

Course Syllabus of B. Sc. (Hons.) Agriculture

(AS PER ICAR - V DEAN'S COMMITTEE RECOMMENDATION)

2017-18



**SCHOOL OF AGRICULTURE
GIET UNIVERSITY
GUNUPUR, RAYAGADA - 765022
ODISHA**

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COURSE STRUCTURE

First Semester		
Course Number	Course Title	Credit Hours
AG-111	Fundamentals of Agronomy	4(3+1)
AG-112	Agricultural Heritage-*	1(1+0)*
AC-111	Fundamentals of Soil Science	3(2+1)
AE-111	Fundamentals of Agricultural Economics	2(2+0)
HORT-111	Fundamentals of Horticulture-	2(1+1)
FO-111	Introduction to Forestry	2(1+1)
EE-111	Fundamentals of Agricultural Extension Education	3(2+1)
PP-111	Fundamentals of Crop Physiology	2(1+1)
SE-111	Comprehension & Communication skills in English	2(1+1)
BB/EM-111	Introductory Biology / Elementary Mathematics-*	2(1+1)* / 2(2+0)*
NSS/NCC/PE-111	NSS/NCC/Yoga**	2(0+2)**
Total		20(13+7)
* "R" Remedial Course, **Non-Gradual Course,		

Second Semester		
Course Number	Course Title	Credit Hours
AG-123	Introductory Agro-meteorology & Climate Change	2(1+1)
PBG-121	Fundamentals of Genetics	3(2+1)
AC-122	Agricultural Microbiology	2(1+1)
ENT-121	Fundamentals of Entomology	4(3+1)
SWE(Ag)-121	Soil & Water Conservation Engineering	2(1+1)
PPT-121	Fundamentals of Plant Pathology	3(2+1)
ABT-121	Fundamentals of Plant Biotechnology	2(1+1)
HORT-122	Production Technology for Fruits & Plantation Crops	2(1+1)
AS-121	Statistical Methods	3(2+1)
EE-122	Human Values & Ethics**	1(1+0)**
Total		23(14+9)

Third Semester		
Course Number	Course Title	Credit Hours
AG-214	Crop Production Technology -I (Kharif Crops)	2(1+1)
PBG-212	Fundamentals of Plant Breeding	3(2+1)
AC-213	Fundamentals of Plant Biochemistry	2(1+1)
ENT-212	Pests of Crops & Stored grain & their Management	3(2+1)
AE-212	Agricultural Finance & Co-operation	3(2+1)
EE-213	Rural Sociology & Educational Psychology	2(2+0)
FMP(Ag)-211	Farm Machinery & Power	2(1+1)
PPT-212	Fundamentals of Nematology	2(1+1)
HORT-213	Production Technology for Vegetables & Spices	2(1+1)
AS-212	Agricultural Informatics	2(1+1)
Total		23(14+9)

Fourth Semester		
Course Number	Course Title	Credit Hours
AG-225	Crop Production Technology-II(Rabi Crops)	2(1+1)
AG-226	Farming Systems & Sustainable Agriculture	1(1+0)
SST-221	Principles of Seed Technology	2(1+1)
AC-224	Problematic Soils & their Management	2(1+1)
ENT-223	Management of Beneficial Insects	2(1+1)
AE-223	Agricultural Marketing, Trade & Prices	3(2+1)
FMP(Ag)-222	Renewable Energy & Green Technology	2(1+1)
PPT-223	Mushroom Cultivation	1(0+1)
FO-222	Environmental Studies & Disaster Management	3(2+1)
EE-224	Communication Skills & Personality Development	2(1+1)
AC(E)-221	Agricultural Chemicals	3(2+1)
HORT(E)-221	Hi-tech Horticulture	
AG(E)-221	Water Management	
PBG(E)-221	Commercial Plant Breeding	
Total		23(13+10)

Fifth Semester		
Course Number	Course Title	Credit Hours
CP(AG)-311	Practical Crop Production-I (kharif Crops)	2(0+2)
AG-317	Rainfed Agriculture & Watershed Management	2(1+1)
PBG-313	Intellectual Property Rights	1(1+0)
PBG-314	Crop Improvement-I(Kharif Crops)	2(1+1)
SST-312	Seed Quality Testing	1(0+1)
AC-315	Manures, Fertilizers & Soil Fertility Management	3(2+1)
ENT-314	Principles of Integrated Pests & Disease Management	3(2+1)
PPT-314	Diseases of Field & Horticultural Crops & their Management-I	3(2+1)
HORT-314	Production Technology for Ornamental, MAP & Landscaping	2(1+1)
EE-315	Entrepreneurship Development & Business Communication	2(1+1)
HORT(E)-312	Landscaping	3(2+1)
AC(E)-312	Bio-Pesticides & Bio-Fertilizers	
AG(E)-312	Weed Management	
ABT(E)-311	Micro Propagation Technologies	
Total		24(13+11)

Sixth Semester		
Course Number	Course Title	Credit Hours
CP(AG)-322	Practical Crop Production -II(Rabi Crops)	2(0+2)
AG_328	Principles of Organic Farming	2(1+1)
PBG-325	Crop Improvement-II(Rabi Crops)	2(1+1)
AG-329	Geo-informatics & Nano-Technology for Precision Farming	2(1+1)
AE-324	Farm Management, Production & Resource Economics	2(1+1)
SWE(Ag)-322	Protected Cultivation & Secondary Agriculture	2(1+1)
PPT-325	Diseases of Field & Horticultural Crops & their Management-II	3(2+1)
HORT-325	Post-Harvest Management & Value addition of Horticultural Crops	2(1+1)
LPM-321	Livestock & Poultry Management	4(3+1)
HORT(E)-323	Protected Cultivation	3(2+1)
AC(E)-323	Soil, Plant, Water & Seed Testing	
AG(E)-323	Agricultural Waste Management	
ABM(E)-321	Agricultural Business Management	
Total		24(13+11)

Seventh Semester		
Course Number	Course Title	Credit Hours
RAWE-411	Village Attachment Programme	0+14
RAWE-412	Agro-Industrial Attachment Programme	0+6
	Total	0+20

Eighth Semester		
Course Number	Course Title	Credit Hours
ELP-421	Experiential Learning Programme	0+20
	Total	0+20

B. Sc. (Ag) SYLLABUS

I. AGRONOMY

1. Title: Fundamentals of Agronomy

Course No: AG- 111

Cr hr: 4(3+1)

Theory

Agronomy and its scope, seeds and sowing, tillage and tith, crop density and geometry, Crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, soil plant water relationship, crop water requirement, water use efficiency, irrigation- scheduling criteria and methods, quality of irrigation water, water logging.

Weeds- importance, classification, crop weed competition, concepts of weed management- principles and methods, herbicides- classification, selectivity and resistance, allelopathy. Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.

Practical

Identification of crops, seeds, fertilizers, pesticides and tillage implements, Effect of sowing depth on germination and seedling vigor, Identification of weeds in crops, Methods of herbicide and fertilizer application, Study of yield contributing characters and yield estimation, Seed germination and viability test, Numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill, Study of soil moisture measuring devices, Measurement of field capacity, particle density, bulk density and infiltration rate, Measurement of irrigation water.

Text/ Reference Books:

Principles of Agronomy

1. Principles of Agronomy - T. Y. Reddy and G.H. Sankar Reddi, Kalyani Publishers (2015)
2. Principles of Agronomy - S. R. Reddy, Kalyani Publishers (2016)
3. The Nature and Properties of Soils - N. C. Brady and R. R. Weil, Prentice Hall Inc. (1996)
4. Manures and fertilizers - K. S. Yawalkar, J. P. Agarwal, and S. Bokde, Agri-Horticultural Publication House. (1967)
5. Soil Conditions and Plants Growth - J.E. Russell, Daya Books (2002)

Water management

1. Irrigation Principles and Practices - V. E. Hansen, O.W. Israelsen, and G. E. Stringham, New York Wiley. (1980)

2. Irrigation: Theory and Practice - A.M. Michael, Vikas Publishing House Pvt. Ltd. (1993)
3. Irrigation and Drainage - D. Lenka, Kalyani Publishers. (1991)
4. Agricultural Drainage : Principles and Practices - U.S.Kadam, Westville Publishing House (2008)
5. Micro-irrigation for Cash Crops - M. L. Choudhary, and U. Kadam, Westville Publishing House. (2006)
6. Handbook on pressurized irrigation techniques - A. Phocaides, FAO. (2007)
7. Irrigation & Water Management : Principles and Practices - D. K. Majumdar
8. Irrigation Agronomy - S. R. Reddy, Kalyani Publishers. (2007)
9. Manual on Water management : Dept. of Agronomy, CA, Bhubaneswar
10. Manual on Irrigation Agronomy - M. Ahmed, and R. D. Mishra (1987)

Weed management

1. Modern Weed Management - O.P. Gupta, Agrobios, India. (2008)
2. Principles of Weed Science - V. S. Rao, CRC Press. (2000)
3. Weed management - V. N. Saraswat, V. M. Bhan, and N.T. Yaduraju, ICAR Publication. (2003)
4. All about Weed Control - S. Subramaniam, A. Mohamed Ali and R. Jaykumar, Kalyani Publishers (2000)
5. Weed Science: Basics and applications -T. K. D, Jain Brothers. (2008)

2. Title: Agriculture Heritage (New Course)

Course No: AG- 112

Cr hr: 1(1+0)

Theory

Introduction of Indian agricultural heritage, status of farmers in society; advice by sages to kings on their duties towards farmers, soil management in ancient, medieval & pre-modern India and its relevance in modern day sustainable agriculture, heritage of crop & water management, plant growth and development & plant protection through vrikshayurveda and traditional knowledge. Heritage of medicinal plants and their relevance today, seed health in ancient & medieval history and its relevance to present day agriculture, description of Indian civilization and agriculture by travelers from China, Europe and United States, our journey in agriculture, green revolution and its impact and concerns, vision for the future.

Text / Reference Books:

1. Kashyapriya Krishisukti (Atreatiseon Agriculture by Kashyapa), agri History Bulletin No: 4. Tr. - S. M. Ayachit, Asian Agri. History foundation, Secunderabad. (2002)
2. Ancient and Medieval History of Indian Agriculture and its relevance to Sustainable Agriculture in the 21 Century - S.L. Choudhary, G. S. Sharma, and Y. L. Nene, Proceedings of the summer school held from 28 May to 27 June 1999, Rajasthan College of Agriculture, Udaipur, India (2000)
3. Agricultural Heritage of India - Y.L. Nene and S. L. Choudhary, Asian Agri., History Foundation, Secunderabad (2002)

4. A History of Agriculture in India - M. S. Randhawa, Vol. I, II, III and IV, Indian Council of Agricultural Research, New Delhi (1980-86)
5. Agriculture in Ancient India - S. P. Raychaudhuri, Indian Council of Agricultural Research, New Delhi (1964)
6. Muskha Dar Fauni-Falahat (The art of Agriculture) - Razia Akbar, Agri-History Bulletin No.3. Asian-Agri-History Foundation, Secunderabad (2000)
7. Surapala's Vrikshayurveda (The science of plant life) - Sadhale Nalini, Asian. History Bulletin No.1. Asian-Agri-History Foundation, Secunderabad (1996)
8. Krishi-Parashara (Agriculture by prashara) - Sadhale Nalini, Agri-History Bulletin No.2. Asian Agri-History Foundation, Secunderabad, India (1999)

3. Title: Introductory Agro meteorology & Climate Change

Course No: AG- 123

Cr hr: 2(1+1)

Theory

Earth atmosphere- its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo; 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 rainmaking. Monsoon- mechanism and importance in Indian agriculture, Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave. Agriculture and weather relations; Modifications of crop microclimate, climatic normals for crop and livestock production. Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national Agriculture.

Practical

Visit of Agrometeorological Observatory, site selection of observatory, exposure of instruments and weather data recording. Measurement of total, shortwave and longwave radiation, and its estimation using Planck's intensity law. Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS. Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis. Measurement of soil temperature and computation of soil heat flux. Determination of vapor pressure and relative humidity. Determination of dew point temperature. Measurement of atmospheric pressure and analysis of atmospheric conditions. Measurement of wind speed and wind direction, preparation of windrose. Measurement, tabulation and analysis of rain. Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET.

Text / Reference Books:

1. Agrometeorology and Remote Sensing - D. D. Sahu, Agrobios (India) (2003)
2. Text book of Agricultural Meteorology - M. C. Varshney, ICAR Publication (2013)
3. Introduction to Agrometeorology - H. S. Mavi, Oxford & IBH Publication(1986)
4. Crops and Weather - S. Venkataraman and A. Krishnan, ICAR Publication (2009)
5. Climate, Weather and Crops in India - D. Lenka, Kalyani Publishers (1998)
6. Principles of Agricultural Meteorology - O. P. Bishnoi, Oxford & IBH Publication, (2007)

4. Title: Crop Production Technology-I (Kharif Crops)**Course No: AG- 214****Cr hr: 2(1+1)****Theory**

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops. Cereals – rice, maize, sorghum, pearl millet and finger millet & other minor millets, pulses-pigeonpea, mungbean, urdbean & horse gram; oilseeds- groundnut, soybean, niger, sesamum & castor; fibre crops- cotton, Jute, mesta & allied fibres; forage crops-sorghum, cowpea, cluster bean and napier.

Practical

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

Text / Reference Books:

1. Manures and Fertilizers - K. S. Yawalkar, J. P. Agarwal and S. Bokde, Agri-Horticultural Pub. House, Nagpur (1992)
2. Principles and Practices of Agronomy - P. Balasubramaniam, and S. P. Palaniappan, Agrobios (India), Jodhpur (2001)
3. Principles of Agronomy - S. R. Reddy, Kalyani Publishers, New Delhi (2002)
4. Principles and Practices of Agronomy - S. S. Singh, Kalyani Publishers, New Delhi (1993)
5. Text book of Field Crops Production – R. Prasad, ICAR, New Delhi.

5. Title: Crop Production Technology-II (Rabi crops)

Course No: AG- 225

Cr hr: 2(1+1)

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops; cereals –wheat and barley, pulses-chickpea, lentil, pea & rajmah; oilseeds-rapeseed, mustard, sunflower, safflower & linseed; sugar crops-sugarcane & sugarbeet; other crops- potato, narcotics-tobacco; Forage crops-berseem, lucerne and oat.

Practical

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

Text / Reference Books:

1. Manures and Fertilizers - K. S. Yawalkar, J. P. Agarwal and S. Bokde, Agri-Horticultural Pub. House, Nagpur (1992)
2. Principles and Practices of Agronomy - P. Balasubramaniam, and S. P. Palaniappan, Agrobios (India), Jodhpur (2001)
3. Principles of Agronomy - S. R. Reddy, Kalyani Publishers, New Delhi (2002)
4. Principles and Practices of Agronomy - S. S. Singh, Kalyani Publishers, New Delhi (1993)
5. Text book of Field Crops Production – R. Prasad, ICAR, New Delhi.

6. Title: Farming Systems and Sustainable Agriculture

Course No: AG- 226

Cr hr: 1(1+0)

Theory

Farming System-scope, importance, and concept, Types and systems of farming system and factors affecting types of farming, Farming system components and their maintenance, Cropping system and pattern, multiple cropping system, Efficient cropping system and their evaluation, Allied enterprises and their importance, Tools for determining production and efficiencies in cropping and farming system; Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture, HEIA, LEIA and LEISA and its techniques for sustainability, Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages, Site specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques, Resource cycling and flow of energy in different farming system, farming system and environment, Visit of IFS model in different agro-climatic zones of nearby states University/ institutes and farmers field.

Text / Reference Books:

1. Fundamental Approaches in Sustainable Agriculture -J. P. Sharma, IK Publishers (2010)
2. Farming System in Tropics - A. Rangaswami, Prentice Hall India ltd (1992)
3. Farming System: Theory and Practice - S. A. Solaimalai, Kalyani Publishers (1990)
4. Text book of Farming System - U. K. Behera, India Agrobios (1992)

7. Title: Rainfed Agriculture and Watershed Management – (New)**Course No: AG- 317****Cr hr: 2(1+1)****Theory**

Rainfed agriculture: Introduction, types, History of rainfed agriculture & watershed in India; Problems and prospects of rainfed agriculture in India ; Soil and climatic conditions prevalent in rainfed areas; Drought: types, effect of water deficit on physio- morphological characteristics of the plants, Mechanism of crop adaptation under moisture deficit condition; Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices, Management of crops in rainfed areas, Contingent crop planning for aberrant weather conditions, Concept, objective, principles and components of watershed management, factors affecting watershed management.

Practical

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Studies on cropping pattern of different dry land areas in the country and demarcation of dry land area on map of India. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought period in the country, effective rainfall and its calculation. Studies on cultural practices viz; mulching, plant density, depth of sowing, thinning and leaf removal for mitigating moisture stress. Characterization and delineation of model watershed. Field demonstration on soil & moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

Text / Reference Books:

1. Dry farming in India - U.S. Sree Ramulu, New Age Publishers (1990)
2. Dryland Agriculture - G. Subba Reddy, Agrotech India Ltd (2008)
3. Watershed Management - V. V. Narayan, G. Shastry and U. S. Pattanaik, Prentice hall (2000)

8. Title: Principles of Organic Farming

Course No: AG- 328

Cr hr: 2(1+1)

Theory

Organic farming, principles and its scope in India; Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture; Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; Choice of crops and varieties in organic farming; Fundamentals of insect, pest, disease and weed management under organic mode of production; Operational structure of NPOP; Certification process and standards of organic farming; Processing, leveling, economic considerations and viability, marketing and export potential of organic products.

Practical

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

Text / Reference Books:

1. Organic Farming: Theory and Practice - S. P. Palaniappan, and K. Annadurai, Scientific Publishers (1999)
2. A Handbook of Organic Farming - A. K. Sharma, Agrobios (2001)
3. Handbook of Organic Farming and Bio-fertilizers - M. K. Gupta, ABD Publishers (2007)

9. Title: Geoinformatics and Nano-technology for Precision Farming

Course No: AG- 329

Cr hr: 2(1+1)

Theory

Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture; Geo-informatics- definition, concepts, tool and techniques; their use in Precision Agriculture. Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Spatial data and their management in GIS; Geodesy and its basic principles; Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), components and its functions; System Simulation- Concepts and principles, Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs; STCR approach for precision agriculture; Nanotechnology, definition, concepts and techniques, brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors, Use of nanotechnology in tillage, seed, water, fertilizer, plant protection for scaling-up farm productivity.

Practical

Introduction to GIS software, spatial data creation and editing. Introduction to image processing software. Visual and digital interpretation of remote sensing images. Generation of spectral profiles of different objects. Supervised and unsupervised classification and acreage estimation. Multispectral remote sensing for soil mapping. Creation of thematic layers of soil fertility based on GIS. Creation of productivity and management zones. Fertilizers recommendations based of VRT and STCR techniques. Crop stress (biotic/abiotic) monitoring using geospatial technology. Use of GPS for agricultural survey. Formulation, characterization and applications of nanoparticles in agriculture. Projects formulation and execution related to precision farming.

Text / Reference Books:

1. Nanotechnology: Fundamentals and Applications - M. Karkare, IK International Pvt. Ltd. (2008)
2. Applied Nanotechnology in Agriculture - S. Choudhary Arise Publishers & Distributors (2011)
3. Geoinformation Applications in Agriculture - A. K. Singh, New India Publishing Agency (2007)
4. Precision Agriculture Technology Application - K. C. Swain
5. Text book of Remote Sensing & GIS - K. C. Sahu

1. Title: Practical Crop Production-I (Kharif Crops)**Course No: CP- 311****Cr hr: 2(0+2)****Practical**

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

Text / Reference Books:

1. Manures and Fertilizers - K. S. Yawalkar, J. P. Agarwal and S. Bokde, Agri-Horticultural Pub. House, Nagpur (1992)
2. Principles and Practices of Agronomy - P. Balasubramaniam, and S. P. Palaniappan, Agrobios (India), Jodhpur (2001)
3. Principles of Agronomy - S. R. Reddy, Kalyani Publishers, New Delhi (2002)
4. Principles and Practices of Agronomy - S. S. Singh, Kalyani Publishers, New Delhi (1993)
5. Text book of Field Crops Production – R. Prasad, ICAR, New Delhi.

6. Practical manuals on nutrient management, water management & weed management - Department of Agronomy, College of Agriculture, OUAT, Bhubaneswar.

2. Title: Practical Crop Production-II (Rabi Crops)

Course No: CP- 322

Cr hr: 2(0+2)

Practical

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

Text / Reference Books:

1. Manures and Fertilizers - K. S. Yawalkar, J. P. Agarwal and S. Bokde, Agri-Horticultural Pub. House, Nagpur (1992)
2. Principles and Practices of Agronomy - P. Balasubramaniam, and S. P. Palaniappan, Agrobios (India), Jodhpur (2001)
3. Principles of Agronomy - S. R. Reddy, Kalyani Publishers, New Delhi (2002)
4. Principles and Practices of Agronomy - S. S. Singh, Kalyani Publishers, New Delhi (1993)
5. Text book of Field Crops Production – R. Prasad, ICAR, New Delhi.
6. Practical manuals on nutrient management, water management & weed management - Department of Agronomy, College of Agriculture, OUAT, Bhubaneswar.

II. GENETICS AND PLANT BREEDING

1. Title: Fundamentals of Genetics

Course No: PBG- 121

Cr hr: 3(2+1)

Theory

Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity, Cell division – mitosis, meiosis, Probability and Chi-square. Dominance relationships, gene interaction.

Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanisms, chromosome mapping. Structural changes in chromosome, Mutation, classification, Methods of inducing mutation & CIB technique, mutagenic agents and induction of mutation. Qualitative & Quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Epistatic interactions with examples. Cytoplasmic inheritance. Genetic disorders,. Nature, structure & replication of genetic material. Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operons.

Practical

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

Text / Reference Books:

1. Benjamin Cummings Genes VIII -Lewin (2003)
2. Fundamentals of Genetics- B. D. Singh, Kalyani Publishers (2009)
3. Principles of Genetics - E. W. Sinnott, L.C. Dunn, T. Dobzhansky, McGraw-Hill Inc.,US (1984)
4. Principles of Genetics - E.J.Gardner, M. J. Simmons and D.P. Snustad, John Willey & Sons (1991)

2. Title: Fundamentals of Plant Breeding

Course No: PBG -212

Cr hr: 3(2+1)

Theory

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self – incompatibility and male sterility- genetic consequences, cultivar options. Domestication, Acclimatization, introduction; Centre of origin/diversity, component of

Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self-pollinated crops-mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept. Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross pollinated crops, modes of selection; Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops, clonal selection and hybridization; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding, mutation breeding-methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders and Farmer's Rights.

Practical

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

Text / Reference Books:

1. Principles of Plant Breeding - R.W. Alard, John Willey & Sons, New York (2000)
2. Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches - G.S. Chahel and S.S. Ghosal, Narosa Publishing House, New Delhi (2002)
3. Plant Breeding - B. D. Singh, Kalyani Publishing House, New Delhi (2005)
4. Essentials of Plant Breeding-Principles and Methods - P. Singh, Kalyani Publishing House, New Delhi (2001)
5. Plant Breeding- Mendelian to Molecular Approach - H. K. Jain, and M. C. Kharackwal, Narosa, Publishing House, New Delhi (2004)

3. Title: Intellectual Property Rights

Course No: PBG -313

Cr hr: 1(1+0)

Theory

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

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, researcher 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.

Text / Reference Books:

1. Intellectual Property Rights - Neeraj Pandey, PHI Learning India (2000)
2. Intellectual Property Rights - S. R. A. Rosedar, Lexis Lexis, Rome (2013)
3. Intellectual Property Rights, Vanita Khanna, Oxford India (2000)

4. Title: Crop Improvement – I (*Kharif*)

Course No: PBG -314

Cr hr: 2(1+1)

Theory

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation Floral biology, study of genetics of qualitative and quantitative characters; Important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Seed production technology in self pollinated, cross pollinated and vegetatively propagated crops. Hybrid seed production technology in Maize, Rice, Sorghum, Pearl millet and Pigeonpea, etc. Ideotype concept and climate resilient crop varieties for future.

Practical

Emasculation and hybridization techniques in different crop species; viz., Rice, Maize, Sorghum, Pearl Millet, Ragi, Pigeonpea, Urdbean, Mungbean, Soybean, Groundnut, Sesame, Caster, Cotton, Cowpea, Pearl millet and Tobacco. Maintenance breeding of different *kharif* crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seeds production in *Kharif* crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops.

Text / Reference Books:

1. Introduction to Cytogenetics, G. Prasad, Kalyani Publishers (2002)
2. Cytogenetics of Crop Plants, P. K. Gupta, U. Sinha and M. S. Swaminathan, Macmillan India Ltd (1983)
3. Cytogenetics - C. P. Swanson, T. Merz and W. J. Young, Prentice-Hall. Inc., Englewood Cliffs, N. J. (1981)

5. Title: Crop Improvement – II (Rabi)**Course No: PBG -325****Cr hr: 2(1+1)****Theory**

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fodder crops and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation; Floral biology, study of genetics of qualitative and quantitative characters; Important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Seed production technology in self pollinated, cross pollinated and vegetatively propagated crops. Hybrid seed production technology of rabi crops. Ideotype concept and climate resilient crop varieties for future.

Practical

Emasculation and hybridization techniques in different crop species namely Wheat, Oat, Barley, Chickpea, Lentil, Field pea, Rapeseed Mustard, Sunflower, Potato, Berseem. Sugarcane, Cowpea; Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seeds production in *Rabi* crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, study of donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops.

Text / Reference Books:

1. Manures and Fertilizers - K. S. Yawalkar, J. P. Agarwal and S. Bokde, Agri-Horticultural Pub. House, Nagpur (1992)
2. Principles and Practices of Agronomy - P. Balasubramaniam, and S. P. Palaniappan, Agrobios (India), Jodhpur (2001)
3. Principles of Agronomy - S. R. Reddy, Kalyani Publishers, New Delhi (2002)
4. Principles and Practices of Agronomy - S. S. Singh, Kalyani Publishers, New Delhi (1993)

III. SOIL SCIENCE & AGRICULTURAL CHEMISTRY

1. Title: Fundamentals of Soil Science

Course No: AC - 111

Cr hr: 3(2+1)

Theory

Soil as a natural body, Pedological and edaphological concepts of soil; Soil genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation; Soil Profile, components of soil; Soil physical properties: soil-texture, structure, density and porosity, soil colour, consistence and plasticity; Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; soil air, composition, gaseous exchange, problem and plant growth; source, amount and flow of heat in soil; soil temperature and plant growth; Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; soil colloids - inorganic and organic; silicate clays: constitution and properties; sources of charge ion exchange, cation exchange capacity, base saturation; soil organic matter: composition, properties and its influence on soil properties; humic substances - nature and properties; soil organisms: macro and micro organisms, their beneficial and harmful effects; Soil pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

Practical

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

Text / Reference Books:

1. The Nature and Properties of Soil - N. C. Brady and R. Ray, Weill, Pearson Education Inc. New Delhi (2002)
2. A Text Book of Soil Science - T.D. Biswas and S. K. Mukherjee, Tata McGraw-Hill Publishing Co. Ltd. (1987)
3. Fundamentals of Soil Science - Indian Society of Soil Science, IARI, New Delhi (2002)
4. Soil Pedology - J. L. Sehgal, Kalyani Publication, Ludhiana (1996)
5. Soil Physics - B.P. Ghildyal and R.P. Tripathy, Willey Eastern Ltd, New Delhi (1987)
6. Introduction to Soil Physics - Daniel Hille, Academic Press (2013)
7. Introductory to Soil Science - Dilip Kumar Das, Kalyani Publication, Ludhiana (1990)

8. Practical Manual for Introduction to Soil Physics - P.K. Das, A.K. Dash, and G.H. Santra, Department of Soil Science & Agricultural Chemistry, OUAT, Bhubaneswar (1995)

2. Title: Agricultural Microbiology

Course No: AC - 122

Cr. hr: 2(1+1)

Theory

Introduction. Microbial world: Prokaryotic and eukaryotic microbes. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination- transformation, conjugation and transduction, plasmids, transposon.

Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and sulphur cycles. Biological nitrogen fixation- symbiotic, associative and aysmbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere. Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation.

Practical

Introduction to microbiology laboratory and its equipments; Microscope- parts, principles of microscopy, resolving power and numerical aperture. Methods of sterilization. Nutritional media and their preparations. Enumeration of microbial population in soil- bacteria, fungi, actinomycetes. Methods of isolation and purification of microbial cultures. Isolation of *Rhizobium* from legume root nodule. Isolation of *Azotobacter* from soil. Isolation of *Azospirillum* from roots. Staining and microscopic examination of microbes. Experiment on organic matter decomposition and evolution of Carbon Dioxide (CO₂) in soil, Experiments on Urea hydrolysis. Morphological studies on Nitrogen fixing nodules. Study of BGA & observation of Heterocyst. Methods of application of bio fertilizer in the field.

Text / Reference Books:

1. Introduction to Soil Microbiology – M. Alexander, Krieger Publishing Company (2011)
2. Agricultural Microbiology - G. Rangaswami and Bagyaraj, Prentice Hall India Learning Pvt. Ltd. (1992)
3. Soil Microorganism and Plant Growth - N.S. Subba Rao, Science Publishers, U.S. (1995)
4. Biofertilizers in Agriculture - N.S. Subba Rao, Science Publishers, U.S. (1993)

3. Title: Fundamentals of Plant Biochemistry

Course No: AC - 213

Cr. hr: 2(1+1)

Theory

Importance of Biochemistry. Properties of Water, pH and Buffer. Carbohydrate: Importance and classification. Structures of Monosaccharides, Reducing and oxidizing properties of Monosaccharides, Mutarotation; Structure of Disaccharides and Polysaccharides. Lipid:

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

Practical

Preparation of solution, pH & buffers, Qualitative tests of carbohydrates and amino acids. Quantitative estimation of glucose/ proteins. Titration methods for estimation of amino acids/lipids, Effect of pH, temperature and substrate concentration on enzyme action, Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides.

Text / Reference Books:

1. Principles of Biochemistry - A. L. Lehninger, Freeman and Company, USA (2004)
2. Outlines of Biochemistry - E. E. Conn, P. K. Stumpf, G. Bruining and R. H. Doi, John Wiley and Sons, New York (2007)
3. Lehninger Principles of Biochemistry - D. L. Nelson and M. M. Cox, Worth Publishers, New York. (2000)

4. Title: Problematic Soils and their Management (New)

Course No: AC - 224

Cr. hr: 2(1+1)

Theory

Soil quality and health, Distribution of Waste land and problem soils in India. Problem soils of Odisha & Iron toxic soils, their categorization based on properties. Reclamation and management of Saline and sodic soils, Acid soils, Acid Sulphate soils, Eroded and Compacted soils, Flooded soils, Polluted soils.

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

Multipurpose tree species, bio remediation through MPTs of soils, land capability and classification, land suitability classification. Problematic soils under different Agroeco systems.

Practical

Identification of soil related crop production constraints (estimation of pH, EC, OC, Soil texture, CEC). Nature of acidity, lime requirement, gypsum requirement, leaching requirement, available nutrients such as N, P, K, S, Ca & Mg, Carbonate & Bicarbonate, estimation of CCE of liming materials.

Text /Reference Books:

1. The Nature and Properties of Soil - N. C. Brady and Ray R. Well, Pearson India (2013)
2. Manures and Fertilizers - K. S. Yawalkar, J. P. Agrawal and S. Bokde, Agrobios India (2012)
3. Soil Conditions and Plant Growth - E. W. Russel and E. J. Russel, Oxford India (1990)

5. Title: Manures, Fertilizers and Soil Fertility Management**Course No: AC - 315****Cr. hr: 3(2+1)****Theory**

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

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

History of soil fertility and plant nutrition. criteria of essentiality. role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions.

Practical

Introduction of analytical instruments and their principles, calibration and applications, Colorimetry and flame photometry. Estimation of available N in soils. Estimation of available P in soils. Estimation of available K. Estimation of available S in soils. Estimation of available Ca and Mg in soils. Estimation of available Zn in soils. Estimation of N in plants. Estimation of P in plants. Estimation of K in plants. Estimation of S in plants. Collection, Processing & Storage of manures/fertilizer samples, estimation of nutrient content (N, P & K) in manures & fertilizers samples, quick test for identification of common fertilizers.

Text / Reference Books:

1. Soil fertility and fertilizers - S. L. Tisdale, W. L. Nelson, J. D. Benton and J. L. Havlin, Pearson education India (2012)
2. Manurs and Fertilizers - S. Yawalker, J. B. Agarwal and S. Bokde, Kalyani publishers (2000)
3. Soil Fertility, Theory and Practice - J. S. Kanwar, Orient Longman India (1990)
4. Chemistry of Insecticides & Fungicides - V. S. Sreeramulu, Oxford publishers (1992)

IV. HORTICULTURE

1. Title: Fundamentals of Horticulture (New)

Course No: HORT - 111

Cr. hr: 2(1+1)

Theory

Horticulture-Its definition and branches, importance and scope; horticultural and botanical classification; climate and soil for horticultural crops; Plant propagation-methods and propagating structures; principles of orchard establishment; Principles and methods of training and pruning, juvenility and flower bud differentiation; unfruitfulness; pollination, pollinizers and pollinators; fertilization and parthenocarpy; kitchen gardening; garden types and parts; lawn making; medicinal and aromatic plants; species and condiments; use of plant bio-regulators in horticulture. Irrigation & fertilizers application-method and quantity.

Practical

Identification of garden tools. Identification of horticultural crops. Preparation of seed bed/nursery bed. Practice of sexual and asexual methods of propagation. Layout and planting of orchard plants. Training and pruning of fruit trees. Transplanting and care of vegetable seedlings. Making of herbaceous and shrubbery borders. Preparation of potting mixture, potting and repotting. Fertilizer application in different crops. Visits to commercial nurseries/orchard.

Text / Reference Books:

1. Introduction to Horticulture - N. Kumar, Oxford Publisher Ltd, Delhi (2010)
2. Basic Horticulture - Jitendra Singh, Kalyani Publishers, Delhi (2014)
3. Fruit Growing - Jules Janick, Willey Blackwell, New York (1994)
4. Floriculture in India - G.S. Randhawa and A. Mukhopadhyay, Kalyani Publishers, Delhi (1990)

2. Title: Production Technology for Fruit and Plantation Crops

Course No: HORT - 122

Cr. hr: 2(1+1)

Theory

Importance and scope of fruit and plantation crop industry in India; High density planting; Use of rootstocks; Production technologies for the cultivation of major fruits-mango, banana, citrus, grape, guava, litchi, sapota & papaya and minor fruits- pineapple, pomegranate, jackfruit & strawberry; plantation crops-coconut, arecanut, cashew, tea, coffee & rubber.

Practical

Seed propagation. Scarification and stratification of seeds. Propagation methods for fruit and plantation crops including Micro-propagation. Description and identification of fruit. Preparation of plant bio regulators and their uses, Pests, diseases and physiological disorders of above fruit and plantation crops, Visit to commercial orchard.

Text / Reference Books:

1. A Text Book of Pomology Vol.-II (Tropical fruits) - T.K. Chattopadhyaya, Kalyani Publishers (2015)
2. A Text Book of Pomology Vol.-III (Sub-Tropical fruits) - T.K. Chattopadhyaya, Kalyani Publishers (2015)
3. Fruits: Tropical and Subtropical - T.K. Bose, and S.K. Mitra, Naya Prakash (1990)

3. Title: Production Technology for Vegetable and Spices**Course No: HORT - 213****Cr. hr: 2(1+1)****Theory**

Importance of vegetables & spices in human nutrition and national economy, brief about origin, area, production, improved varieties and cultivation practices such as time of sowing, sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting, storage, physiological disorders of important vegetable crops like solanaceous fruit vegetables (brinjal, tomato & chilli), tuber crops (Potato), cucurbits (pumpkin, cucumber, watermelon & gourds), pod vegetables (pea & bean), cole crops (cabbage & cauliflower), bulb crops (onion, garlic), root crops (radish & carrot), common leafy vegetables, spices: turmeric and ginger, black pepper and cardamom.

Practical

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

Text / Reference Books:

1. Vegetable Crops in India - T.K. Bose and M. G. Som, Naya Prakash (1990)
2. Vegetables for the Tropical Region - P. Nath, S. Velayudhan, and D. P. Singh, ICAR Publication (1987)
3. Vegetable Crops- Production Technology, Volume-II - B. R. Choudhary, R.S. Dhaka & M. S. Fageria, Kalyani Publishers (2012)
4. Principles of Vegetable Production - S.P. Singh, Neha Publishers & Distributors (2011)

4. Title: Production Technology for Ornamental Crops, MAPs and Landscaping**Course No: HORT - 314****Cr. hr: 2(1+1)****Theory**

Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers. Production technology of important cut flowers like rose, gerbera, carnation, lily and orchids under protected conditions and gladiolus, tuberose, chrysanthemum under open

conditions. Package of practices for loose flowers like marigold and jasmine under open conditions. Production technology of important medicinal plants like asparagus, aloe, costus, Cinnamomum, periwinkle, isabgol, *Rauwolfia*, *Andropogon* and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver & long pepper. Processing and value addition in ornamental crops and MAPs produce.

Practical

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

Text / Reference Books:

1. Floriculture in India - G. S. Randhawa and A. Mukopadhyay, Allied Publishers (1998)
2. Complete Gardening in India - K.S.G. Gopalswami, Oxford, Delhi (1990)
3. Commercial Flowers - T.K. Bose and L.P. Yadav, New Age Publishers (1990)
4. Text Book of Floriculture and Land scaping - N. Roychowdhury and H.P. Mishra, Allied Publishers (2000)

5. Title: Post-harvest Management and Value Addition of Horticultural Crops

Course No: HORT - 325

Cr. hr: 2(1+1)

Theory

Importance of fruits and vegetables, extent and possible causes of post harvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Role of ethylene; Post harvest disease and disorders; Heat, chilling and freezing injury; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric); Value addition concept; Principles and methods of preservation; Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards; Fermented and non-fermented beverages. Tomato products- Concepts and Standards; Drying/ Dehydration of fruits and vegetables – Concept and methods, osmotic drying. Canning — Concepts and Standards, packaging of products.

Practical

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

Text / Reference Books:

1. Fruit and Vegetable Preservation, Principles and Practices - R. P. Srivastava and S. Kumar, Agrobios India (2005)
2. Commercial Fruits and Vegetables Products - W. V. Cruess, Agrobios India (2004)
3. Major Spices of India. Crop Management & Post harvest Technology - J. S. Pruthi, ICAR, New Delhi (1993)
4. Post-Harvest Technology of Cereals, Pulses and Oilseeds - T. Kudra, & G. S. V. Raghavan, Oxford IBH Publishing Co. Pvt. Ltd., New Delhi (1999)
5. Protected Cultivation - Adikant Pradhan, Satish Serial Publishing House (2012)

V. ENTOMOLOGY

1. Title: Fundamentals of Entomology

Course No: ENT - 121

Cr. hr: 4(3+1)

Theory

Part - I

History of Entomology in India. Factors for insect's abundance. Major points related to dominance of Insecta in Animal kingdom. Classification of phylum Arthropoda upto classes. Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of Head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. Structure of male and female genital organ. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs like simple and compound eyes, chemoreceptor.

Part-II

Systematics: Taxonomy –importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta upto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae. Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

Part III

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. Concepts of Balance of life in nature, biotic potential and environmental resistance and causes for outbreak of pests in agro-ecosystem.

Part – IV

Pest surveillance and pest forecasting. Categories of pests. Host plant resistance, Cultural, Mechanical, Physical. Legislative. Biological (parasites, predators & transgenic plant pathogens such as bacteria, fungi and viruses) methods of control. Chemical control-

importance, hazards and limitations. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Recent methods of pest control, use of novel insecticides, repellents, pheromones, antifeedants, hormones, attractants, gamma radiation and genetic control. Practices, scope and limitations of IPM. Insecticides Act 1968-Important provisions. Application techniques of spray fluids. Phytotoxicity of insecticides. Symptoms of poisoning, first aid and antidotes.

Practical

Methods of collection and preservation of insects including immature stages; External features of Grasshopper/Blister beetle; Types of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae; Dissection of digestive system in insects (Grasshopper); Dissection of male and female reproductive systems in insects (Grasshopper); Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance. Acquaintance with plant protection appliances and their use.

Text / Reference Books:

1. The Insects: Structure and Function - R.F. Chapman, Cambridge University Press (1998)
2. A General Text Book of Entomology - A.D. Imms, EP Dutton & Co. Inc., New York (1929)
3. General and Applied Entomology - K.K. Nayar, T.N. Ananthakrishnan, and B.V. David, Tata McGraw-Hill (1981)

2. Title: Pests of Crops and Stored Grains and their Management

Course No: ENT - 212

Cr. hr: 3(2+1)

Theory

General account on nature and type of damage by different arthropods pests. Scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practice other important arthropod pests of various field crops such as cereals (rice, wheat, maize, sorghum, ragi), Pulses (green gram, black gram, arhar, Bengal gram), oil seeds (ground nut, mustard, sesamum, castor, sunflower), fiber crops (cotton, jute), vegetable crops (brinjal, potato, sweet potato, tomato, chilli, cucurbits, cole crops, okra, beans), fruit crops (mango, citrus, banana, pomegranate, ber, sapota, litchi, guava, papaya, grapes & apple), plantation crops (coconut, cashew nut, tea, coffee), ornamental crops (rose, marigold, tuberose, chrysanthemum), spices and condiments (onion, garlic, cardamom, black pepper, turmeric, ginger) & sugarcane. Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain. Insect pests, mites, rodents, birds and microorganisms associated with stored grain

and their management. Storage structure and methods of grain storage and fundamental principles of grain store management.

Practical

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

Text / Reference Books:

1. Integrated Pest Management, Concepts and Approaches - G. S. Dhaliwal and R. Arora Agrobios india (2000)
2. A Textbook of Applied Engomology - K. P. Srivastava, Agrobios Indsia (2000)
3. Elements of Economic Entomology - B. Vasantharaj David, Brillion Publishing (1990)
4. Crop Protections Management Strategies - D. Prasad, Oxford Publishers (2000)
5. Agricultural Insect Pests and their Control - V. B. Awasthi, Mamrutha publishers (2000)
6. A Textbook of Plantation Crops - K. M. Pillai, Oxford Publishers (2002)

3. Title: Management of Beneficial Insects

Course No: ENT - 223

Cr. hr: 2(1+1)

Theory

Importance of beneficial Insects pollinating plants. Types of honey bees and their caste system, history of bee keeping, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee. Insecticidal poisoning in honey bees.

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

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

Beneficial insects: parasites and predators used in pest control and their mass multiplication techniques. Important groups of microorganisms, bacteria, viruses and fungi used in pest

control and their mass multiplication techniques. Important species of pollinator, weed killers and scavengers with their importance.

Practical

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

Text / Reference Books:

1. Integrated Pest Management: Concepts and Approaches - G. S. Dhaliwal, and R. Arora, Kalyani Publishers (2002)
2. Agricultural Entomology and Pest Control - S. Pradhan, ICAR Publication (1983)
3. Entomology and Pest Management - L. P. Pedigo, Macmillan Publishing Company (1989)
4. Insects and Mites of Crops in India - M. R. G. K. Nair, ICAR Publication (1975)

4. Title: Principles of Integrated Pest and Disease Management

Course No: ENT - 314

Cr. hr: 3(2+1)

Theory

Categories of insect pests and diseases, IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of insect pests, diseases and pest risk analysis. Methods of detection and diagnosis of insect pest and diseases. Calculation and dynamics of economic injury level and importance of Economic threshold level. Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment. Introduction to conventional pesticides for the insect pests and disease management. Surveysurveillance and forecasting of Insect pest and diseases. Development and validation of IPM module. Implementation and impact of IPM (IPM module for Insect pest and disease. Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM programmes.

Practical

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

Text / Reference Books:

1. Elements of Economic Entomology - B. V. David, Texas A & M University Press (1989)
2. Integrated Pest Management: Concepts and Approaches - G. S. Dhaliwal and R. Arora, Pearson Publication (2013)
3. Insect Pest Management - Larry P. Pedigo, Pearson Publication (2008)
4. Insects and mites of crops in India - M. R. G. K. Nair, ICAR, Haward Publication (2002)
5. Introduction to Principles of Plant Pathology – R. S. Singh, Oxford & IBH Publishing Company Pvt. Ltd. (2017)
6. Plant Pathology – R. P. Singh, Kalyani Publishers, (2016)

VI. PLANT PATHOLOGY

1. Title: Fundamentals of Plant Pathology

Course No: PPT - 121

Cr. hr: 3(2+1)

Theory

Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Pathogenesis. Cause and classification of plant diseases. Important plant pathogenic organisms. Fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them. Diseases and symptoms due to abiotic causes.

Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions, sub-divisions, orders and classes; Bacteria and mollicutes: general morphological characters. Basic methods of classification and reproduction; Viruses: nature, architecture, multiplication and transmission; Study of phanerogamic plant parasites.

Principles and methods of plant disease management; Nature, chemical composition, classification, mode of action and formulations of fungicides and antibiotics.

Practical

Acquaintance with various laboratory equipments and microscopy. Preparation of media, isolation and Koch's postulates. General study of different structures of fungi. Study of symptoms of various plant diseases. Study of representative fungal genera. Staining and identification of plant pathogenic bacteria. Transmission of plant viruses. Study of phanerogamic plant parasites.

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

Text / Reference Books:

1. Plant Pathogens: The Fungi -R.S. Singh, New India Publishing, Delhi (2013)
2. An Introduction to Fungi -H.C. Dubey, CABI Canada (2012)
3. Principles of Plant Pathology -R.S. Singh, Oxford & IBH Publishers, Delhi (2009)

2. Title: Fundamentals of Nematology

Course No: PPT - 212

Cr. hr: 2(1+1)

Theory

Structure of plant parasitic Nematodes, association of plant parasitic Nematodes in various crop plants, economic importance of nematodes, classification of nematodes based on feeding habits, various above and below ground symptoms, economically important nematodes affecting rice, wheat, important vegetable, fruits and ornamentals with their symptoms, biology, spread of diseases and integrated nematode management.

Practical

Study of Nematological laboratory appliances, study of binocular stereoscopic and research microscopes, collection of soil and plant samples, Extraction of nematodes from soil by Cobb's sieving and decantation technique followed by modified Baermann technique. Isolation of plant parasitic nematodes from plant parts, staining and preservation of root knot nematode infected root samples. Identification of *Hoplolaimus*, *Helicotylenchus*, *Criconemella*, *Meloidogyne*, *Rotylenchulus*, *Tylenchulus*, *Anguina*, *Aphelenchoides*, *Pratylenchus* & *Rhadopholus*. Study of Nematicides, Biopesticides, Oilcakes and their method of application.

Text / Reference Books:

1. Text book on Introductory Plant Nematology - R.K. Walia and H.K. Bajaj, ICAR, New Delhi (2003)
2. A Treatise on Phytonematology - P.P. Reddy, Agricole Publishing Academy, New Delhi (1987)
3. Introduction to Plant Nematology - V.H. Dropkin, Wiley-Blackwell, (1980)

3. Title: Mushroom Cultivation**Course No: PPT - 223****Cr. hr: 1(0+1)****Practical**

Acquaintance with different mushroom species, significance of mushroom cultivation. Preparation of mother culture & sub-culture, production of mother spawn and commercial spawn. Cultivation techniques of *Volvariella*, *Calocybe*, *Pleurotus* and *Agaricus*, harvesting, packing & storage. Contaminants, insect pests and diseases of mushrooms and their management. Economics of mushroom cultivation. Processing and preservation of mushrooms. Economics of spawn production and mushroom recipes. Disposal of Spent Mushroom Substrate.

Text / Reference Books:

1. Cultivation Technology of Paddy Straw Mushroom - O. P. Ahlawat and R. P. Tewari, NRCM (ICAR), Solan (HP) (2007)
2. Mushroom Cultivation -J. N. Kapoor, ICAR Publication (2004)
3. Recent Advances in the Cultivation Technology of Edible Mushrooms - R. N. Verma, NRCM (ICAR), Solan (HP) (2002)

4. Title: Diseases of Field & Horticultural Crops & their Management-I**Course No: PPT - 314****Cr. hr: 3 (2+1)****Theory**

Symptoms, etiology, disease cycle and management of major diseases of following crops:

Field Crops: Rice: blast, brown spot, bacterial blight, sheath blight, false smut, khaira and tungro; Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra :downy mildew and ergot; Groundnut: early and late leaf spots, wilt

Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; Pigeonpea: Phytophthora blight, wilt and sterility mosaic; Finger millet: Blast and leaf spot; black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic; Castor: Phytophthora blight; Tobacco: black shank, black root rot and mosaic. Horticultural Crops: Guava: wilt and anthracnose; Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top; Papaya: foot rot, leaf curl and mosaic; Pomegranate: bacterial blight; Cruciferous vegetables: Alternaria leaf spot and black rot; Brinjal: Phomopsis blight and fruit rot and Sclerotinia blight; Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic; Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot; Colocasia: Phytophthora blight; Coconut: wilt and bud rot; Tea: blister blight; Coffee: rust

Practical

Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems. Collection and preservation of plant diseased specimens for Herbarium.

Text / Reference Books:

1. An Introduction to Fungi - H. C. Dubey, Scientific Publishers (2012)
2. Plant Disease - R. S. Singh, Oxford and IBH Publishing (2009)
3. Plant Pathology - R.S. Mehrotra, Tata Mc Grow Hill Pub. Co. Ltd., New Delhi (1998)

5. Title: Diseases of Field & Horticultural Crops & their Management-II

Course No: PPT - 325

Cr. hr: 3 (2+1)

Theory

Symptoms, etiology, disease cycle and management of following diseases:

Field Crops:

Wheat: rusts, loose smut, karnal bunt, powdery mildew, alternaria blight, and ear cockle;

Sugarcane: red rot, smut, wilt, grassy shoot, ratoon stunting and Pokkah Boeng;

Sunflower: Sclerotinia stem rot and Alternaria blight; Mustard: Alternaria blight, white rust, downy mildew and Sclerotinia stem rot; Gram: wilt, grey mould and Ascochyta blight; Lentil: rust and wilt; Cotton: anthracnose, vascular wilt, and black arm; Pea: downy mildew, powdery mildew and rust; Horticultural Crops: Mango: anthracnose, malformation, bacterial blight and powdery mildew; Citrus: canker and gummosis; Grape vine: downy mildew, Powdery mildew and anthracnose; Apple: scab, powdery mildew, fire blight and crown gall.

Strawberry: leaf spot Potato: early and late blight, black scurf, leaf roll, and mosaic;

Cucurbits: downy mildew, powdery mildew, wilt; Onion and garlic: purple blotch, and Stemphylium blight; Chillies: anthracnose and fruit rot, wilt and leaf curl; Turmeric: leaf spot Coriander: stem gall; Marigold: Botrytis blight; Rose: dieback, powdery mildew and black leaf spot.

Practical

Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems. Collection and preservation of plant diseased specimens for herbarium.

Text / Reference Books:

1. Plant Diseases - R. S. Singh, Science Publisher, U.S. (2001)
2. Plant Pathology - R.S. Mehrotra, McGraw Hill Publication (2003)
3. Plant Pathology - P.D. Sharma, Rastogi Publication, Meerut (2013)
4. Diseases of Crop Plants in India - G. Rangaswami, Prentice Hall India Private Limited (1998)

VII. AGRICULTURAL ECONOMICS

1. Title: Fundamentals of Agricultural Economics

Course No: AE - 111

Cr. hr: 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. Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points. 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. Banking: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy. Agricultural and public finance: meaning, micro v/s macro finance, need for agricultural finance, public revenue and public expenditure. *Tax*: meaning, direct and indirect taxes, agricultural taxation, VAT. *Economic systems*: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.

Text / Reference Books:

1. Elementary Economic Theory - K. K. Dewett and J. D. Varma, S. Chand and Company Ltd., Ramnagar, New Delhi (1999)
2. International Economics - H.G. Mannur, Vikas Publishing House, New Delhi (1999)
3. Fundamentals of Agricultural Economics - A. N. Sudhu and A. Singh, Kalyani Publishers (2010)

4. Economics - P.A. Samuelson and W.D. Nordhaus, McGraw-Hill Inc. New York (1995)

2. Title: Agricultural Finance and Co-Operation

Course No: AE - 212

Cr. hr: 3(2+1)

Theory

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4 R's, and 3C's of credits. Sources of agricultural finance: institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks, Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent development in agricultural credit. Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis.

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

Practicals

Determination of most profitable level of capital use. Optimum allocation of limited amount of capital among different enterprise. Analysis of progress and performance of cooperatives using published data. Analysis of progress and performance of commercial banks and RRBs using published data. Visit to a commercial bank, cooperative bank and cooperative society to acquire firsthand knowledge of their management, schemes and procedures. Estimation of credit requirement of farm business – A case study. Preparation and analysis of balance sheet – A case study. Preparation and analysis of income statement – A case study. Appraisal of a loan proposal – A case study. Techno-economic parameters for preparation of projects. Preparation of Bankable projects for various agricultural products and its value added products. Seminar on selected topics.

Text/Reference Books:

1. Agricultural Finance: Theory and Practice - J. P. Singh, Ashish Publishing House, New Delhi (1990)
2. Agricultural Finance - A. G. Nelson and W.G. Murray, IOWA State University Press, Ames, IOWA, USA (1988)

3. Title: Agricultural Marketing, Trade and Prices

Course No: AE - 223

Cr. hr: 3(2+1)

Theory

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and

characteristics of agricultural markets; demand, supply and producer's surplus of agri-commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; product life cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits & demerits; marketing process and functions: Marketing process-concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (Agmark); Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; GATT and WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR.

Practical

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

Text / Reference Books:

1. Agricultural Marketing in India - S. S. Acharya and N. L. Agarwal, Kalyani Publishers (1990)
2. Agricultural Price Policy - S. S. Acharya and N. L. Agarwal, Prentice Hall India (1990)
3. Marketing of Agricultural Products - R. L. Kohis and N. Joseshuhf, Oxford India (1992)
4. Agricultural Price Analysis - G. E. Shephard, Orient longman India (2000)

4. Title: Farm Management, Production and Resource Economics

Course No: AE - 324

Cr. hr: 2(1+1)

Theory

Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factor determining types and size of farms. Principles of farm management: concept of production function and its type, use of production function in decision-making on a farm, factor-product, factor-factor and product-product relationship, law of equi-marginal/or principles of opportunity cost and law of comparative advantage. Meaning and concept of cost, types of costs and their interrelationship, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income and farm business income. Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting-linear programming, appraisal of farm resources, selection of crops and livestock's enterprises. Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies, Crop/livestock/machinery insurance – weather based crop insurance, features, determinants of compensation. Concepts of resource economics, differences between NRE and agricultural economics, unique properties of natural resources. Positive and negative externalities in agriculture, Inefficiency and welfare loss, solutions, Important issues in economics and management of common property resources of land, water, pasture and forest resources etc.

Practical

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

Text / Reference Books:

1. Fundamentals of Farm Business Management - S. S. Johl and T. Kapur, New Age Publishers (2005)
2. Production Economics - J. P. Doll and F. Orazem, CBS Publication, New Delhi (2007)
3. Economics of Agricultural Production and Farm Management - J. M. Dhaka, Pointer Publication (2009)

VIII. AGRICULTURAL EXTENSION EDUCATION

1. Title: Fundamentals of Agricultural Extension Education

Course No: EE - 111

Cr. hr: 3(2+1)

Theory

Education: Meaning, definition & Types; Extension Education- meaning, definition, scope and process; objectives and principles of Extension Education; Extension Programme planning- Meaning, Process, Principles and Steps in Programme Development. Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); various extension/ agriculture development programmes launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND,NATP, NAIP, etc.). New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc.

Rural Development: concept, meaning, definition; various rural development programmes launched by Govt. of India. Community Dev.-meaning, definition, concept & principles, Physiology of C.D. Rural Leadership: concept and definition, types of leaders in rural context; extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes; transfer of technology: concept and models, capacity building of extension personnel; extension teaching methods: meaning, classification, individual, group and mass contact methods, media mix strategies; communication: meaning and definition; models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

Practical

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

2. Title: Human Value and Ethics

Course No: EE - 122

Cr. hr: 1(1+0)

Theory

Values and Ethics-An Introduction. Goal and Mission of Life. Vision of Life. Principles and Philosophy of happy life. Self Exploration. Self Awareness. Self Satisfaction. Decision Making. Motivation. Sensitivity. Success. Selfless Service. Case Study of Ethical Lives. Positive Spirit. Body, Mind and Soul. Attachment and Detachment. Spirituality Quotient. Examination.

Text / Reference Books:

1. A foundation Course in Human Values and Professional Ethics - R. R. Gaur, R. Sangal, G. P. Bagaria, Excel Books Private limited, New Delhi (2009)
2. Teacher's Manual, A foundation Course in Human Values and Professional Ethics - R. R. Gaur, R. Sangal, G. P. Bagaria, Excel Books Private limited, New Delhi (2009)
3. Human Values - A. N. Tripathy, New Age International Publishers (2003)
4. Small is Beautiful: A study of economics as if people mattered - E. F. Schumacher, Blond & Briggs, Britain (1973)
5. How to practice Natural Farming - Subhas Paleker, Pracheen (Vaidik) Krishi Tantra Sodh, Amaravati (2000)
6. How the other half dies - Sussan George, Penguin Press (1986)
7. Foundations of Ethics and Management - P. B. Banerjee, Excel Books Pvt. Ltd., New Delhi (2005)
8. Fundamentals of Ethics of Scientists and Engineers - E. G. Seebauer & Robert L. Berry, Oxford University Press (2000)

3. Title: Rural Sociology & Educational Psychology

Course No: EE - 213

Cr. hr: 2(2+0)

Theory

Sociology and Rural sociology: Definition and scope, its significance in agriculture extension, Rural society, Social Groups, Social Stratification, Culture concept, Social Institution, Social Change & Development. Educational psychology: Meaning & its importance in agriculture extension. Behavior: Cognitive, affective, psychomotor domain, Personality, Learning, Motivation, Theories of Motivation, Intelligence.

Text / Reference Books:

1. Introductory Rural Sociology - J.B. Chitamber, New Age International (P) Ltd., Kolkata (1960)
2. Social Change - B. Kuppaswamy Vikash, Publishing House Pvt. Limited, Ansari Road, New Delhi (2004)
3. Rural Sociology and Educational Psychology - Sagar Mandal, Kalyani publisher, Kolkata (2001)
4. Elementary Psychology - S.M. Mohsin, Motilal Bainshidas Publishers, New Delhi (1960)

5. General Psychology - Hans Raj Bhatia, Oxford & IBH Publication, Kolkata (2000)

4. Title: Communication Skills and Personality Development

Course No: EE - 224

Cr. hr: 2(1+1)

Theory

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

Practical

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

Text / Reference Books:

1. Personality Development and Soft Skills - B. K. Mitra, Oxford University Press (2011)
2. Communication Skills and Personality Development - P. C. Sharma, Nirali Prakashan (2014)
3. Personality Development and Communication Skills - S. S. Narula, Taxmann Publications Private Limited (2011)

5. Title: Entrepreneurship Development and Business Communication

Course No: EE - 315

Cr. hr: 2(1+1)

Theory

Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs; Assessment of entrepreneurship skills, SWOT Analysis & achievement motivation, Entrepreneurial behavior, Government policy and programs and institutions for entrepreneurship development, impact of economic reforms on agri-business/agri-enterprise, Entrepreneurial Development Process; Business Leadership Skills; Communication skills for entrepreneurship development, Developing organizational skill, Developing Managerial skills, Problem solving skill, Achievement motivation; time management; Supply chain management and Total quality management, Project Planning Formulation and report preparation, financing of enterprise. Opportunities for entrepreneurship and rural enterprise.

Practical

Assessing entrepreneurial potential, problem solving ability, managerial skills and achievement motivation, exercise in creativity, time audit, preparation of business plan and proposal writing, visit to entrepreneurship development institute and entrepreneurs.

Text / Reference Books:

1. Indian Agriculture & Agri-Business Management - S. Diwase, Scientific Publisher India (2014)
2. A Textbook of Agri-Business Management - Sanket S. Kadam, Universal Prakashan, Pune, India (2016)
3. Agri-Business Management - Yashasvi R Rajpara, Pragun Publication, India (2012)
4. Management and Entrepreneurship –N. V. R. Naidu, T. Krishna Rao, I K International Publishing House Pvt. Ltd. (2008)
5. Entrepreneurship - Madhurima Lall, Shikha Sahai, Excel Books (2008)

IX. SEED SCIENCE AND TECHNOLOGY

1. Title: Principles of Seed Technology

Course No: SST - 221

Cr. hr: 2(1+1)

Theory

Seed and seed technology: introduction, definition and importance. Deterioration causes of crop varieties and their control; Maintenance of genetic purity during seed production, seed quality; Definition, Characters of good quality seed, different classes of seed. Foundation and certified seed production of important **cereals, pulses, oilseeds, fodder and vegetables**. Seed certification, phases of certification, procedure for seed certification, field inspection. Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, Varietal Identification through Grow Out Test and Electrophoresis, **Molecular and Biochemical test. Detection of genetically modified crops, Transgene contamination in non-GM crops, GM crops and organic seed production.**

Seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing. Seed storage; general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage. Seed marketing: structure and organization, sales generation activities, promotional media. Factors affecting seed marketing, Role of WTO and OECD in seed marketing.

Practical

Seed production in major cereals: Wheat, Rice, Maize, Sorghum and Bajra. Seed production in major pulses: Urd, Mung, Pigeonpea, Lentil, Gram, Fieldpea. Seed production in major oilseeds: Soybean, Rapeseed and Mustard. Seed production in vegetable crops. Seed certification: Procedure, Field inspection, Preparation of field inspection report. Visit to seed production farms, seed testing laboratories and seed processing plant.

Text / Reference Books:

1. Seed Technology - R. L. Agrawal, Oxford & IBH (2008)
2. Principles of Seed Technology - G.M. Kulkarni, Kalyani Publishers (2015)
3. Structure Development and Reproduction in Angiosperms - V. Singh, P. C. Pande & D. K Jain, Kalyani Publishers (1998)

2. Title: Seed Quality Testing

Course No: SST - 312

Cr. hr: 1(0+1)

Practical

Seed testing objectives, types of seed quality test, management of seed testing works in STL. Seed sampling – procedure of drawing samples and preparation of working sample. Moisture estimation, purity analysis and related tests, germination test, seed viability test, assessment of seed vigour, genetic purity testing – laboratory (chemical, biochemical & molecular)

methods and field plots (grow out) test. Seed health testing for pathogen and insect damage, detection of GM seeds.

Text / Reference Books:

1. Seed Technology - R. L. Agrawal, Oxford & IBH (2008)
2. Principles of Seed Technology - G.M. Kulkarni, Kalyani Publishers (2015)
3. Structure Development and Reproduction in Angiosperms - V. Singh, P. C. Pande & D. K Jain, Kalyani Publishers (1998)

X. PLANT PHYSIOLOGY

1. Title: Fundamentals of Crop Physiology

Course No: PP - 111

Cr. hr: 2(1+1)

Theory

Introduction to crop physiology and its importance in Agriculture; Plant cell: an Overview; Diffusion and osmosis; Absorption of water, transpiration and Stomatal Physiology; Mineral nutrition of Plants: Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms; Photosynthesis: Light and Dark reactions, C3, C4 and CAM plants; Respiration: Glycolysis, TCA cycle and electron transport chain; Fat Metabolism: Fatty acid synthesis and Breakdown; Plant growth regulators: Physiological roles and agricultural uses, Physiological aspects of growth and development of major crops: Growth analysis, Role of Physiological growth parameters in crop productivity.

Practical

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

Text / Reference Books:

1. Principles of Seed Technology - G.N. Kulkarni, Kalyani Publishers, Delhi (2004)
2. Plant Physiology - R.G.S. Bidwell, Academic Press Inc (1991)
3. A Text book of plant physiology - C.P. Mallick and A.K. Srivastav, Student Advisor Publications Pvt. Ltd. (2015)
4. The germination of seeds - A.M. Mayer and A. Poljakoff-Mayber, Pergamon Press (1929)
5. Plant Physiology - R.K.Sinha, Kalyani Publisher (1998)
6. The physiology and biochemistry of seed development, dormancy and germination - A.A.Khan, Kalyani Publisher, Delhi (2004)
7. Seed Physiology - K. Vanangamudi, Associated Publishing Company (2006)

XI. AGRICULTURAL STATISTICS

1. Title: Statistical Methods

Course No: AS - 121

Cr. hr: 2(1+1)

Theory

Introduction to Statistics and its Applications in Agriculture, Graphical Representation of Data, Measures of Central Tendency & Dispersion, frequency distribution – purpose and types (inclusive and exclusive), cumulative frequency, histograms, frequency polygon and curves with examples. Partition values – calculation of Quartiles, Deciles & Percentiles. Moments measures of skewness and kurtosis, normal distribution. Definition of Probability, Addition and Multiplication Theorem (without proof). Simple Problems Based on Probability. Binomial & Poisson Distributions, Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation. Linear Regression Equations. Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2×2 Contingency Table. Introduction to Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.

Practical

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

Text / Reference Books:

1. Fundamentals of Mathematical Statistics - S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi (1997)
2. A Text Book of Agricultural Statistics - R. Rangaswamy, New Age International Publishers Ltd, New Delhi (1987)
3. Fundamental of Statistics, Vol. I & II - Goon, Gupta and Dasgupta, The World Press Pvt. Ltd, Calcutta (1986)
4. Statistical Methods for Agricultural and Biological Sciences - S. J. Amdekar, Narsa Publishing House, New Delhi (1999)

2. Title: Agricultural Informatics

Course No: AS - 212

Cr. hr: 2(1+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 advises, 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.

Practical

Study of Computer Components, accessories, practice of important DOS Commands. Introduction of different operating systems such as windows, Unix/ Linux, Creating, Files & Folders, File Management. Use of MS-WORD and MS Power-point for creating, editing and presenting a scientific Document. MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, 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, for generating information important for Agriculture. Hands on practice on preparation of Decision Support System. Preparation of contingent crop planning.

Text / Reference Books:

1. Agro-informatics - G .Vanitha & M .Kalpana, New India Publishing Agency (1990)
2. Computer Fundamentals and Programming in C - Pradip Dey, Oxford University Press (2013)
3. Let us C - Yashavant Kanetkar, BPB Publications (2016)
4. Java: Object Oriented Programming with C++ – E. Balagurusamy, McGraw Hill Education (2014)
5. Visual Basic Programming - A. Murugan & K. Shyamala, Margham Publications (2012)
6. Computer Fundamentals - P.K.Sinha, BPB Publications (2004)

XII. AGRICULTURAL BIOTECHNOLOGY

1. Title: Fundamentals of Plant Biotechnology

Course No: ABT - 121

Cr. hr: 2(1+1)

Theory

Concepts and applications of plant biotechnology: Scope, organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications; Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization and cybrids; Somaclonal variation and its use in crop improvement; cryo-preservation; Introduction to recombinant DNA methods: physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods; Transgenics and its importance in crop improvement; PCR techniques and its applications; RFLP, RAPD, SSR; Marker Assisted Breeding in crop improvement; Biotechnology regulations.

Practical

Composition of various tissue culture media and preparation of stock solutions for MS nutrient medium. Callus induction from various explants. Micro-propagation, hardening and acclimatization. Demonstration on isolation of DNA. Demonstration of gel electrophoresis techniques and DNA finger printing.

Text / Reference Books:

1. Gene Cloning and DNA Analysis- An Introduction - T. A. Brown, Blackwell Science, London (2001)
2. Biotechnology and Genomics - P. K. Gupta, Rastogi Publication, Meerut (2006)
3. Biotechnology - S. S. Purohit, Agrobotanical Publication, Bikaner (1997)
4. Introduction to Plant Biotechnology - H. S. Chawala, CRC Press (2009)
5. Plant Biotechnology - A. Slater, Oxford University Press (2008)
6. Handbook of Plant Tissue Culture – ICAR Publication
7. Plant tissue Culture: Theory and Practice - S. S. Bhojwani and M. K. Razdan, Oxford and IBH, New Delhi (2004)

XIII. AGRICULTURAL ENGINEERING

1. Title: Soil and Water Conservation Engineering

Course No: SWE (Ag) - 121

Cr. hr: 2(1+1)

Theory

Introduction to Soil and Water Conservation, 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 Loss Soil Equation. Soil loss measurement techniques. Principles of erosion control: Introduction to contouring, strip cropping. Contour bund. Graded bund and bench terracing. Grassed water ways and their design. Water harvesting and its techniques. Wind erosion: mechanics of wind erosion, types of soil movement. Principles of wind erosion control and its control measures.

Practical

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

Text / Reference Books:

1. A Text Book of Surveying and Levelling - P.C. Purnima, Orient Longman, Chennai (2006)
2. Land & Water Management Engineering - V.V.N. Murty, Kalyani Publishers, Delhi (2002)
3. Soil Erosion and Conservation - R.P. Tripathy and H.P. Singh, Kalyani Publishers, Delhi (2000)

2. Title: Farm Machinery and Power

Course No: FMP (Ag) - 211

Cr. hr: 2(1+1)

Theory

Status of Farm Power in India, Sources of Farm Power , I.C. engines, working principles of I C engines, comparison of two stroke and four stroke cycle engines , Study of different components of I.C. engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication ,fuel supply and hydraulic control system of a tractor, Familiarization with Power transmission system : clutch, gear box, differential and final drive of a tractor , Tractor types, Cost analysis of tractor power and attached implement, Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture, implement for intercultural operations, Familiarization with sowing and planting equipment, calibration of a seed drill and solved

examples, Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.

Practicals

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

Text /Reference Books:

1. Principles of Agricultural Engineering - Michael and T.P. Ojha, Jain Brothers, Jodhpur (1987)
2. Farm Tractors, Maintenance and Repair - Rai and Jain, Tata Mc Grow Hill Publ. New Delhi (1989)
3. Elements of Farm Machinery - A.C. Srivastava, Oxford IBH Publ. Company, New Delhi (1989)
4. Elements of Agricultural Engineering - Singhal, O.P. Suraj Prakashan, Oxford IBH Publ. Company, New Delhi (1989)
5. Element of Agriculture engineering - Sahya, Jagdishwar, Agro. Book Agency, New Chitragupta Nagar, Patna (1990)

3. Title: Renewable Energy and Green Technology

Course No: FMP (Ag) - 222

Cr. hr: 2(1+1)

Theory

Classification of energy sources, contribution of these of sources in agricultural sector, Familiarization with biomass utilization for biofuel production and their application, Familiarization with types of biogas plants and gasifiers, biogas, bio-alcohol, biodiesel and biooil production and their utilization as bioenergy resource, introduction of solar energy: solar radiation, spectral distribution of solar radiation, beam and diffuse radiation, air mass. Collection and their application, solar radiation measuring instruments, pyrhiometer, pryranometer and sun shine recorder their working principle and components. Familiarization with solar energy gadgets: solar flat and focusing type plate collector, solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system: its basics and applications, solar cell, solar module and solar array. Solar photovoltaic application: solar PV water pumping system, solar lantern and solar fencing. Introduction of wind energy: wind energy resources, origin of wind, advantages and disadvantages, power of wind. Type of wind turbine, components and

operation of horizontal and vertical axis wind turbine. Operational characteristics of wind turbines and application of wind mill for water pumping.

Practical

Familiarization with renewable energy gadgets. To study biogas plants. To study the constructional details of different types of gasifier. To study the production process of biodiesel. To study briquetting machine. To study the production process of bio-fuels. Familiarization with different solar energy gadgets. To study solar photovoltaic system: solar light, solar water heater, solar dryer, solar pumping, solar fencing. To study constructional details of solar cooker. To study solar drying system. To study solar distillation and solar pond. Familiarization of various components of horizontal and vertical axis wind mill.

Text / Reference Books:

1. Non Conventional Energy Sources - G. D. Raj, Khanna Publication (2005)
2. Energy Technology Nonconventional, Renewable and conventional - S. Rao, B. B. Parulekar, Visalandhra Publishing House (2005)
3. Non Conventional Energy Resources - D. S. Chauhan, S. K. Srivastava, Pearson Publication (1990)
4. Fundamentals of Renewable Energy Sources - G.N. Tiwari and M. K. Ghosal, Alpha Science International Ltd (2007)
5. Fundamentals of Renewable Energy Sources - N. S. Rathore, Himanshu Publications (2010)

4. Title: Protected Cultivation and Secondary Agriculture

Course No: SWE (Ag) – 322

Cr. hr: 2(1+1)

Theory

Green house technology: Introduction, Types of Green Houses; Plant response to Green house environment, Planning and design of greenhouses, Design criteria of green house for cooling and heating purposes. Green house equipments, materials of construction for traditional and low cost green houses, Naturally ventilated solar greenhouse, high-tech greenhouse, concept and construction of low tunnel greenhouse, use of shade net house in protected cultivation. Irrigation systems used in greenhouses, typical applications, passive solar green house, hot air green house heating systems, green house drying. Cost estimation and economic analysis.

Important Engineering properties such as physical, thermal and aero & hydrodynamic properties of cereals, pulses and oilseed, their application in PHT equipment design and operation. Concept of cleaning and grading. Drying and dehydration; moisture measurement, EMC, drying theory, various drying method, commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, recirculatory dryer and solar dryer). Material handling equipment; conveyer and elevators, their principle, working and selection.

Practical

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

Text / Reference Books:

1. Elements of Agricultural Engineering - J. Sahay, Prentice Hall India (1990)
2. Principles of Agriculturl Processing - P. H. Pandey, Orient longman India (1990)
3. Post Harvest Technology of Cereals, Pulses and Oilseeds - A. Chakravorty, FAO (1990)

XIV. FORESTRY

1. Title: Introduction to Forestry (New)

Course No: FO - 111

Cr. hr: 2(1+1)

Theory

Introduction – definitions of basic terms related to forestry, objectives of silviculture, forest classification, salient features of Indian Forest Policies. Forest regeneration, Natural regeneration - natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers; Artificial regeneration – objectives, choice between natural and artificial regeneration, essential preliminary considerations. Crown classification. Tending operations – weeding, cleaning, thinning – mechanical, ordinary, crown and advance thinning. Forest mensuration – objectives, diameter measurement, instruments used in diameter measurement; Non instrumental methods of height measurement - shadow and single pole method; Instrumental methods of height measurement - geometric and trigonometric principles, instruments used in height measurement; tree stem form, form factor, form quotient, measurement of volume of felled and standing trees, age determination of trees. Agroforestry – definitions, importance, criteria of selection of trees in agroforestry, different agroforestry systems prevalent in the country, shifting cultivation, taungya, alley cropping, wind breaks and shelter belts, home gardens. Cultivation practices of two important fast growing tree species of the region (Acacia & Bamboo).

Practical

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

Text / Reference Books:

1. Principles and Practices of Silviculture - S. Khanna, Sanskrit Press, Kolkata (1995)
2. A Text book of Silviculture - P. Dwivedi, International Book, Dehradun (1995)
3. Text book of Agro-forestry - S. Chundawat and S. K. Goutam, Kalyani Publishers, Delhi (1980)

2. Title: Environmental Studies and Disaster Management

Course No: FO - 222

Cr. hr: 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) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, 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 sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, 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.

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

Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Environmental Pollution: definition, cause, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.

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

Disaster management

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

Disaster Management- Effect to mitigate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

Practical

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

Text/ Reference Books:

1. Perspective of Environmental Sciences - Kaushik & Kaushik, Agrobios, Delhi (1992)
2. Air Environment and Pollution - S. S. Purohit, New Age Publishers, Delhi (1990)
3. Water Pollution Causes, Effects and Control - P. K. Goel, Agrobios Publisher, Delhi (1991)
4. Biodiversity and Forest Genetic Resource - D. N. Tiwari, Oxford Publishers, Delhi (1990)
5. Environmental Engineering - G. Kiely, Pearson India Ltd. (1990)
6. Environmental Engineering - B. K Nanda and T. Biswal, Oxford Publishers, Delhi (1990)

XV. ANIMAL SCIENCE

1. Title: Livestock & Poultry Management

Course No: LPM - 321

Cr. hr: 4(3+1)

Theory

Role of livestock in the national economy. Reproduction in farm animals and poultry. Housing principles, space requirements for different species of livestock and poultry. Management of calves, growing heifers and milch animals. Management of sheep, goat and swine. Incubation, hatching and brooding. Management of growers and layers.

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

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

Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and poultry.

Practical

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

Text / Reference Books:

1. A Text Book of animal Husbandry VIII ed. - G. C. Banerjee, Oxford and IBH Publications, New Delhi (2011)
2. Hand Book of Animal Husbandry –DIPA, ICAR, New Delhi (2011)
3. Animal Nutrition and Feeding Practices - S. K. Ranjan, Vikash Publication, New Delhi (1994)
4. Poultry Production - R. A. Singh, Kalyani Publications, New Delhi (1985)
5. Outlines of Dairy Technology - Sukumar Dey, Oxford University Press, New Delhi (2000)
6. Farm Animal Management and Poultry Production - Thomas C. K. Sastry, NSR and R. A. Singh, Vikash Publishing House (1982)

XVI. ELECTIVES

GROUP - I

1. Title: Agrochemicals

Course No: AC (E) - 221

Cr. hr: 3(2+1)

Theory

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

Herbicides-Major classes, properties and important herbicides. Fate of herbicides.

Fungicides - Classification – Inorganic fungicides - characteristics, preparation and use of sulfur and copper, Mode of action-Bordeaux mixture and copper oxy chloride.

Organic fungicides-Mode of action-Dithio carbamates-characteristics, preparation and use of Zineb and maneb.

Systemic fungicides-Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use. Introduction and classification of insecticides: inorganic and organic insecticides Organo-chlorine, Organo-phosphates, Carbamates, Synthetic pyrethroids Neo-nicotinoids, Biorationals, Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, Fate of insecticides in soil & plant. IGRs Bio pesticides, Reduced risk insecticides, Botanicals, plant and animal systemic insecticides their characteristics and uses.

Fertilizers and their importance: Nitrogenous fertilizers: Feed stocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate.

Mixed and complex fertilizers: Sources and compatibility–preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitro phosphates and NPK complexes. Fertilizer control order. Fertilizer logistics and marketing.

Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

Practical

Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances. Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer. Calculation of doses of insecticides to be used. To study and identify various formulations of insecticide available in market. Estimation of nitrogen in Urea. Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate. Estimation of potassium in Muriate of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of

sulphur content in sulphur fungicide. Determination of thiram. Determination of ziram content.

Text / Reference Books:

1. Essentials of Agricultural Entomology - G. S. Dhaliwal, R. Singh & B. S. Chhillar, Kalyani Publication (2006)
2. Hand Book of Pesticides - W. T. Hayes & E. T. Laws, Academic Press (1991)
3. Toxicology of Insecticides - F. Matsumura, Plenum Publication (1985)
4. Role of Plant Quarantine in IPM - K. Rajeev & R. C. Mukherjee, Aditya Books (1996)

2. Title: Hi-tech. Horticulture

Course No: HORT (E) - 221

Cr. hr: 3(2+1)

Theory

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

Practical

Types of playhouses 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.

Text / Reference Books:

1. Introductory Ornamental Horticulture – J. S. Arora, Kalyani Publishers, Delhi (2006)
2. Advances in Ornamental Horticulture, Vols. I-VI - S. K. Bhattacharjee, Pointer Publication (2006)
3. Commercial Flowers - T. K. Bose and L. P. Yadav, , Naya Prakash (1989):
4. Floriculture and Landscapin – T. K. Bose, R. G. Maiti, R. S. Dhua and P. Das, Naya Prakash (1999)
5. Ornamental Horticulture in India - K. L. Chadhe and B. Chaudhury, ICAR (1992)
6. High-tech Floriculture – S. Reddy, B. Janakiram, T. Balaji, S. Kulkarni and R. L. Mishra, Indian Society of Ornamental Horticulture, New Delhi (2007)

3. Title: Water Management and Micro Irrigation

Course No: AG (E) - 221

Cr. hr: 3(2+1)

Theory

Irrigation: definition and objectives, water resources and irrigation development in India and Orissa; Soil plant water relationships; Methods of soil moisture estimation, soil water movement, evapotranspiration and crop water requirement; effective rainfall, scheduling of irrigation; Methods of irrigation: surface and subsurface, Micro irrigation, sprinkler and drip irrigation; Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management. Water management of different crops (rice, wheat, maize, groundnut, sun flower, mustard, pulses, sugarcane, cotton, potato, mango, banana and tomato); Agricultural drainage, Agricultural drainage Onfarm water management, water trading .

Practical:

Determination of particle & bulk density; Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter; Determination of field capacity by field method; Determination of permanent wilting point; Measurement of irrigation water through flumes and weirs; Calculation of irrigation water requirement (Problems); Determination of infiltration rate; Demonstration of furrow method of irrigation; Demonstration of check basin and basin method of irrigation; Visit to farmers field and cost estimation of drip irrigation system; Demonstration of filter cleaning, fertigation, injection and flushing of laterals; Erection and operation of sprinkler irrigation system; Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability; Determination of EC, pH, carbonates, bicarbonates, Ca⁺⁺ and Mg⁺⁺ in irrigation water (quality parameters)

Text/Reference Book:

1. Irrigation Principles and Practices - O.W. Israelsen and V.E. Hansen
2. Irrigation and Drainage - D. Lenka
3. Irrigation, Theory and Practices - A. M. Michael
4. Water Management in Crops - WTC, IARI Manual
5. Efficient Use of Irrigation Water – G. H. Sankara Reddy & Yellamananda Reddy
6. Agricultural Drainage: Principles and Practices – U.S. Kadam
7. Micro-Irrigation for Cash Crops – M.L. Choudhary
8. Handbook on Pressurized Irrigation Techniques – A. Phocaides (FAO)
9. Manual on Irrigation and Agronomy – R. R. Mishra & M. Ahmad.
10. Irrigation Water Management: Principles and practices - D. K. Majumdar
11. Irrigation Agronomy - S. R. Reddy
12. Manual on Water management - Dept. of Agronomy, OUAT, Bhubaneswar

4. Title: Commercial Plant Breeding

Course No: PBG (E) - 221

Cr. hr: 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 purity 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 and cultivars: haploid inducer, tissue culture techniques and biotechnological tools. IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FR Act. Variety testing, release and notification systems in India. Principles and techniques of seed production, types of seeds, quality testing in self and cross pollinated crops.

Practical

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

Text / Reference Books:

1. Principles of Plant Breeding - R. W. Alard, John Willey & Sons, New York (2000)
2. Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches - G. S. Chahal, and S. S. Ghosal, Narosa Publishing House, New Delhi (2002)
3. Plant Breeding - B. D. Singh, Kalyani Publishers, New Delhi (2005)
4. Essentials of Plant Breeding- Principles and Methods – P. Singh, Kalyani Publishers, New Delhi (2001)

GROUP - II**1. Title: Landscaping****Course No: HORT (E) - 312****Cr. hr: 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.

Practical

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

Text / Reference Books:

1. Floriculture and Landscaping - T. K. Bose, R. G. Maiti, R. S. Dhua & P. Das, Naya Prakash (1999)
2. Design Elements of Landscape Gardening - K. M. P. Nambisan, Oxford & IBH (1992)
3. Floriculture: Fundamentals and Practices – A. Lauria & H. R. Victor, Agrobios (2001)

2. Title: Biopesticides & Biofertilizers**Course No: AC (E) - 312****Cr. hr: 3(2+1)****Theory**

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

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

Practical

To study about mass production technology of important biopesticides. Identification of important botanicals. Visit to biopesticide lab. working 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 inoculums production of biofertilizers. Isolation of AM fungi -Wet sieving method and sucrose gradient method. Mass production of AM inoculants.

Text / Reference Books:

1. Biological control by Natural enemies - P. De Bach, Cambridge University Press (1974)
2. Critical Issues in Biological Control - Manfred Mackaur, Laster E. Ehler and Jens Roland, Intercept Ltd. (1990)
3. Technology for Mass Production of Natural Enemies - Project Directorate of Biological Control, Technical Bulletin (1994)
4. Microbial control of crop pests - R. J. Ravindra, J. S. Kennedy, N. Sathaiah, B. Rajasekharan, and M. R. Srinivasan, TNAU (2001)
5. Integrated Pest Management: Concepts and Approaches – G. S. Dhaliwal & R. Arora, Kalyani Publication, New Delhi (2001)
6. Biopesticides and Pest Management – G. S. Dhaliwal, and O. Koul, Kalyani Publication, New Delhi (2007)
7. Biofertilizers: Technology, Marketing and usage - M. R. Motsara, P. Bhattacharyya, Beena Srivastava, Fertilizer Development and Consultation Organization, New Delhi (1995)

3. Title: Weed Management

Course No: AG (E) - 312

Cr. hr: 3(2+1)

Theory

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

Practical

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

Text/Reference Books:

1. Weed Management - V. N. Saraswat, V. M. Bhan, and N. T. Yaduraju, ICAR, New-Delhi (2003)
2. Weed Management: Principles and Practices - O. P. Gupta, Agribios (India), Jodhpur (2005)
3. Weed Management in Horticultural crops - K. G. Shanmugavelu, R. Aravindan, and A. Rajagopal, Agrobios (India). Jodhpur (2004)
4. Modern Weed Management - O. P. Gupta, Agrobios (India), Jodhpur (2008)
5. Weed Science: Basics and Applications - T. K. Das, Jain Brothers, New-Delhi (2008)

4. Title: Micro propagation Technologies

Course No: ABT (E) - 311

Cr. hr: 3(2+1)

Theory

Meaning and concept of *in vitro* culture and micro-propagation; Historical milestones, advancement and future prospects of micro-propagation; totipotency, dedifferentiation; Tissue culture methodology: Sterile techniques, synthetic and natural media components, growth regulators, environmental requirement, genetic control of regeneration; Plant regeneration pathways - Organogenesis and Somatic embryogenesis;

Micro-propagation- Definition, methods, stages of micro-propagation and its significance; Axillary bud proliferation approach- Shoot tip and meristem culture; Organogenesis- Purpose, methods and requirements for organogenesis, indirect and direct organogenesis; Somatic embryogenesis- Procedures and requirements for organogenesis, indirect and direct

embryogenesis; Differences between somatic and gametic embryogenesis, Synthetic seed- Concepts, necessity, procedure and requirements for production of synthetic seeds.

Practical

Laboratory organization, sterilization techniques for explants, glassware, plastic wares, lab wares and working platform. Preparation of stocks and working solution. Preparation and sterilization of growth regulators. Preparation of working medium and experimentation on determining optimum concentration of growth regulators. Callus induction and regeneration of whole plants from different parts of plants. Direct regeneration into whole plants using bud, node and other tissues. Induction of somatic embryos. Experiments of synthetic seeds production and testing storability and germination efficiency.

Text / Reference Books:

1. Introduction to Plant Biotechnology - H. S. Chawala, Oxford & IBH (2000)
2. Elements of Biotechnology - P. K. Gupta, Rastogi Publications, Meerut (2008)
3. Plant Biotechnology, in vitro principles, Techniques and Applications – M. S. Shekhawat, MJP Publishers, Chennai (2011)
4. Hand book of Plant Tissue Culture - A. F. Mascarenhas, , ICAR (2008)

GROUP - III

1. Title: Protected Cultivation

Course No: HORT (E) - 323

Cr. hr: 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, liliun, tulip, tomato, bell pepper, cucumber, strawberry, pot plants, etc. Cultivation of economically important medicinal and aromatic plants. Off-season production of flowers and vegetables. Insect pest and disease management.

Practical

Raising of seedlings and saplings under protected conditions, use of protrays 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 ad misting.

Text / Reference Books:

1. Proceedings of All India Seminar on Potential and Prospects for Protective Cultivation - Anonymous, Organized by Institute of Engineers, Ahmednager (2003)

2. Cultivating Vegetables in Green House – S. Chandra and V. Som, Indian Horticulture 45:17-18. (2000)
3. Greenhouse Management for Horticultural Crops – S. Prasad and U. Kumar, Agrobios (2005)
4. Green House Technology for Controlled Environment – G. N. Tiwari, Narosa Publication House (2003)

2. Title: Soil, Plant, Water and Seed Testing

Course No: AC (E) - 323

Cr. hr: 3(2+1)

Theory

Principle of pH meter, EC meter, spectrophotometer, flame photometer and AAS.

Soil analysis: Objectives, sampling of soil, procedure and precautions. Determination of texture, bulk density. Interpretation of analytical data viz., pH, EC, organic carbon, N, P, K, S and micronutrients (Fe, Mn, Zn, Cu, B) and nutrient index.

Plant analysis: Sampling stages and plant part to be sampled. Analysis of nutrients, Quantitative rating of plant analysis data and interpretation of results, critical nutrient concentration, critical nutrient ranges.

Water analysis: Quality criteria, classification and suitability of irrigation water and water quality index.

Seed: Introduction, definition and importance, seed germination, viability, vigor and storage.

Use of soil testing kit for major and micronutrient analyzer.

Practical

Standardization of solutions and reagents, collection and preparation of soil samples, estimation of pH, EC, organic carbon, NPKS, micronutrients, CEC and exchangeable sodium in soil. Determination of EC and pH of saturation extract/paste. Estimation of cations and anions. Plant sampling and sample preparation for analysis, digestion of plant material and estimation of N, P, K in plant. Rapid plant tissue test for N, P, and K. Determination of EC, pH, cations (Ca^{++} , Mg^{++} , Na^+ , K^+) and anions (B , CO_3^- , HCO_3^- , Cl^-) in irrigation water . Computation of SAR and RSC. Seed quality testing: Germination, viability, moisture and vigor.

Suggested Text book / Reference books:

1. Soil Chemical Analysis – M. L. Jackson, Prentice Hall of India Pvt. Ltd. New Delhi (1973)
2. Soil and Plant Analysis – C. S. Piper, Scientific Publishers, India (2010)
3. Methods of Soil Analysis, Part-2 – A. L. Page, R. H. Miller and R. Keeney, American Society of Agronomy and Soil Science, Society of America Publication, Madison, Wisconsin, USA (1982)
4. Analytical Agricultural Chemistry – S. I. Chopra and J. S. Kanwar, Kalyani Publishers (2014)
5. Seed Technology - R. L. Agarwal, Oxford & IBH Co. Pvt. Ltd., New Delhi (1997)

6. Seed Science and Technology – N. C. Singhal, Kalyani Publishers (2016)
7. Techniques in Seed Science and Technology – P. K. Agrawal & M. Dadlani, South Asian Publ (1992)
8. Handbook of Seed Testing – P. K. Agrawal, Ministry of Agriculture, GOI, New Delhi (1993)

3. Title: Agricultural Waste Management

Course No: AG (E) - 323

Cr. hr: 3(2+1)

Theory

Introduction to agricultural waste management, Nature and characteristics of agricultural waste and their impact on the environment, Kinds of wastes, Classification, role of soil and plants in waste management, sources of waste, impact of waste on soil and plant quality, Biological processes of waste management, Utilization and Recycling of Agricultural waste, Potential of Recyclable Crop Residues and its management, In-situ management of agriculture waste, Composting and Vermicomposting for bio conservation of biodegradable waste, Biogas Technology, Agricultural waste and water, air and animal resources, Impacts of waste on human, animal health and environment. Management of bedding & litter, wasted feed, run-off from feed lots and holding areas and waste water from dairy parlors, agro-waste recycling through farming system, waste management machineries, environmental benefit of waste management.

Practical

Collection and preparation agricultural waste sample. Determination of pH, EC, CECe, heavy metals, BOD, COD, TSS, TDS, NH₄, Total P, and dissolved reactive P. Nutrient status (N, P, K, secondary and micronutrients) analysis of agricultural waste. Waste management equipment operation, Maintenance and safety hazards, computer software and models. Survey of different agri waste from live stock, dairy, poultry, food processing, fruit & vegetable and agri-chemicals, Preparation of compost, Vermicomposting, biogas and analysis of compost.

Text/Reference books

1. Agricultural Waste Management: Problems, Processes, and Approaches - Raymond C. Loehr
2. Sustainable Technologies for the Management of Agricultural Wastes - Zainul Akma Zakaria.

4. Title: Agri-business Management

Course No: ABM (E) - 321

Cr. hr: 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, procedures 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.

Practical

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

Text / Reference Books:

1. Principles and practice of Marketing in India - C. B. Mamoria and Joshi, Kitab Mahal, India (2003)
2. Agricultural finance and Management - S. Subba Reddy and P. Raghu Ram, Vijay Nocole (1996)
3. Indian Agriculture & Agri-Business Management - S. Diwase, Scientific Publisher India (2014)
4. A Textbook of Agri-Business Management - Sanket S. Kadam, Universal Prakashan, Pune, India (2016)
5. Agri-Business Management - Yashasvi R Rajpara, Pragun Publication, India (2012)

XVII. LANGUAGE

1. Title: Comprehension and Communication Skills in English

Course No: SE - 111

Cr. hr: 2(1+1)

Theory

War Minus Shooting- The sporting Spirit. A Dilemma- A layman looks at science Raymond B. Fosdick. You and Your English – Spoken English and broken English G.B. Shaw.

Reading Comprehension, Vocabulary- Antonym, Synonym, Homophones, Homonyms, often confused words. Exercises to Help the students in the enrichment of vocabulary based on TOEFL and other competitive examinations. Functional grammar: Articles, Prepositions, Verb, Subject verb Agreement, Transformation, Synthesis, Direct and Indirect Narration. Written Skills: Paragraph writing, Precise writing, Report writing and Proposal writing. The Style: Importance of professional writing. Preparation of Curriculum Vitae and Job applications. Synopsis Writing. Interviews: kinds, Importance and process.

Practical

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

Text / Reference Books:

1. Handbook of Reading Research - P. David Pearson, Routledge (2016)
2. Improving Vocabulary Skills - Sherrie L Nist, Townsend Press (2009)
3. Writing Skills - Judith F Olson, Goodwill Publishing House (2013)
4. Introducing Functional Grammar - Geolf Thompson, Routledge (2013)
5. An Introduction to Functional Grammar - M.A.K. Halliday, Hodder Arnold (1985)
6. Functional English Grammar - Graham Lock, Cambridge University Press (1995)

XVIII. REMEDIAL COURSES

1. Title: Agriculture Heritage (New Course)

Course No: AG- 112

Cr hr: 1(1+0)

Theory

Introduction of Indian agricultural heritage, status of farmers in society; advice by sages to kings on their duties towards farmers, soil management in ancient, medieval & pre-modern India and its relevance in modern day sustainable agriculture, heritage of crop & water management, plant growth and development & plant protection through vrikshayurveda and traditional knowledge. Heritage of medicinal plants and their relevance today, seed health in ancient & medieval history and its relevance to present day agriculture, description of Indian civilization and agriculture by travelers from China, Europe and United States, our journey in agriculture, green revolution and its impact and concerns, vision for the future.

Text / Reference Books:

1. Kashyapriya Krishisukti (Atreatiseon Agriculture by Kashyapa), agri History Bulletin No: 4. Tr. - S. M. Ayachit, Asian Agri. History foundation, Secunderabad. (2002)
2. Ancient and Medieval History of Indian Agriculture and its relevance to Sustainable Agriculture in the 21 Century - S.L. Choudhary, G. S. Sharma, and Y. L. Nene, Proceedings of the summer school held from 28 May to 27 June 1999, Rajasthan College of Agriculture, Udaipur, India (2000)
3. Agricultural Heritage of India - Y.L. Nene and S. L. Choudhary, Asian Agri., History Foundation, Secunderabad (2002)
4. A History of Agriculture in India - M. S. Randhawa, Vol. I, II, III and IV, Indian Council of Agricultural Research, New Delhi (1980-86)
5. Agriculture in Ancient India - S. P. Raychaudhuri, Indian Council of Agricultural Research, New Delhi (1964)
6. Muskha Dar Fauni-Falahat (The art of Agriculture) - Razia Akbar, Agri-History Bulletin No.3. Asian-Agri-History Foundation, Secunderabad (2000)
7. Surapala's Vrikshayurveda (The science of plant life) - Sadhale Nalini, Asian. History Bulletin No.1. Asian-Agri-History Foundation, Secunderabad (1996)
8. Krishi-Parashara (Agriculture by prashara) - Sadhale Nalini, Agri-History Bulletin No.2. Asian Agri-History Foundation, Secunderabad, India (1999)

2. Title: Introductory Biology (New)

Course No: BB - 111

Cr. hr: 2(1+1)

Theory

Introduction to the living world, diversity and characteristics of life, origin of life, Evolution and Eugenics. Binomial nomenclature and classification Cell and cell division. Morphology of flowering plants. Seed and seed germination. Plant systematic- viz; Brassicaceae, Fabaceae and Poaceae. Role of animals in agriculture.

Practical

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

3. Title: Elementary Mathematics (New)**Course No: EM - 111****Cr. hr: 2(2+0)****Theory**

Straight lines : Distance formula, section formula (internal and external division), Change of axes (only origin changed), Equation of co-ordinate axes, Equation of lines parallel to axes, Slope-intercept form of equation of line, Slope-point form of equation of line, Two point form of equation of line, Intercept form of equation of line, Normal form of equation of line, General form of equation of line, Point of intersection of two st. lines, Angles between two st. lines, Parallel lines, Perpendicular lines, Angle of bisectors between two lines, Area of triangle and quadrilateral. Circle: Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points (x_1, y_1) & (x_2, y_2) , Tangent and Normal to a given circle at given point (Simple problems), Condition of tangency of a line $y = mx + c$ to the given circle $x^2 + y^2 = a^2$. Differential Calculus : Definition of function, limit and continuity, Simple problems on limit, Simple problems on continuity, Differentiation of x^n , e^x , $\sin x$ & $\cos x$ from first principle, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it), Differentiation by substitution method and simple problems based on it, Differentiation of Inverse Trigonometric functions. Maxima and Minima of the functions of the form $y=f(x)$ (Simple problems based on it).

Integral Calculus : Integration of simple functions, Integration of Product of two functions, Integration by substitution method, Definite Integral (simple problems based on it), Area under simple well-known curves (simple problems based on it).

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

XIX. NON-GRADIAL COURSES

1. Title: Human Value and Ethics

Course No: EE - 122

Cr. hr: 1(1+0)

Theory

Values and Ethics-An Introduction. Goal and Mission of Life. Vision of Life. Principles and Philosophy. Self Exploration. Self Awareness. Self Satisfaction. Decision Making. Motivation. Sensitivity. Success. Selfless Service. Case Study of Ethical Lives. Positive Spirit. Body, Mind and Soul. Attachment and Detachment. Spirituality Quotient. Examination.

Text / Reference Books:

1. A foundation Course in Human Values and Professional Ethics - R. R. Gaur, R. Sangal, G. P. Bagaria, Excel Books Private limited, New Delhi (2009)
2. Teacher's Manual, A foundation Course in Human Values and Professional Ethics - R. R. Gaur, R. Sangal, G. P. Bagaria, Excel Books Private limited, New Delhi (2009)
3. Human Values - A. N. Tripathy, New Age International Publishers (2003)
4. Small is Beautiful: A study of economics as if people mattered - E. F. Schumacher, Blond & Briggs, Britain (1973)
5. How to practice Natural Farming - Subhas Paleker, Pracheen (Vaidik) Krishi Tantra Sodh, Amaravati (2000)
6. How the other half dies - Sussan George, Penguin Press (1986)
7. Foundations of Ethics and Management - P. B. Banerjee, Excel Books Pvt. Ltd., New Delhi (2005)
8. Fundamentals of Ethics of Scientists and Engineers - E. G. Seebauer & Robert L. Berry, Oxford University Press (2000)

2. Title: NSS/NCC/Physical Education & Yoga Practices

Course No: NSS/NCC/PE - 111

Cr. hr: 2(0+2)

Theory

Course aims at evoking social consciousness among students through various activities viz., working together, constructive and creative social work, to be skilful in executing democratic leadership, developing skill in programme development to be able for self employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society.

Following activities are to be taken up under the NSS course:

- Introduction and basic components of NSS: Orientation
- NSS programmes and activities

- Understanding youth
- Community mobilisation
- Social harmony and national integration
- Volunteerism and shramdan
- Citizenship, constitution and human rights
- Family and society
- Importance and role of youth leadership
- Life competencies
- Youth development programmes
- Health, hygiene and sanitation
- Youth health, lifestyle, HIV AIDS and first aid
- Youth and yoga
- Vocational skill development
- Issues related environment
- Disaster management
- Entrepreneurship development
- Formulation of production oriented project
- Documentation and data reporting
- Resource mobilization
- Additional life skills
- Activities directed by the Central and State Government

All the activities related to the National Service Scheme course is distributed under four different courses viz., National Service Scheme I, National Service Scheme II, National Service Scheme III and National Service Scheme IV each having one credit load. The entire four courses should be offered continuously for two years. A student enrolled in NSS course should put in at least 60 hours of social work in different activities in a semester other than five regular one day camp in a year and one special camp for duration of 7 days at any semester break period in the two year. Different activities will include orientation lectures and practical works. Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction.

Rural Agriculture Work Experience

*The minimum attendance for RAW E programme is 85%. Students shall complete the record work based on dally field observation notebooks and weekly diaries maintained by them. They will be evaluated by course coordinator as well as by a designated evaluation committee.

SN	Activities	No. of Weeks	Credit Hours
1	General Orientation & On campus training by different faculties	1	20 (0+20)
2	Village attachment	12	
3	Unit attachment in Univ. / College. KVK / Research Station Attachment	2	
4	Plant Clinic	1	
5	Agro-Industrial Attachment <ul style="list-style-type: none"> • The students would be attached with the agro-industries for a period of 3 weeks to get an experience of the industrial environment and working. 	3	
6	Project Report Preparation, Presentation and Evaluation	1	
TOTAL		20	

Experiential Learning Programme

Modules for skill development and Entrepreneurship: A student has to register 20 credits opting for two modules of (0+10) credits each (total 20 credits) from the package of modules in the VIII Semester.

Sl. No	Title of the Module	Credits
1	Bioagents and Biofertilizer Production	0+10
2	Seed Production and Technology	0+10
3	Mushroom Cultivation	0+10
4	Soil, Plant, Water and seed Testing Services	0+10
5	Beekeeping	0+10
6	Poultry Production	0+10
7	Applied Hi-Tech Horticulture	0+10
8	Agri-Business Management	0+10
9	Hybrid Seed Production Technologies	0+10
10	Floriculture and Landscaping	0+10
11	Commercial Vegetable Production	0+10
12	Tissue-Culture Technologies	0+10
13	Agriculture Waste Management	0+10
14	Organic Production Technology	0+10
15	Nursery Management	0+10
16	Practicing Protected Horticulture	0+10
TOTAL		0+20

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