO, TRIPs and WIPO, Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc.; Types of Intellectual Property and legislations covering IPR in India: - Patents, Copyrights, Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets, Patents Act 1970 and patent system in India, patentability, process and product patent, filing of patent, patent specification, patent claims, Patent opposition and revocation, infringement, Compulsory licensing, Patent Cooperation Treaty, Patent search and patent database: 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, researchers and farmers rights, 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. Understanding Intellectual Property Rights in ancient India.

Course Title: Principles of Agricultural Economics and Farm Management Ag. Econ. 212 2 (2+0)

Theory

Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis: micro and macro economics, positive and normative analysis, Nature of economic theory: rationality assumption, concept of equilibrium, economic laws as generalization of human behavior, Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare, Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development, Agricultural planning and development in the country,. Demand: meaning, law of demand, demand schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle, Consumer's equilibrium and derivation of demand curve, concept of consumer surplus, Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity, Production: process, creation of utility, factors of production, input output relationship, Laws of returns: Law of variable proportions and law of returns to scale, Cost: Cost concepts, short run and long run cost curves, Supply: Stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply, Distribution theory: meaning, factor market and pricing of factors of production, Concepts of rent, wage, interest and profit, National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement, Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control, Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation, Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning, Forms of business organizations, international trade and balance of payments, GST and its implication on Indian economy.

Semester VII		
NF-411	Community Mobilization for Natural Farming	2(1+1)
NF-412	Water Management	2(1+1)
NF-413	Research Methodology and Ethics	2(1+1)
NF-414	Weather Forecasting	3(2+1)
STAT	Basic and Applied Agricultural Statistics	3(2+1)
	Elective Course-I	3(2+1)
	Elective Course-II	3(2+1)
	Elective Course-III	3(2+1)
	Total	21(13+8)

Course Title : **Community Mobilization for Natural Farming Course Code**
NF-411

Credits Hours : **2 (1+1)**

Theory

Community mobilization – Meaning, historical background, types, strategies, steps, opportunities and challenges, Community mobilization process: community mobilization in rural areas and different models, community entry, profiling, social mapping, Yoga for community mobilization - purpose, concepts, importance, types, benefits, SWOT Analysis - Meaning, advantages, case study, Social core value systems - Ethical principles, purpose, benefits, Development of understanding about rural society, Behavioral change and attitude, Programme Planning - Introduction, need and interest, concept, objectives and principles, process, Organizational structure - Define, key elements, types, span of control, Centralization and decentralization, formalization. Diffusion and Adoption Process- Define, meaning and Stages.

Group - Definition, types, stages of group formation, modes of group development, process for group formation - stages of SHG, FPO/FPC and FBO development, group decision making techniques, FPO - benefits, activities, implementing agencies to form and promote FPOs, procedure to form FPC and Organizational structure, Conflict - Meaning, types, process, conflict resolution and management strategies.

Motivation - Definition, elements, individual and group needs, motivation process, Maslow's Hierarchy theory of needs and Adam's Equity theory, motivation cycle, classification of motives, types of motivation, techniques of motivation, role/importance/factors of motivation. Capacity building and institutionalizing mechanism, Counseling – need, functions and types, Mentoring

- definition, process, philosophy and mentor-mentee relationship, Training - meaning, advantages, types and process, training methodologies for creating awareness about natural farming, Monitoring and Evaluation - Define, objectives, types, concept, difference, importance. Impact analysis on social, economic and environmental effects of natural farming.

Case studies on community mobilization in natural farming, Traditional and social media for promoting natural farming, Government schemes and role of public and private institutions in promoting community mobilization in natural farming.

Practicals

Preparation of “Community Resource Mapping” in selected rural village, Community needs assessment techniques – Participatory Rural Appraisal, Yoga, SWOT analysis, Organization involved in community mobilization, Programme planning and organizing events, Formation and functioning of SHG, Establishment, organizational structure and promotion of FPO and FBO, Group decision making techniques - Conduct of focused group discussion, Conflict management techniques, Motivation – preparation of Maslow's hierarchy

theory of needs assessment, Counselling and mentoring- conduct sessions among beneficiaries of natural farming community, Organizing, capacity building programmes, Socio economic impact analysis on natural farming, Traditional and social media for promoting natural farming, Public and private institutions promoting community mobilization for natural farming.

Course Title : Water Management Course Code : NF-412

Credits Hours : 2 (1+1)

Theory

History of water management in ancient and medieval India, Rainfed and irrigated farming water management: Definition, scope and importance, Water resources: Use and over- utilization of surface and ground water, floods, drought, dams-benefits and problems, Region specific traditional water harvesting and management systems, Rainfed Farming, Rainwater conservation technologies - in-situ and ex-situ storage, water harvesting and recycling, Rain water harvesting, Farm ponds, Ground water recharge, Contour and graded bunding, *Chalkhal*, Water budgeting, Irrigation water requirement, Micro irrigation: Sprinkler, Drip irrigation systems, pitcher irrigation system, maintenance of micro irrigation system, fertigation, advantages and limitations of fertigation, Watershed management - concept, objectives, factors affecting and watershed planning, Reservoirs, Ground Water Harvesting and Conservation (Tanka, Talai, Nadi, Nada, Talab, Khadin), Indian Traditional Knowledge in Rain water management, soil and water conservation.

Practicals

Measurement of soil moisture by different soil moisture measuring instruments, Measurement of irrigation water requirement, Determination of bulk density by field method,

Determination of field capacity by field method, Determination of permanent wilting point, Case study on water budgeting, Study of different types of farm ponds, Estimation of farm pond storage capacity, Testing of irrigation water quality, EC, pH and TDS, Study of different components of sprinkler irrigation system, Study of different components of drip irrigation, Field visit to micro irrigation system, Maintenance of different components of micro irrigation systems, Survey of watershed resources, Field visit to watershed, Field visit to water harvesting structure,

Course Title : Research Methodology and Ethics Course Code : NF-413

Credits Hours : 2 (1+1)

Theory

Research Ethics: Introduction, ethical ethos- researcher's obligations & participants rights, Research Ethics: Researcher-Participant, General Ethics, Ethical Issues in India, Ethics Committees. Experimental techniques: Research design, sampling, data collection, On-station experimentation, On-Farm experimentation, tabulation, Statistical tools and analysis, techniques for interpretation of data, Geo-referenced characterization: Questionnaire design principles, Questionnaire design for consumers of organic products, Questionnaire design for farmers and producers of organic products, Questionnaire design for processors/traders/exporters, Geo-spatial analysis and mapping of natural farms/ producers/traders/consumers.

Meta data analysis: Concepts, Niche area and crops for natural farming: Parameters for niche area and crop, Different scales of niche area, Tools and steps in niche area and crop identification, Parameterization and classification based on macro, regional and micro level.

Climate resilience of natural farming: Methodology for identification of climate resilient production systems, GHG's estimation using IPCC, GHG's measurement using instrumentation, Global warming potential, Energy &

Carbon budgeting, Bio-chemical and molecular signature of natural produces, Commercial project formulation on natural Farming: Internal rate of return, Pay Back period, B:C ratio, Net Present Value, Model project formulation for organic farming, Impact analysis tools and methods, Farming System model development: Practical Synthesis of Natural farming system model, Estimation of GHG emission from Natural farm using IPCC tools, Identification of niche area and crops for a district block, Identification of Climate resilient production system using long term meteorological data, Commercial project formulation, Geo-spatial analysis using GIS platform, Comparative carbon and energy budgeting between organic and natural farms, Comparative food quality between natural and conventional produces by meta-analysis.

Course Title : Weather Forecasting Course Code : NF-414

Credits Hours : 3 (2+1)

Theory

Ancient wisdom on weather forecasting: Rainfall prediction, analysis and forecast of winter monsoon based on ancient literature and simulated models, Rain forecasting in India Almanacs (Panchangs), Measurement of rainfall, Testing of traditional methods of weather forecast, Ancient astronomers, Indian Almanac (Nakshatras, Rashi, Months, Paksha, Seasons, Tithi, Var, Yog, karn, nadi.), Krishi Panchang, Effect of Planets on Weather, Ancients methods of weather forecast (Analytical methods, Observational methods). Principles of Astro-Meteorology, Rainfall predictions techniques 1. Parashara technique, 2. Varahamihira technique, 3. Predictions based on planets, 4. Bio-indicators, 5. Other ancient rainfall predictions, Sudden rainfall, Indications of famine, The Method of ascertaining the type of cloud of the year, Folklore regarding weather forecasting (Ghagh and his wife Bhaddri), 6 ITKs with description and the practitioner for weather forecasting, Meaning and scope of agricultural meteorology, Earth atmosphere-its composition, extent and structure, Atmospheric weather variables, Atmospheric pressure, its variation with height, Nature and properties of solar radiation, solar constant, depletion of solar radiation, shortwave, longwave and the normal radiation, net radiation, albedo, Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Energy balance of earth, 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 rain making. Wind: causes and types of wind, cyclone, anticyclone, land breeze and sea breeze, General circulation; Indian Monsoon - mechanism and importance in Indian agriculture, Weatherforecasting - types of weather forecast and their uses, ITK in weather forecasting, Weather hazards- High winds, drought, floods, tornado, frost, tropical cyclones, thunderstorms, dust storm, lightning and hailstorms and extreme weather conditions such as heat-wave and cold-wave, Agriculture and weather relations, Modifications of crop microclimate, climatic normal's for crop and livestock production, Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national agriculture, Types of Climate Models – GCM and RCM.

Practicals

Visit of Agrometeorological Observatory, site selection, layout, exposure to instruments and data acquisition techniques, Study and use of different instruments for measuring air temperature, rainfall, Estimation of net short-wave radiation, net long wave radiation, total global and net radiation, Measurement of albedo and sunshine duration, wind speed & direction, Measurement of evaporation rate using USWB Class A open pan Evaporimeter, Determination of relative humidity and vapour pressure, Study and use of Duvdevani Dew Gauge for measurement of Dew, Computation of climatic normal using historical weather data, Study of ancient methods of weather forecast, Preparation of Krishi Panchang, Testing local folklore for weather forecasting.

Course Title : Basic and Applied Agricultural Statistics Course Code Ag. Stat -323 3 (2+1)

Theory

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

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

Measures of Dispersion, Characteristics for an Ideal Measure of Dispersion, Different Types of Measures of Dispersions, Definition of Range, Interquartile Range, Quartile Deviation and Mean Deviation, Standard Deviation- Definition, Properties, S.D. and Variance for Grouped and Ungrouped Data, Variance of Combined Series, Coefficients of Dispersions. Co-efficient of Variation,

Measures of Skewness and Kurtosis: Definition of Symmetrical Distribution, Definition of Skewness, Measures of Skewness, Definition of Kurtosis, Measure of Kurtosis, Relationship between Mean, Median and Mode for Symmetrical and Skewed Distribution.

Probability Theory and Normal Distribution, Introduction to Probability, Basic Terminologies, Classical Probability- Definition and Limitations, Empirical Probability- Definition and Limitations, Axiomatic Probability, Addition and Multiplication Theorem (without proof), Conditional Probability, Independent Events, Simple Problems based on Probability, Definition of Random Variable, Discrete and Continuous Random Variable, Normal Distribution- Definition, Prob. Distribution, Mean and Variance, Assumptions of Normal Distribution, Normal Probability Curve.

Correlation and Regression, Definition of Correlation, Scatter Diagram, Karl Pearson's Coefficient of Correlation, Types of Correlation Coefficient, Properties of Correlation Coefficient, Definition of Linear Regression, Regression Equations, Regression Coefficients, Properties of Regression Coefficients.

Tests of Significance, Definition, Null and Alternative Hypothesis, Type I and Type II Error, Critical Region and Level of Significance, One Tailed and Two Tailed Tests, Test Statistic, One Sample, Two Sample and Paired t-test with Examples. F-test for Variance.

ANOVA and Experimental Designs, Definition of ANOVA, Assignable and Non-assignable Factors, Analysis of One-way Classified Data, Basic Examples of Experimental Designs, Terminologies, Completely Randomized Design (CRD).

Sampling Theory, Introduction, Definition of Population, Sample, Parameter and Statistic, Sampling Vs Complete Enumeration, Sampling Methods, Simple Random Sampling with Replacement and without Replacement, Use of Random Number Table.

Practicals

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

Semester VIII		
Project Work/Experiential Learning/Internship	For Student opting for 4 Year B.Sc. (Hons.) Natural Farming Degree Student READY (RAWE/Industrial Attachment/Experiential Learning/Hands on Training/Project Work)/ Internship	20 credits (Minimum 20 weeks)
	For Student opting for 4 Year B.Sc. Natural Farming (Research) Research work	20 credits
Total		20(0+20)

S. No.	Course Title	Credit Load
1.	For students opting for 4-year B. Sc. (Hons.) Natural Farming degree Based on the theme of Student READY Programme, students may be allotted Experiential Learning/Hands on Training/Skill development/RAWE/ Industrial attachment/IPT/ student project and Internship depending upon the resources & priorities. Experiential LearningRAWE IPT/Industrial Attachment Student Project For student opting for 4 year B. Sc. Natural Farming (Research) Research work	20 Credits (Minimum 20 weeks) 8 6 4 2 20 credits

For B.Sc. Natural Farming (Hons.)

- Project work: Student Project will be either R&D based, field study based (RAWE) or entrepreneurship based (incubation/experiential learning). The project work will be of above mentioned credits (Minimum 20

weeks) during which they will be attached to projects to learn, field experience, laboratory and field research or incubation centres or experiential learning units for developing viable projects.

- Internship work: The students will be attached to industry/ research institute/commercial farm/ NGO/ agribusiness entrepreneur for 10 weeks with 10 credits to complete internship work and to learn entrepreneurship skills.
- Each student will submit individual report for both project work and internship work which will be evaluated and given grades.

B.Sc. Natural Farming (Research)

The students opting for B.Sc. Natural Farming (Research) degree will undergo 40 credits research work in 4th year out of which 20 credits will be elective courses related to his/ her research project.

Skill Enhancement Courses

A student admitted into 1st year of B.Sc. (Hons.) Natural Farming degree programme will take 2 skill enhancement courses each of 2 credits in each semester of first year. Likewise the student continuing his/her study into 2nd year of B.Sc. (Hons.) Natural Farming will undergo 2 skill enhancement course each of 2 credits in each of the 2 semesters of 2nd year.

The student can select these courses from a basket of skill enhancement courses as indicated below or courses offered by a College. The courses may be offered as module of complementing courses to help the student to achieve skill in a specific area of his interest.

A college will select such skill enhancement courses in which it has strength as well as there is prospect of local employment and entrepreneurship development.

Indicative List of Skill Enhancement Courses

S. No.	Course Title	Credits
1.	Natural Farming for Crops, Vegetables and Orchard	2(0+2)
2.	Production Technology of Bio-inputs	2(0+2)
3.	Business Management in Natural Farming	2(0+2)
4.	Seed Production and Certification under Natural Farming	2(0+2)
5.	Agro-Eco Tourism in Natural Farming	2(0+2)
6.	Animal Feed Management under Natural Farming	2(0+2)
7.	Analytical Techniques and Instrumentation for Soil Health Card	2(0+2)
8.	Landscape Designing and Gardening	2(0+2)
9.	Self Sustainable Kitchen Gardening	2(0+2)
10.	Commercial Bee-Keeping under Natural Farming	2(0+2)
11.	Commercial Sericulture	2(0+2)
12.	Beneficial insect farming	2(0+2)
13.	Bio-fertilizer and biopesticide (microbials) production	2(0+2)
14.	Production Technology of Biocontrol agents	2(0+2)
15.	Mushroom Production Technology	2(0+2)

S. No.	Course Title	Credits
16.	Post-harvest Processing technology	2(0+2)
17.	Plantation Crop Production and Processing	2(0+2)
18.	Poultry Production Technology	2(0+2)
19.	Piggery Production Technology	2(0+2)
20.	Commercial Horticulture	2(0+2)
21.	Floriculture and Landscaping	2(0+2)
22.	Natural Food Processing	2(0+2)
23.	Agriculture Waste Management	2(0+2)
24.	Video Production	2(0+2)
25.	E-marketing for natural farm produce	2(0+2)
26.	Production & Marketing of aerated and non-aerated liquid manures	2(0+2)

Elective Courses

S. No.	Course Number	Title
1.	Ag Econ (E) 413	Agri-Business Management
2.	Agron (E) 413	Management of natural resources
3.	EE (E) 413	Agricultural Journalism
4.	Hort (EA) 323	Landscaping
5.	GPB (E) 413	Commercial Plant breeding
6.	Hort (EB) 323	Food safety and standards
7.	PP (EA) 322	Bio formulation and Nano formulation
8.	PP (EB) 413	Bio pesticides and Bio fertilizers
9.	Ag Met (EA) 413	System Simulation and Agro advisory
10.	Hort (EC) 413	Hi-tech Horticulture
11.	Hort (ED) 413	Protected cultivation
12.	Ag Met (EB) 413	Climate Resilient Agriculture
13.	ABT(E) 413	Biotechnology of Crop Improvement
14.	Soil (E) 412	Geoinformatics and Remote Sensing, precisionfarming
15.	Hort (EE) 413	Micro-propagation Technologies
16.	SST-413	Commercial Seed Production

- More electives to be included by the universities / institutions, based on the facilities available, such as nano formulations, drones use in agriculture etc

Elective Course 1

Course Title : **Agri-Business Management Course**

Code : **Ag Econ (E) 413**

Credits Hours : **3 (2+1)**

Theory

Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems, Importance of agribusiness in the Indian economy and New Agricultural Policy, Distinctive features of Agribusiness Management: Importance and needs of agro-based industries, Classification of industries and types of agro based industries, Institutional arrangement, procedure to set up agro based industries, Constraints in establishing agro-based industries, Agri-value chain: Understanding primary and support activities and their linkages, Business environment: PEST & SWOT analysis, Management functions: Roles & activities, Organization culture, Planning, meaning, definition, types of plans, Purpose or mission, goals or objectives, strategies, policies, procedures, rules, programs and budget, Components of a business plan, Steps in planning and implementation, Organization staffing, directing and motivation, Ordering, leading, supervision, communications, control, Capital management and Financial management of Agribusiness, Financial statements and their importance, Marketing Management: Segmentation, targeting & positioning, Marketing mix and marketing strategies, Consumer behavior analysis, Product Life Cycle (PLC), Sales & Distribution Management, Pricing policy, various pricing methods, Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation, Project Appraisal and evaluation techniques.

Practicals

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

Elective Course 2

Course Title : **Management of Natural Resources** **Course Code:**

Agron (E) 413

Credits Hours : **3 (2+1)**

Theory

Introduction to Natural Resource Bases: Concept of resource, classification of natural resources, Factors influencing resource availability, distribution and uses, Interrelationships among different types of natural resources, Concern on Productivity issues, Ecological, social and economic dimension of resource management, Land resources: Land as a resource, Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification, Landscape impact analysis, wetland ecology & management, Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems, Water ecology and management, Energy resources: Growing energy needs, renewable and non-

renewable energy sources, use of alternate energy sources, Resource Management Paradigms: Resource management the evolution and history of resource management paradigms, Resource conflicts: Resource extraction, access and control system, Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches: integrated resource management strategies, Introduction to soil and water conservation and causes of soil erosion, Definition and agents of soil erosion, water erosion - Forms of water erosion, Gully classification and control measures, Soil loss estimation by universal soil loss equation - Soil loss measurement techniques. Principles of erosion control - Introduction to contouring, strip cropping, Contour bund - Graded bund and bench terracing, Wind erosion - Mechanics of wind erosion, types of soil movement - Principles of wind erosion control and its control measures, Water harvesting techniques - Lining of ponds, tanks and canal systems.

Practicals

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

Elective Course 3

Course Title : **Agricultural Journalism Course**
Code : **EE (E) 413**
Credits Hours : **3 (2+1)**

Theory

Journalism – Meaning, nature, importance, and types of journalism, Agricultural Journalism – Meaning, definition, principle, objectives, types, and scope, Similarities and difference between agricultural journalism and other types of journalism, Role of agricultural journalist, Training of agricultural journalist, Qualities of journalist, Role of journalist /journalism in agricultural development and development of newspaper and magazines readers, Newspaper and magazines as communication media: Characteristics, kinds and functions of newspaper and magazines, Characteristics of newspaper and magazines readers, Form, content, style and language of newspaper and magazines, Standard part of newspaper and magazines, The agricultural story: Types of Agriculture stories, subject matter of the agricultural story, structure of the agricultural story, Gathering farm information-Sources of farm information: abstracting from research and scientific materials, interviews, coverage of events, other sources: electronic media, field study. Success stories-definition, nature, components, guidelines of writing a success story Writing a news story difference between news and feature story, the principle of writing a news story, Inverted pyramid structure, Organizing the material, treatment of the story, writing the news lead and the body Readability measure-readability ease score, automated readability index, gunning fog index How to improve readability of articles and stories, Use of photograph in agricultural journalism- Basic principles of photography – composition, exposure, lens, light Use of artwork (Graphs, charts maps, etc) Writing the captions Editorial mechanism: Copy reading, headline and title writing Proofreading: definition, signs and symbols of proofreading, level of proofreading, duties of a proof-reader Layout– meaning, principles of layout and design.

Practicals

Practice in writing an agricultural news story, Practice in writing an agricultural feature story, Covering agricultural events for the information collection, Practice in interviewing for the information collection, Abstracting stories from research and scientific materials and wire services, Selecting pictures and artwork for the agricultural story,

Practice in editing, copy reading, Practice in headline and title writing Practicing proof reading,, Practice in layouting of newspaper, Testing copy with a readability formula, Visit a publishing office.

Elective Course 4

Course Title : **Landscaping**
Course Code : **Hort (EA) 323**
Credits Hours : **3 (2+1)**

Theory

Importance and scope of landscaping, Principles of landscaping, garden styles and types terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery water garden, walk-paths, bridges, other constructed features etc. gardens for special purposes, Trees: selection, propagation, planting schemes, canopy management, shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture, Climber and creepers importance, selection, propagation, planting, Annuals: selection, propagation, planting scheme, Other garden plants: palms, ferns, grasses and cacti succulents, Pot plants: selection, arrangement, management, Bio-aesthetic planning: definition, need, planning; landscaping of urban and rural areas, Peri-urban landscaping, Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions, Bonsai principles and management, lawn: establishment and maintenance. CAD application.

Practicals

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

Learning Outcomes

Elective Course 5

Course Title : Commercial Plant Breeding Course Code : GPB (E)
413
Credits Hours : 3 (2+1)

Theory

Types of crops and modes of plant reproduction, Line development and maintenance breeding in self and cross pollinated crops (A/B/R and two line system) for development of hybrids and seed production, Genetic test of commercial hybrids, Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc. Quality seed production of vegetable crops under open and protected environment, Alternative strategies for the development of the line cultivators: haploid inducer, tissue culture techniques and biotechnological tools, IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FRA Act, Variety testing, release and notification systems in India, Principles and techniques of seed production, types of seeds, quality testing in self and cross pollinated crops.

Practicals

Floral biology in self and cross pollinated species, selfing and crossing techniques, Techniques of seed production in self and cross pollinated crops using A/B/R and two line system, Learning techniques in hybrid seed production

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

Elective Course 6

Course Title : **Food Safety and Standards Course**
Code : **Hort (EB) 323**
Credits Hours : **3 (2+1)**

Theory

Food safety –Definition, Importance, Scope and Factors affecting Food Safety, Hazards and Risks, Type of Hazards - Biological, Chemical Physical hazards, Management of hazards – Need, Control of Parameters, Temperature Control, Food Storage, Production Design, Hygiene and Sanitation in Food Service Establishments-Introduction. Sources of contamination and their control, Waste Disposal, Pest and Rodent Control, Personnel Hygiene, Food safety Measures, Food Safety Management Tool- Basic concepts, PRPs, GHPs, GMPs, SSOPs etc. HACCP.ISO series, TQM- concept and need for quality, components of TQM, Kaizen, Risk Analysis, Accreditation and Auditing, Water Analysis, Surface Sanitation and Personal Hygiene, Food laws and Standards Indian Food Regulatory Regime, FSSAI, Global Scenario CAC, Other laws and standards related to food, Recent Concerns-New and Emerging Pathogens, Packaging, Product labelling and Nutritional labelling, Genetically modified food/transgenic, Organic foods, Newer approaches to food safety, Recent Outbreaks, Indian and International Standards for food products.

Practicals

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

Elective Course 7

Course Title : **Bioformulation and Nanoformulation Course Code**
: **PP (EA) 322**
Credits Hours : **3 (2+1)**

Theory

Introduction and history of biological control of pests and diseases, Microbial biopesticides: the global and Indian market scenario; biopesticides for organic agriculture, Different phytopathogenic biocontrol agents: Mode of action, Different entomopathogenic biocontrol agents: Mode of action, Microbial inoculants as biofertilizer candidates, Production, quality assessment and methods of application of biopesticides and biofertilizers, Regulatory system of

biopesticides in India, Formulations of plant essential oils, botanicals, Pheromone, and parapheromone and their application in insect pest management, Use of predators and parasitoids for insect pest management, Nanotechnology: its applications in pest and disease diagnosis and management, Nano biopesticides: Concept and importance, different techniques of producing nano biopesticides, Nano Fertilizers: Concept and importance, Types of nano fertilizers, Different techniques of producing nano fertilizers, Green synthesis of nano fertilizers, green slow-release fertilizer composition based on urea-modified hydroxyapatite nanoparticles

Practicals

Introduction & acquaintance with biopesticide laboratory, Preparation of culture media, Isolation and purification of bioagent from soil and infected insects, Microscopic study of different microbial bioagents, *In vitro* assay of microbial bioagents against plant pathogens.

In vitro compatibility study among different microbial bioagents, Mass multiplication of biopesticides, Population enumeration of biocontrol agents in different biopesticides, Preparation of plant extracts and their efficacy test against insect pests, Use of pheromone parapheromone for monitoring and management of insect pests, Bioassay of Entomopathogenic biocontrol agents on insect pests, Preparation of microbial inoculants of biofertilizer microbes, Compatibility of biofertilizer microbes, Preparation of solid & liquid consortia of biofertilizer microbes.

Elective Course 8

Course Title : Biopesticides and Biofertilizers Course

Code : PP (EB)413

Credits Hours : 3 (2+1)

Theory

History and concept of bio pesticides, Importance, scope and potential of bio pesticides, Definitions, concepts and classification of bio pesticides viz. Pathogen, botanical pesticides, and bio rationales. Botanicals and their uses. Mass production technology of bio-pesticides, Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes, Methods of application of bio pesticides. Methods of quality control and Techniques of bio pesticides. Impediments and limitation in production and use of bio pesticides.

Biofertilizers - Introduction, status and scope. Structure and characteristics features of bacterial biofertilizers – Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia; Cyanobacterial bio fertilizers- Anabaena, Nostoc, Hapalosiphon and fungal biofertilizers – AM mycorrhiza and ectomycorrhiza. Nitrogen fixation – Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilisation and phosphate mobilization, K solubilisation. Production Technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertilizers, FCO specifications and quality control of biofertilizers. Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers-Storage, shelf life, quality control and marketing. Factors influencing the efficiency of biofertilizers.

Practicals

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

Elective Course 9

Course Title : **System Simulation and Agro-advisory Course Code**
: **Ag Met (EA) 413**
Credits Hours : **3 (2+1)**

Theory

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

Practicals

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

Elective Course 10

Course Title : Hi-tech Horticulture, Hort (EC) 413 Credits Hours 3 (2+1)

Theory

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

Practicals

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

Elective Course 11

Course Title : Protected Cultivation Course

Code : Hort (ED) 413 Credits Hours : 3

(2+1)

Theory

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

Practicals

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

Elective Course 12

Course Title : Climate Resilient Agriculture Course Code : Ag Met (EB) 413

Credits Hours : 3 (2+1)

Theory

Climate change and impacts of climate change on agriculture and food security; crop productivity under different climate change scenarios including extreme events such as drought, flood, pest and disease outbreak etc. Basics of adaptation and mitigation in the agricultural sectors; analyzing and assessing climate vulnerability to identify vulnerable sectors and possible adaptation options in agriculture; assessing biophysical and socio-economic impacts on agricultural sector; risk assessment strategies, preparedness for weather and climate risks in agriculture; application of geospatial tools and techniques for sustainable agriculture.

Climate resilient agriculture (CRA) – concept, scope and importance with special reference to India, climate resilient technologies for enhancing crop productivity and sustainability – role of weather & climatic information, agro-advisories, ICTs and simulation models; climate resilient agronomic practices – crop/cultivar selection, crop diversification/ crop mixtures; water management practices – rain water harvesting, micro-irrigation, deficit irrigation and drainage management, organic/natural farming, integrated farming systems (IFS); site specific nutrient management (SSNM), conservation agriculture technologies to build soil organic carbon, harnessing microbial biodiversity, biomass recycling; use of renewable sources of energy; climate resilient pest-disease management strategies.

Breeding strategies for development of climate change resilient crops and varieties, development of biotic and abiotic stress tolerant/resistant cultivars under changed climatic scenarios including extreme weather events.

Practicals

Acquaintance with meteorological instruments including AWS, Statistical techniques to study trend of climatic parameters, Analysis of extreme weather events using non-parametric tests, Building climate change scenarios under different futuristic emission of GHGs, Designing strategies to mitigate the effect of climate change using

climate resilient crops/cultivars, climate resilient technologies and manipulation of cropping patterns, Acquaintance with ICTs for effective dissemination of local weather information and agro-advisories, Analysing carbon sequestration potential of different agro-ecosystems; Designing 'climate smart village' model considering the availability of resources. Awareness programme on climate change and climate resilient agriculture among farming community.

Elective Course 13

Course Title : Biotechnology of Crop Improvement 3 (2+1) Course Code : ABT (E) 413

Credits Hours : 3 (2+1)

Theory

Impact of Biotechnology on crop improvement and the perspective of society: Various biotechnological techniques available for crop improvement – Plant Tissue Culture, Genetic Engineering, Genome editing, Marker Assisted breeding and Genomic Selection, Biosafety regulations and their application in Agricultural Biotechnology, Soma clonal variation and its use in crop improvement: embryo culture, anther/pollen culture, somatic embryogenesis, artificial seeds, techniques of protoplast culture, regeneration and somatic cell hybridization, achievements and limitations, utility in the improvement of crop plants, Direct and Indirect methods of gene transfer in plants - Agrobacterium-mediated gene transfer in dicots and monocots, Direct DNA delivery methods (microinjection, particle gun method, electroporation), gene targeting, Gene silencing techniques, introduction to siRNA, siRNA technology, Micro RNA, construction of siRNA vectors, principle and application of gene silencing, creation of transgenic plants, debate over GM crops, introduction to methods of genetic manipulation in different model systems.

Introduction to genome editing – Various tools of genome editing, CRISPR-Cas9 with specific emphasis on Indian regulations, Cloning genomic targets into CRISPR/Cas9 plasmids, electroporation of Cas9 plasmids into cells, purification of DNA from Cas9 treated cells and evaluation of Cas9 gene editing, *in vitro* synthesis of single guide RNA (sgRNA), using Cas9/sgRNA complexes to test for activity on DNA substrates, evaluate Cas9 activity by T7E1 assays and DNA sequence analysis, Applications of CRISPR/cas9 technology in crop plants, Marker Assisted Breeding & Genomic Selection: Introduction to various DNA- based markers and their use in marker-assisted breeding, Foreground Selection, Recombinant Selection and background Selection, Marker-assisted backcross breeding, marker-assisted selection – success stories, Introduction to Genomic Selection.

Practicals

Agrobacterium-mediated transformation in tobacco – preparation of construct, transfer to binary vector, transform *Agrobacterium*, prepare explant, Inoculation and Co-cultivation, antibiotic based selection of putative transformants, validation using PCR; Genome editing- preparation of CRISPR/Cas construct, direct transfer to plant, analysis of the targets, Planning of a MABB programme – selection of parents, crossing strategies, marker analysis.

Elective Course 14

Course Title : Geoinformatics and Remote Sensing, Precision farming

Course Code : Soil (E) 412

Credits Hours : 3 (2+1)

Theory

Introduction and history of remote sensing; sources, Principles of remote sensing, propagation of radiations in

atmosphere; Interaction with matter, Application of remote sensing techniques land use soil surveys, crop stress and yield forecasting, Advantages and disadvantages of remote sensing, Remote sensing institutes in India, Basic Concepts about geoinformatics.

What is artificial intelligence; History of artificial intelligence, Fundamentals of big data & machine learning (ML), Use of artificial intelligence in autonomous systems: agricultural robots and drone monitoring systems, driverless tractors, automated sprinklers and self-harvesting machines etc.; Use of AI in crop analysis: monitoring soil quality, promoting organic crops, monitoring weeds, precision agriculture, using drones for crop analysis; Role of AI for sustainability and climate change, yield and demand forecasting, food tech/wider value chain including impact of blockchain, AI use for in the emerging markets; Technology deployment like sensors, AI and agricultural technologies and How to scale AI for agricultural technologies applications, Responsible AI in agriculture, Data sharing; Expert System: Introduction to expert system, Characteristics and features of expert system, Applications of Expert System, Importance of Expert system, Rule based system architecture; Software Agents.

Practicals

Familiarization with different remote sensing equipments and data products, Interpretation of aerial photographs and satellite data for mapping of land resources, Global positioning system (GPS), Basics of Geographic Information System (GIS), Georeferencing of topo sheets.

Live examples and case study of AI use in Agriculture, Search and Control strategies: Blind search, Breadth - first search, Depth First search, Hill climbing method, Best First search, Branch and Bound search, Programming in Prolog Syntax and meaning of Prolog Programs, Using Data Structures, Controlling Back- tracking, Input and Output, Built-in Predicates, Using Prolog Grammar Rules, Higher level assignments/exercises for implementation using Prolog.

Elective Course 15

Course Title : Micro-propagation Technologies Course Code : Hort (EE 413)

Credits Hours : 3 (2+1)

Theory: Introduction, History, Advantages and limitations. Types of cultures (seed, embryo, organ, callus, cell), Stages of micro propagation, Axillary bud proliferation (Shoot tip and meristem culture, bud culture), Organogenesis (callus and direct organ formation), Somatic embryogenesis, cell suspension cultures, production of secondary metabolites, Soma clonal variation, Cryopreservation.

Practicals

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

Elective Course 16

Course Title : Commercial Seed Production Course

Code : SST-413

Credits Hours : 3 (2+1)

Theory

General Principles of Seed Production: Raising the seed crop, Introduction, Procurement of a class of Improved seeds, Reporting to Monitoring or certification Agency, Principles and practices of selection of area and agronomic requirement of seed production of field crops, Importance of isolation distance and Rouging, Principles of hybrid seed production in field crops, Principles and practices of selection of area and agronomic requirement of seed production of horticultural crops, Concept of apomixis, male sterility and self-incompatibility and its application in hybrid seed production of horticultural crops.

General Principles of Seed Processing: Introduction, Objectives of Seed Processing, Seed Drying, Principles of Drying, Water vapour equilibrium, Methods of drying seeds, Cleaning and grading, Air and screen machines, Dimensional separators, Density separators, Surface texture separators, Colour separators, Spiral separators, Electric separators, Vibrator separators, Separation based on Affinity to liquids, Seed treatment, Temperature treatment, Chemical treatment, Bagging and Labelling

General Principles of Seed Testing: Seed testing-Introduction, Procedure of Seed testing, components of seed quality testing genetic, physical, physiological and seed health testing, Seed sampling, Types of seed sampling, Requirements of sampling, Concept of seed viability and vigour; dormancy, types and principles of seed dormancy, Physiological quality of seed, Principles of seed Germination, types of germination, biochemical and genetic basis.

Seed Certification: History, concept and objectives of seed certification; seed certification agency/organization and staff requirement Indian Minimum Seed Certification Standards (I.M.S.C.S.) - general and specific crop standards including GM varieties, field and seed standards.

Seed Industry and Seed Marketing : Introduction, Evolution of the seed industry, Development of the vegetable and Flower seed industry, Seed marketing – concept, definition and purpose, importance and promotion of quality seed, formal and informal seed supply systems, Seed marketing intelligence and product mix, sales promotion, distribution channels, marketing costs and margins; packaging and labeling, Seed Associations, Factors influencing seed marketing, Seed marketing programs, Seed industry organizations, Marketing of public versus private players, Demand and supply of seed; role of seed replacement rate (SRR), seed multiplication ratio (SMR), economics of seed production; determining seed needs, Seed pricing and price policy, seed processing and /packaging, demand forecasting and factors affecting demand for seeds, effect of price and farm income on seed demand.

Biotechnology in Seed Technology: History of plant tissue culture, Laboratory organization, Composition of nutrient medium, Micro-propagation, Axillary bud proliferation approach, Meristem and shoot tip culture, Bud culture, Advantages of Micro-propagation, Problems associated with micro-propagation, Synthetic seed production, Types of synthetic seeds, methods of development of synthetic seeds, Components of nutrient media for synthetic seed development, Storage of synthetic seeds, Advantages and limitations of synthetic seed production.

Practicals

Planning of Seed Production, requirements for different classes of seeds in field crops - unit area and rate.

Operation and handling of mechanical drying equipments; effect of drying temperature and duration on seed germination and storability seed processing equipments; seed treating equipments.

Seed production in cross pollinated crops with special reference to land, isolation, Planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony; supplementary pollination, pollen storage, hand emasculation and pollination in tomato, Hybrid seed production in Maize, detasseling in maize, identification of rogues and pollen shedders, Pollen collection, storage, viability and stigma receptivity; gametocide application and visits to seed production plots etc., Visit to seed processing plant and commercial controlled and uncontrolled Seed Stores, Seed industries and local entrepreneurs visit to nearby areas, Different methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage,

detection of seed borne fungi, bacteria and viruses, identification of storage fungi, control of seed borne diseases, seed treatment methods., Maintenance of aseptic conditions and sterilization techniques, Preparation of nutrient stocks for synthetic media, Selection of explants for callus induction, Preparation of MS medium for micro-propagation and Callus induction, Selection of explants for callus induction,Preparation of MS medium for micro-propagation and Callus induction, Inoculation of explants for micro-propagation, Inoculation of explants for callus induction and subsequently regeneration of plantlets from matured seeds of field and horticultural crops, Synthetic seed preparation.

Online Courses

The students will have to take a minimum of 20 credits of online courses (any one or more courses totaling at least 16 weeks or 30 hours' duration) as a partial requirement for the B.Sc (Hons) Natural Farming. The online courses can be from any field such as Basic Sciences, Humanities, Commerce, Business Management, Languages including foreign language, Communication skills, Music, etc. and can be taken from SWAYAM, Diksha, NPTEL, mooKIT, edX, Coursera, or any other portal. The objective is to allow the students to groom their passion or strengthen their knowledge and competency in any field beyond prescribed courses. The courses will be non-gradual as separate certificates would be issued by the Institute/ University offering the courses. However, the University/ institute will keep a record of such courses registered and completed by each student and will indicate the title of the (successfully completed) courses in final transcript issued to the student. The courses can be taken during whole span of degree programme as per choice of students. The courses will be non-gradual (as separate certificates would be issued by the institutes offering the course). The MOOC courses taken by the student will be separately registered/ approved at the University level. The final transcript will indicate the title of courses taken by the student and the total weeks.

List of Suggestive On-line Courses

Course Title	Duration	Credits
Digital Media	16 weeks	1
Basics of Photography	12 weeks	1
Design, Technology and Innovation	8 weeks	1
Visual Communication Design for Digital Media	4 weeks	1
Certificate course in Environmental Sustainability	8 weeks	1
Consumer Protection Legislation	8 weeks	1
Communication and Extension for Sustainable Development	15 weeks	1
Intellectual Property	12 weeks	1
Biopsychology	15 weeks	1

Course Title	Duration	Credits
NGO'S and Sustainable Development	15 weeks	1
Counseling Psychology	12 weeks	1
Gender Sensitization: Society Culture and Change	16 weeks	1
Basics of Health Promotion and Education Intervention	8 weeks	1
Psychology of Stress, Health and Well-being	12 weeks	1
Diet Management in Health & Disease	12 weeks	1
Dairy and Food process and products technology	12 weeks	1
Thermal Processing of Foods	12 weeks	1
Nano-technology, Science and Applications	8 weeks	1
Food Science & Processing	12 weeks	1
Diet Management in Health & Disease	8 weeks	1
Human Nutrition and Biochemistry	12 weeks	1
Personality Development and Communication Skills	8 weeks	1
Public Speaking	8 weeks	1
Personality Development	8 weeks	1
Emotional Intelligence	8 weeks	1
Yoga Practices1	12 weeks	1
Yoga Practices2	12 weeks	1
Ethics: Theories and Applications	12 weeks	1
Information Sources and Library Services	6 weeks	1
Qualitative Research Methods and Research Writing	12 weeks	1
Food Science & Processing	12 weeks	1
Food Safety & Quality Control	8 weeks	1
*Communication Skills and Computer Operations	24 weeks	2
*Human Resource Management	24 weeks	2
*Business Plan and Finance Management	24 weeks	2
\$ Physical Education, First Aid and Yoga (to be added)	Compulsory Non-credit Course (CNC)	
\$ Start-up (to be developed)		

SAUs will be free to include more Elective courses with approval from their competent bodies.

\$ Compulsory Non-Credit (CNC) course for student.

* The list of Non-Credit courses will be uploaded on College/University website.

The student will have choice to select courses of his/her choice up to 20 credits.