

Course Curriculum

(As per V Dean's Committee Recommendations)



B.Sc. (Hons.) Agriculture



Sri Sri University

Sri SriVihar, Bidyadarpur Arilo, Ward No. 3, Cuttack 754 006, Odisha

The course curricula of B.Sc. (Hons.) Agriculture is as per the recommendations of 5th Dean's Committee Report, Indian Council of Agriculture Research (ICAR), New Delhi. The course curriculum is distributed in 8 semesters during 4 year's period.

Program outcome: Promotes student centric mentoring and imparting technical knowledge on agriculture and allied science. Besides, students are also exposed to yogic sciences, human values and ethics, spiritualism and experiential learning and internship in industries. Students after completion of the program should be able to i) Comprehend the interdisciplinary science of agriculture, forestry, animal science and allied scientific knowledge required to increase the income of farmers; ii) Comprehensively gain the knowledge on status of agriculture in India and income generating enterprises associated with farming activities; iii) Contribute to knowledge dissemination regarding various technique used in farming and farming system in India; and iv) Create platform for profitable enterprises to market agricultural produce.

Graduates have several career option to serve at various capacity viz., Agriculture officer, Farm or Plantation Manager, Agricultural Research Scientist, Agriculture Development Officers, Agriculture Technician, Practicing progressive agriculturists, Business Development Executive, Marketing Executive, professional in colleges and universities, Technical advisor in NGOs, Agricultural innovators and entrepreneurs.

Discipline-wise Courses

Course Code	Course Title	Credit Hours
Agronomy		
AGR 101	Fundamentals of Agronomy	4 (3+1)
AGR 102	Introductory Agro-meteorology & Climate change	2 (1+1)
AGR 103	Crop Production Technology – I (<i>Kharif</i> crops)	2 (1+1)
AGR 104	Crop Production Technology – II (<i>Rabi</i> crops)	2 (1+1)
AGR 105	Farming System & Sustainable Agriculture	1 (1+0)
AGR 106	Practical Crop Production - I (<i>Kharif</i> crops)	2 (0+2)
AGR 107	Practical Crop Production - II (<i>Rabi</i> crops)	2 (0+2)
AGR 108	Principles of Organic Farming	2 (1+1)
AGR 109	Geo-informatics and Nanotechnology and Precision Farming	2 (1+1)
AGR 110	Rainfed Agriculture and Watershed Management	2 (1+1)
Genetics and Plant Breeding		
GPB 101	Fundamentals of Genetics	3 (2+1)
GPB 102	Principles of Seed Technology	3 (1+2)
GPB 103	Fundamentals of Plant Breeding	3 (2+1)
GPB 104	Crop Improvement-I (<i>Kharif</i> crops)	2 (1+1)
GPB 105	Crop Improvement-II (<i>Rabi</i> crops)	2 (1+1)
Soil Science and Agricultural Chemistry		
SAC 101	Fundamentals of Soil Science	3 (2+1)
SAC 102	Manures, Fertilizers and Soil Fertility Management	3 (2+1)
SAC 103	Problematic soils and their Management	2 (2+0)

Entomology		
AET 101	Fundamentals of Entomology	4 (3+1)
AET 102	Pests of Crops and Stored Grain and their Management	3 (2+1)
AET 103	Management of Beneficial Insects	2 (1+1)
Agricultural Economics		
AEC 101	Fundamentals of Agricultural Economics	2 (2+0)
AEC 102	Agricultural Finance and Co-Operation	3 (2+1)
AEC 103	Agricultural Marketing Trade and Prices	3 (2+1)
AEC 104	Farm Management, Production and Resource Economics	2 (1+1)
Agricultural Engineering		
AEG 101	Soil and Water Conservation Engineering	2 (1+1)
AEG 102	Farm Machinery and Power	2 (1+1)
AEG 103	Renewable Energy and Green Technology	2 (1+1)
AEG 104	Protected Cultivation and Secondary Agriculture	2 (1+1)
Plant Pathology		
PLP 101	Fundamentals of Plant Pathology	4 (3+1)
PLP 102	Diseases of Field and Horticultural Crops and their Management-I	3 (2+1)
PLP 103	Diseases of Field and Horticultural Crops and their Management-II	3 (2+1)
PLP 104	Principles of Integrated Pest and Disease Management	3 (2+1)
Horticulture		
HRT 101	Fundamentals of Horticulture	2 (1+1)
HRT 102	Production Technology for Fruit and Plantation Crops	2 (1+1)
HRT 103	Production Technology for Vegetables and Spices	2 (1+1)
HRT 104	Production Technology for Ornamental Crops, MAP and Landscaping	2 (1+1)
HRT 105	Post-harvest Management and Value Addition of Fruits and Vegetables	2 (1+1)
Food Science and Technology		
FSN 101	Principles of Food Science and Nutrition	2 (2+0)
Agricultural Extension and Communication		
AEX 101	Fundamentals of Agricultural Extension Education	3 (2+1)
AEX 102	Rural Sociology & Educational Psychology	2 (2+0)
AEX 103	Communication Skills and Personality Development	2 (1+1)
AEX 104	Entrepreneurship Development and Business Communication	2 (1+1)
Biochemistry, Crop Physiology, Microbiology, Environmental Sciences		
PBB 101	Fundamentals of Plant Biochemistry and Biotechnology	3 (2+1)
FCP 102	Fundamentals of Crop Physiology	2 (1+1)
AMB 103	Agricultural Microbiology	2 (1+1)
ENS 104	Environmental Studies and Disaster Management	3 (2+1)
IFR 105	Introduction to Forestry	2 (1+1)
Statistics, Computer Application and IPR		
AST 101	Statistical Methods	2 (1+1)
AGI 102	Agri- Informatics	2 (1+1)
IPR 103	Intellectual Property Rights	1 (1+0)
Animal Production		

ASC 101	Livestock and poultry Management	4 (3+1)
Language		
ENG 101	Comprehension and Communication Skills in English	2 (1+1)
Remedial Courses		
AGH 101	Agricultural Heritage	1 (1+0)
IBL 101	Introductory Biology	2 (1+1)
EMT 101	Elementary Mathematics	2 (2+0)
Non-Gradial Courses		
PYE 101	Physical Education and Yoga Practices	2 (0+2)
HME 101	Human Values and Ethics	1 (1+0)
EST 101	Educational Tour	2 (0+2)

New Courses

Course code	Course Title	Credit Hours
AGR 109	Geo-informatics, Nanotechnology and Precision Farming	2 (1+1)
AGR 110	Rainfed Agriculture and Watershed Management	2 (1+1)
SAC 103	Problematic Soils and their Management	2 (2+0)
AEG 103	Renewable Energy and Green Technology	2 (1+1)
AET 103	Management of Beneficial Insects	2 (1+1)
HRT 101	Fundamentals of Horticulture	2 (1+1)
IFR 105	Introduction to forestry	2 (1+1)
AGI 102	Agri- Informatics	2 (1+1)
IPR 103	Intellectual Property Rights	1 (1+0)
FSN 101	Principles of Food Science and Technology	2 (2+0)
ENG 101	Communication Skills and Personality Development	2 (1+1)
PLP 104	Principles of Integrated Pest and Diseases Management	3 (2+1)
IBL 101	Introductory Biology	2 (1+1)*
EMT 101	Elementary Mathematics	2 (2+0)*
HME 101	Human Values and Ethics	1 (1+0)**
AGH 101	Agricultural Heritage	1 (1+0)**

* Remedial courses

** Non-gradial courses

Elective Courses: A student can select three elective courses out of the following and offered during 4th, 5th and 6th semesters.

Course Code	Courses	Credit Hours
ABM 201	Agribusiness Management	3 (2+1)
AGC 201	Agrochemicals	3 (2+1)
GPB 201	Commercial Plant Breeding	3 (1+2)
HRT 201	Landscaping	3 (2+1)
FSN 201	Food Safety and Standards	3 (2+1)
AMB 201	Bio-pesticides and Bio-fertilizers	3 (2+1)
HRT 203	Protected Cultivation	3 (2+1)

MPT 101	Micro propagation Technologies	3 (1+2)
HRT 301	Hi-tech Horticulture	3 (2+1)
AGR 201	Weed Management	3 (2+1)
SSA101	System Simulation and Agro-advisory	3 (2+1)
AGJ 101	Agricultural Journalism	3 (2+1)

Discipline-wise summary of credit hours

Group	Credits
Agronomy	21 (10+11)
Genetics & Plant Breeding	13 (7+6)
Soil Science & Agricultural Chemistry	8 (6+2)
Entomology	9 (6+3)
Agricultural Economics	10 (7+3)
Agricultural Engineering	8 (4+4)
Plant Pathology	13 (9+4)
Horticulture	10 (5+5)
Food Science	2 (2+0)
Agricultural Extension	9 (6+3)
Biochemistry/Physiology/Microbiology/Environmental Sciences	12 (7+5)
Statistics, Computer Application and IPR	5 (3+2)
Animal Production	4 (3+1)
English	2 (1+1)
Biology/Mathematics	2 (1+1)/2 (2+0)
Physical Education and Yoga Practices	2 (0+2)
Human Values and Ethics	1 (1+0)
Educational Tour	2 (0+2)
RAWE and Experiential Learning	20+20
Total Credits	184

Courses offered in each Semester

Semester- I		
HRT 101	Fundamentals of Horticulture	2 (1+1)
PBB 101	Fundamentals of Plant Biochemistry and Biotechnology	3 (2+1)
SAC 101	Fundamentals of Soil Science	3 (2+1)
IFR 105	Introduction to Forestry	2 (1+1)
ENG 101	Comprehension & Communication Skills in English	2 (1+1)
AGR 101	Fundamentals of Agronomy	4 (3+1)
IBL 101/ EMT 101	Introductory Biology/Elementary Mathematics*	2 (1+1)/2 (2+0)*
AGH 101	Agricultural Heritage	1 (1+0)*
AEX 102	Rural Sociology & Educational Psychology	2 (2+0)
HME 101	Human Values & Ethics	1 (1+0)**
PYE 101	Physical Education and Yoga Practices**	2 (0+2)**
Total		18+03*+03**
Semester- II		
GPB 101	Fundamentals of Genetics	3 (2+1)
AMB 103	Agricultural Microbiology	2 (1+1)
AEG 101	Soil and Water Conservation Engineering	2 (1+1)
FCP 102	Fundamentals of Crop Physiology	2 (1+1)
AEC 101	Fundamentals of Agricultural Economics	2 (2+0)
PLP 101	Fundamentals of Plant Pathology	4 (3+1)
AET 101	Fundamentals of Entomology	4 (3+1)
AEX 101	Fundamentals of Agricultural Extension Education	3 (2+1)
AEX 103	Communication Skills and Personality Development	2 (1+1)
Total		24 (16+8)
Semester- III		
AGR 103	Crop Production Technology– I (<i>Kharif Crops</i>)	2 (1+1)
GPB 103	Fundamentals of Plant Breeding	3 (2+1)
AEC 102	Agricultural Finance and Cooperation	3 (2+1)
AGI 102	Agri- Informatics	2 (1+1)
AEG 102	Farm Machinery and Power	2 (1+1)
HRT 103	Production Technology for Vegetables and Spices	2 (1+1)
ENS 104	Environmental Studies and Disaster Management	3 (2+1)
AST 101	Statistical Methods	2 (1+1)
ASC 101	Livestock and Poultry Management	4 (3+1)
Total		23 (14+9)
Semester- IV		
AGR 104	Crop Production Technology –II (<i>Rabi Crops</i>)	2 (1+1)
HRT 104	Production Technology for Ornamental Crops, MAP and Landscaping	2 (1+1)
AEG 103	Renewable Energy and Green Technology	2 (1+1)
SAC 103	Problematic Soils and their Management	2 (2+0)
HRT 102	Production Technology for Fruit and Plantation Crops	2 (1+1)
GPB 102	Principles of Seed Technology	3 (1+2)

AGR 105	Farming System & Sustainable Agriculture	1 (1+0)	
AEC 103	Agricultural Marketing Trade & Prices	3 (2+1)	
AGR 102	Introductory Agro-meteorology & Climate Change	2 (1+1)	
	Elective Course	3 (2+1)	
Total		19 (11+8) + 3	
Semester-V			
PLP 104	Principles of Integrated Pest and Disease Management	3 (2+1)	
SAC 102	Manures, Fertilizers and Soil Fertility Management	3 (2+1)	
AET 102	Pests of Crops and Stored Grain and their Management	3 (2+1)	
PLP 102	Diseases of Field and Horticultural Crops and their Management -I	3 (2+1)	
GPB 104	Crop Improvement-I (<i>Kharif Crops</i>)	2 (1+1)	
AEX 104	Entrepreneurship Development and Business Communication	2 (1+1)	
AGR 104	Geo-informatics and Nano-technology and Precision Farming	2 (1+1)	
AGR 106	Practical Crop Production – I (<i>Kharif crops</i>)	2 (0+2)	
IPR 103	Intellectual Property Rights	1 (1+0)	
	Elective Course	3 (2+1)	
EST 101	State Study Tour	2 (0+2)	
Total		21 (12+09) + 3	
Semester-VI			
AGR 110	Rainfed Agriculture & Watershed Management	2 (1+1)	
AEG 104	Protected Cultivation and Secondary Agriculture	2 (1+1)	
PLP 103	Diseases of Field and Horticultural Crops and their Management-II	3 (2+1)	
HRT 105	Post-harvest Management and Value Addition of Fruits and Vegetables	2 (1+1)	
AET 103	Management of Beneficial Insects	2 (1+1)	
GPB 105	Crop Improvement-II (<i>Rabi crops</i>)	2 (1+1)	
AGR 107	Practical Crop Production –II (<i>Rabi crops</i>)	2 (0+2)	
AGR 108	Principles of Organic Farming	2 (1+1)	
AEC 104	Farm Management, Production & Resource Economics	2 (1+1)	
FSN 101	Principles of food science and nutrition	2 (2+0)	
BSE 106	Bio-safety and Bio-ethics	1 (1+0)	
	Elective Course	3 (2+1)	
Total		21 (11 + 10) + 3	
Semester-VIII			
Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE and AIA)			
	Activities	No. of weeks	Credit Hours
RWE 401	General orientation & On campus training by different faculties	1	14
RWE 402	Village attachment	8	
RWE 403	Unit attachment in Univ./ College. KVK/Research Station Attachment	5	
RWE 404	Plant clinic	2	
RWE 405	Agro-Industrial Attachment	3	
RWE 406	Project Report Preparation, Presentation and Evaluation	1	
Total weeks for RAWE & AIA		20	

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

Educational tour will be conducted in break between IV & V Semester or VI & VII Semester

RAWE Component-I

Village Attachment Training Program

	Activity	Duration
1.	Orientation and Survey of Village	1 week
2.	Agronomical Interventions	1 week
3.	Plant Protection Interventions	1 week
4.	Soil Improvement Interventions (Soil sampling and testing)	1 week
5.	Fruit and Vegetable production interventions	1 week
6.	Food Processing and Storage interventions	1 week
7.	Animal Production Interventions	1 week
8.	Extension and Transfer of Technology activities	1 week

RAWE Component –II

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

Activities and Tasks during Agro-Industrial Attachment Program: Acquaintance with industry and staff, Study of structure, functioning, objective and mandates of the industry, study of various processing units and hands-on trainings under supervision of industry staff, ethics of industry, employment generated by the industry, contribution of the industry promoting environment, learning business network including outlets of the industry, Skill development in all crucial tasks of the industry, Documentation of the activities and task performed by the students, Performance evaluation, appraisal and ranking of students.

Semester-VIII

Modules for Skill Development and Entrepreneurship: A student has to register 20 credits opting for 2-modules of (0+10) credits each (20 credits) from the package of modules in the semester.

	Title of the module	Credits
PBB 401	Production Technology for Bio-agents and Bio-fertilizers	0+10
SPT 402	Seed Production and Technology	0+10
MCT 403	Mushroom Cultivation Technology	0+10
SPW 404	Soil, Plant, Water and Seed Testing	0+10
CBE 405	Commercial Beekeeping	0+10
PPT 406	Poultry Production Technology	0+10
CHR 407	Commercial Horticulture	0+10
FLC 408	Floriculture and Landscaping	0+10

FPR 409	Food Processing	0+10
AWM 410	Agriculture Waste Management	0+10
OPT 411	Organic Production Technology	0+10
CSE 412	Commercial Sericulture	0+10

NOTE

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

Evaluation of Experiential Learning Program/Hands On Training (HOT)

	Parameters	Max. Marks
1.	Project Planning and Writing	10
2.	Presentation	10
3.	Regularity	10
4.	Monthly Assessment	10
5.	Output delivery	10
6.	Technical Skill Development	10
7.	Entrepreneurship Skills	10
8.	Business networking skills	10
9.	Report Writing Skills	10
10.	Final Presentation	10
11.	Total	100

SYLLABUS

AGRONOMY

AGR-101 Fundamentals of Agronomy 4 (3+1)

Objective: Provide insights on basic theory, concepts and practices involved in crop cultivation.

Course outcome: Upon completion of the course students will be able to;

- Explain the several practices involved in field scale crop cultivation and management practices.
- Identify various crop seeds, plant types in their natural existence.
- Able to categorize crops grown in different agro-climatic conditions.
- Practice techniques involved in crop management.

Theory

Agronomy and its scope, seeds and sowing, tillage and tilling, 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, 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, study of agro-climatic zones of India, Identification of weeds in crops, Methods of herbicide and fertilizer application, Study of yield contributing characters and yield estimation, Seed germination and viability test, Numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill, Study of soil moisture measuring devices, Measurement of field capacity, bulk density and infiltration rate, Measurement of irrigation water.

Suggested Reading

Reddy, S.R. (2016). Principles of Agronomy. Kalyani Publishers, Ludhiana - 5th edition
Yellamanda Reddy, T. and Sankara Reddi, G.H. (2016). Principles of Agronomy. Kalyani Publishers, Ludhiana.
De, G.C. (1989). Fundamentals of Agronomy. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
Gupta, O.P. (2011). Modern weed management. Agrobios (India), Jodhpur.

AGR-102 Introductory Agro-meteorology and Climate Change 2 (1+1)

Objective: Provide basic knowledge about atmospheric phenomenon and their relation with crop production.

Course outcome: Upon completion of the course students will be able to;

- Understand about various atmospheric weather variables and their measurement.
- Explain how weather variables effect crop production.

- Explain climate change and their impact on agriculture.
- Emphasize the importance of weather forecasting in crop production.

Theory

Meaning and scope of agricultural meteorology; Earth atmosphere- its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo; 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 wind rose. Measurement, tabulation and analysis of rain. Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET.

Suggested Reading

Radhakrishnamurthy, V. (2002) Basic Principles of Agricultural meteorology. B.S Publications, Koti, Hyderabad.
 Radhakrishnamurthy, V. (2016). Principles and practices of agricultural disaster management. B.S Publications, Koti, Hyderabad.
 Reddy, S.R. (2014). Introduction to Agriculture and Agrometeorology. Kalyani Publishers, Ludhiana, Punjab.

AGR-103 Crop Production Technology-I (*Kharif*Crops) 2 (1+1)

Objective: Provide basic knowledge about production of kharif crops.

Course outcome: Upon completion of the course students will be able to;

- List the Kharif crops and know about the morphological characters of various kharif crops.
- Explain about soil and climatic requirements of different kharif crops.
- Describe the cultural practices associated with various kharif crops.
- Identify the yield contributing characters and calculation of yield.

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, pulses-pigeon pea, mungbean and urdbean; oilseeds- groundnut, and soybean; fibre crops- cotton & jute; forage crops-sorghum, cowpea, cluster bean and napier.

Practical

Rice nursery preparation, transplanting of rice, sowing of soybean, pigeon pea and mungbean. maize, groundnut and cotton, effect of seed size on germination and seedling vigour of *kharif* 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.

Suggested Reading

Rajendra Prasad. (2006).Text book of field crops production. ICAR, New Delhi.
Reddy, S.R. and Reddi Ramu. 5th edition. (2016). Agronomy of field crops. Kalyani publishers, Ludhiana.
Gururaj hunsigi and Krishna, K.R.(2007).Scientific field crop production. Oxford & IBH Publishing Co. Pvt. Ltd.
De Datta, S.K. (1981).Principles and practices of rice Production. John Wiley and Sons, New York
Singh, C., Singh, P and Singh, R. (2003). Modern techniques of raising field crops. Oxford & IBH Publishing house, New Delhi.
Panda, S.C. (2014). Agronomy of fodder and forage crops, Kalyani publishers, Ludhiana

AGR-104 Crop Production Technology-II (*Rabi* crops) 2 (1+1)

Objective: Provide basic knowledge about production of rabi crops.

Course outcome: Upon completion of the course students will be able to;

- Know about the morphological characters of various rabi crops.
- Explain about soil and climatic requirements of different rabi crops.
- Describe the cultural practices associated with various rabi crops
- Identify the yield contributing characters and calculation of yield.

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, peas, oilseeds-rape seed, mustard and sunflower; sugar crops-sugarcane; medicinal and aromatic crops-mentha, lemon grass and citronella, 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.

Suggested Reading

Rajendra Prasad.(2006) .Text book of field crops production. ICAR, New Delhi.
Reddy, S.R and Reddi Ramu. 5th edition.(2016). Agronomy of field crops. Kalyani publishers, Ludhiana.
Gururaj hunsigi and Krishna, K.R..(2007). Scientific field crop production. Oxford & IBH Publishing Co. Pvt. Ltd.
De Datta, S.K.(1981). Principles and practices of rice Production. John Wiley and Sons, New York
Singh, C., Singh, P and Singh, R. (2003) Modern techniques of raising field crops. Oxford & IBH Publishing house, New Delhi.
Panda S.C. (2014) Agronomy of fodder and forage crops, Kalyani publishers, Ludhiana.

AGR-105 Farming System and Sustainable Agriculture 1 (1+0)

Objective: Provide knowledge about integrated farming and other new concepts related to farming.

Course outcome: Upon completion of the course students will be able to;

- Explain farming systems suitable for various agro-climatic regions.
- Identify the tools required for determining the efficiency of various cropping and farming systems.
- Complementary use of on farm residues for improving resource use efficiency.
- Learn new concepts and types of farming.

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.

Suggested Reading

Arun K. Sharma. (2006) A hand book of organic farming - Agrobios (India) Jodhpur
Jayanthi C, Devasenapathy P and Vinnila, C. (2008) Farming systems principles and practice. Satish serial publishing house, Delhi
Panda S.C. (2011) Cropping and farming systems. Agrobios (India) Jodhpur.
Ruthenburg, H. (1980) Farming systems in the tropics. Oxford university press

AGR-106 Practical Crop Production-I (Kharif Crops) 2 (0+2)

Objective: Practical aspects of kharif crop production under field condition.

Course outcome: Upon completion of the course students will be able to;

- Calculate seed rate and learn about methods of sowing.
- Learn about various agrochemicals used in different kharif crops and their rate of application.
- Select irrigation practices and methods of harvesting of various kharif crops.

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.

Suggested Reading

Rajendra Prasad. (2006). Text book of field crops production. ICAR, New Delhi.
Reddy, S.R and Reddi Ramu. 5th edition. (2016). Agronomy of field crops. Kalyani publishers, Ludhiana.
Gururaj hunsigi and Krishna, K.R.(2007).Scientific field crop production. Oxford & IBH Publishing Co. Pvt. Ltd.
De Datta, S.K. (1981). Principles and practices of Rice Production. John Wiley and Sons, New York
Chidda Singh, Singh, P and Singh, R. (2003). Modern techniques of raising field crops. Oxford & IBH Publishing house, New Delhi.
Panda S.C. (2014). Agronomy of fodder and forage crops, Kalyani publishers, Ludhiana

AGR-107 Practical Crop Production-II (*Rabi Crops*) 2 (0+2)

Objective: Practical aspects of rabi crop production under field condition

Course outcome: Upon completion of the course students will be able to;

- Calculate seed rate and learn about methods of sowing.
- Learn about various agrochemicals used in different rabi crops and their rate of application.
- Select irrigation practices and methods of harvesting of various rabi crops.

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.

Suggested Reading

Rajendra Prasad. (2006) Text book of field crops production. ICAR, New Delhi.
Reddy, S.R and Reddi Ramu. 5th edition. (2016). Agronomy of field crops. Kalyani publishers, Ludhiana.
Gururaj hunsigi and Krishna, K.R.(2007).Scientific field crop production. Oxford & IBH Publishing Co. Pvt. Ltd.
De Datta, S.K. (1981).Principles and practices of rice Production. John Wiley and Sons, New York
Chidda Singh, Singh, P and Singh, R. (2003). Modern techniques of raising field crops. Oxford & IBH Publishing house, New Delhi.
Panda S.C. (2014). Agronomy of fodder and forage crops, Kalyani publishers, Ludhiana.

AGR-108 Principles of Organic Farming 2 (1 + 1)

Objective: To learn about principles and practices of organic farming.

Course outcome: Upon completion of the course students will be able to;

- Understand the fundamentals of nutrient use, insect, pest, disease and weed management under organic mode of

- production.
- Familiarize with organic certification process and standards of organic products set by various agencies.
- Identify agencies related with organic production practices in India.
- Understand the socio-economic status of farmers and environmental quality due to adoption of organic production practices.

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, vermin compost, bio-fertilizers/bio-inoculants and their quality analysis; Indigenous technology knowledge (ITK) for nutrient, insect, pest disease and weed management; Cost of organic production system; Post harvest management; Quality aspect, grading, packaging and handling.

Suggested Reading

Arun K. Sharma. (2002) .A Hand book of organic farming. Agrobios, India.
 Palaniappan, S.P and Annadurai, K. (1999).Organic farming-Theory and Practice. Scientific publishers, Jodhpur, India.
 Mukund Joshi and Prabhakarasetty, T.K. (2006). Sustainability through organic farming. Kalyani publishers, New Delhi.
 Balasubramanian, R., Balakishnan, K and Siva Subramanian, K. (2013). Principles and practices of organic farming. Satish Serial Publishing House.
 Tarafdar, J.C., Tripathi, K.P and Mahesh Kumar (2009). Organic agriculture. Scientific Publishers, India.
 Tiwari, V.N., Gupta, D.K., Maloo, S.R and Somani, L.L. (2010). Natural, organic, biological, ecological and biodynamic farming. Agrotech Publishing Academy, Udaipur.
 Dushyent Gehlot. (2005). Organic farming- standards, accreditation, certification and inspection. Agrobios, India.

AGR 109 Geo-informatics, Nano-technology and Precision Farming 2(1+1)

Objective: To learn about new technologies and how they are useful in farming.

Course outcome: Upon completion of the course students will be able to;

- Manage the fields according to site specific issues related to various aspects of crop production.
- Examine the utility of simulation Models for optimization of Agricultural Inputs.
- Gained knowledge on nanotechnology and their use in agriculture.

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; Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), components and its functions; Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs; STCR approach for precision agriculture; Nanotechnology, definition, concepts and techniques, brief introduction

about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors, Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity.

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 on VRT and STCR techniques. Crop stress (biotic/abiotic) monitoring using geospatial technology. Use of GPS for agricultural survey. Formulation, characterization and applications of nanoparticles in agriculture. Projects formulation and execution related to precision farming.

Suggested Reading

Pradeep. T. (2007). NANO: The Essentials: Understanding Nanoscience and Nanotechnology. Tata McGraw-Hill Publishing Company Limited, New Delhi
Lillesand, T.M. and Kiefer, R. W. (1994) Remote sensing and image interpretation. (3rd edition), John Wiley and Sons.
Anji Reddy, M. (2006). Text book of Remote sensing and Geographical Information Systems, (3rd edition), B.S. Publications, Hyderabad.

AGR-110 Rainfed Agriculture and Watershed Management 2 (1 + 1)

Objective: To learn about management of crops in rainfed areas.

Course outcome: Upon completion of the course students will be able to;

- Categorize the extent of rainfed area in India and their soil and climatic condition.
- Manage extreme weather conditions by contingent planning.
- Gained the skills to manage watersheds and various water harvesting techniques.
- Gained the knowledge suitable crop raising techniques for rainfed areas.

Theory

Rainfed agriculture: Introduction, types, History of rainfed agriculture and watershed in India; Problems and prospects of rainfed agriculture in India ; Soil and climatic conditions prevalent in rainfed areas; Soil and water conservation techniques, Drought: types, effect of water deficit on physio-morphological characteristics of the plants, Crop adaptation and mitigation to drought; 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 rainfed areas in the country and demarcation of rainfed area on map of India. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought period in the country, effective rainfall and its calculation. Studies on cultural practices for mitigating moisture stress. Characterization and delineation of model watershed. Field demonstration on soil & moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

Suggested Reading

Reddy, S. R and Prabhakar Reddy, G. (2015). Dryland Agriculture. Kalyani Publishers.
Arnon, I. (1972) Crop Production in Dry Regions (Vol. I), Leonard Hill Pub. Co, London.
Dhruva Narayana, V.V., Sastry, G.S. and Patnaiak, V.S. (1999) Watershed Management in India. ICAR, New Delhi.
Jeevananda Reddy, S. (2002) Dryland Agriculture in India: An agro-climatological and agro-meteorological perspective. B S publications.

GENETICS AND PLANT BREEDING

GPB- 101 Fundamentals of Genetics 3 (2+1)

Objective: To provide the concept of fundamental biology principles occurring inside the cell and its influence on character expression.

Outcome: Upon completion of the course students will be able to;

- Explain inheritance and expression of characters.
- Explain how variation occurs within living organisms.
- Acquainted with genetic terminology and its application.
- Gained the knowledge on the genetic principles behind the development of variety

Theory

Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity. Architecture of chromosome; chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; special types of chromosomes. Chromosomal theory of inheritance- cell cycle and cell division- mitosis and meiosis. Probability and Chi-square. Dominance relationships, Epistatic interactions with example.

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 and numerical variations in chromosome and their implications, Use of haploids, dihaploids and doubled haploids in Genetics. Mutation, classification, Methods of inducing mutations & CIB technique, mutagenic agents and induction of mutation. Qualitative & Quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, 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. Mitosis and Meiosis cell division. Experiments on monohybrid, dihybrid, trihybrid, test cross and back cross, Experiments on epistatic interactions including test cross and back cross, Practice on mitotic and meiotic cell division, Experiments on probability and Chi-square test. Determination of linkage and cross-over analysis (through two-point test cross and three-point test cross data). Study on sex linked inheritance in *Drosophila*. Study of models on DNA and RNA structures.

Suggested Reading

Pundhan Singh. (2006). Genetics. Kalyani Publishers, Ludhiana.
Singh, B.D. (2015). Fundamentals of Genetics. Kalyani Publishers, Ludhiana.
Gupta, P.K. (2007). Genetics. Rastogi Publications, Meerut.
Khanna, V.K. (2002) Genetics Numerical Problems. Kalyani publishers. 2nd edition.
Pundhan Singh. (2011). Genetics at a Glance. Kalyani Publishers, Ludhiana.

Verma, P.S and Agarwal, P.K. (2013) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Pvt. Ltd., Kolkata.
Snustad, D.P and Simmons, M.J. (2010) Principles of Genetics. 5th Ed. John Wiley & Sons, 111, River Street, Hoboken, NJ, U.S.A.
Strickberger, M.W. (2006) Genetics. Prentice- Hall of India Pvt. Ltd., New Delhi.

GPB-102 Principles of Seed Technology 3 (1+2)

Objective: Provide insights on basic theory, practices and technology involved in seed production of different crop.

Outcome: Upon completion of the course students will be able to;

- Explain about basic principles behind seed production.
- Know how different classes of seed are produced.
- Know how certified seed is produced by farmer.
- Acquired knowledge on different practices and processes for quality seed production.

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. Private and public sectors and their production and marketing strategies.

Practical

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

Suggested Reading

Agarwal, P.K. (1994) Principles of Seed technology. ICAR, New Delhi.
Agarwal, P.K and Dadlani, M. (1986) Techniques in Seed Science and Technology. South Asian Publishers, New Delhi.
Agarwal, R.L. (1995). Seed Technology. Oxford and IBH Publication Co., New Delhi.
Dhirendra Khare and Mohan S. Bhale. (2007). Seed Technology. Scientific Publishers (India), Jodhpur.
Thomson, J.R. (1979). An introduction of Seed Technology. Leonard Hill, London

GPB-103 Fundamentals of Plant Breeding 3 (2+1)

Objective: Provide insights on basic theory, genetic principles and methods applied for development of variety.

Outcome: Upon completion of the course students will be able to;

- Acquainted with floral biology of crop.
- Explain about basic principles of variety development.
- Know different methods applied in different crop for development of variety.

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-in compatibility and male sterility-genetic consequences, cultivar options. Domestication, Acclimatization and Introduction; Centres of origin/ diversity, components of Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self- pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept. Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross pollinated crops, modes of selection; Population improvement Schemes-Ear to row method, Modified Ear to Row, recurrent selection schemes; Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops, clonal selection and hybridization; Maintenance of breeding records and data collection; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding, mutation breeding-methods and uses; 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 experiments, analysis of Randomized Block Design. To work out the mode of pollination in a given crop and extent of natural out-crossing. Prediction of performance of double cross hybrids.

Suggested Reading

Phundan Singh. (2014). Essentials of Plant Breeding. Kalyani Publishers, New Delhi.
Singh, B.D. (2015). Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
Gupta, S.K. (2010). Plant Breeding Theory and Techniques. Wiley India Pvt. Ltd. New Delhi.
Allard, R.W. (2010). Principles of Plant Breeding. John Wiley and Sons, New York.
Poehlman, J.M and Borthakur, D. (1995). Breeding of Asian Field Crops. Oxford and IBH Publishing Co., New Delhi.
Sharma, J.R. (1994). Principles and Practice of Plant Breeding. Tata McGraw Hill, Publishing Company Ltd., New Delhi.

GPB-104 Crop Improvement – I (*Kharif*) 2 (1+1)

Objective: Provide insights on basic theory, practices and methods applied for improvement of field crop.

Outcome: Upon completion of the course students will be able to;

- Know about floral biology of different crops.
- Acquiring knowledge how different breeding method will be applied depending on nature of crop.
- Know commercial importance of field crop.

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

Practical

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

Suggested Reading

Allard, R.W. 1960. Principles of Plant Breeding. John Wiley & Sons, New York.
Phundan Singh. 2006. Essential of Plant Breeding. Kalyani Publishers, Ludhiana.
Poehlman, J.M and Borthakur, D. 1995. Breeding of Asian Field Crops. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
Sharma, J.R. 1994. Principles and Practices of Plant Breeding. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
Kalloo, G. 1994. Vegetable Breeding. Panima Educational Book Agency, New Delhi.
Kumar, N. 2006. Breeding of Horticultural Crops-Principles and Practices. New India Publishing Agency, New Delhi
George Acquaah. 2012. Principles of Plant Genetics and Breeding. Blackwell Publishing Ltd., USA 8. Mono graphs available on specific crops.

GPB-105 Crop Improvement – II (*Rabi*) 2 (1+1)

Objective: Provide insights on basic theory, practices and methods applied for development stress resistance variety.

Outcome: Upon completion of the course students will be able to;

- Able to know Plant Genetic Resources of different crops.
- Acquired knowledge on how fundamental mechanisms behind resistance and how this resistance transferred from wild to cultivated variety.

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; study of genetics of qualitative and quantitative characters; 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); Hybrid seed production technology of *rabi* crops. Ideotype concept and climate resilient crop varieties for future.

Practical

Floral biology, emasculation and hybridization techniques in different crop species namely Wheat, Oat, Barley, Chickpea, Lentil, Field pea, Rajma, Horse gram, Rapeseed Mustard, Sunflower, Safflower, Potato, Berseem. Sugarcane, Tomato, Chilli, Onion; 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

Suggested Reading

Allard, R.W. (1960). Principles of Plant Breeding. John Wiley & Sons, New York.
Phundan Singh. (2006). Essential of Plant Breeding. Kalyani Publishers, Ludhiana. 54
Poehlman, J.M and Borthakur, D. (1995). Breeding of Asian Field Crops. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
Sharma, J.R. (1994). Principles and Practice of Plant Breeding. Tata McGraw-Hill Publishing Co. Ltd., New Delhi. Kalloo, G. (1994). Vegetable Breeding. Panima Educational Book Agency, New Delhi.
Kumar, N. (2006). Breeding of Horticultural Crops - Principles and Practices. New India Publishing Agency, New Delhi.
George Acquaaah. (2012). Principles of Plant Genetics and Breeding. Blackwell Publishing Ltd., USA.

SOIL SCIENCE & AGRICULTURAL CHEMISTRY

SAC-101 Fundamentals of Soil Science 3 (2+1)

Objective: To acquaint with soil forming process, its properties- physical, chemical and biological, as a plant growth medium.

Course outcome: Upon completion of the course students will be able to;

- Explain the soil forming process to relate to the soil forming factors in various climatic conditions.
- List the physical properties and chemical properties that affect both plant growth and biological activity
- Explain soil as medium of plant growth, soil quality and soil health in relation to plant growth.

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 plantgrowth, Soil temperature; source, amount and flow of heat in soil; effect on plant growth, Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; 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 microorganisms, 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.

Suggested Reading

Indian Society of Soil Science. (2012). Fundamentals of Soil Science, IARI, New Delhi.
Das, D. K. (2015). Introductory Soil Science, 4th Edition, Kalyani Publishers, New Delhi
Sehgal, J. (2015). A Text Book of Pedology – Concepts and Applications, Kalyani Publishers, New Delhi.

SAC-102 Manures, Fertilizers and Soil Fertility Management 3 (2+1)

Objective: To provide detailed information on types of fertilizers of different chemical properties and their essential nutrient content and forms.

Course outcome: Upon completion of the course students will be able to;

- Explain the criteria of essentiality and available forms of nutrients in soils.
- List types of fertilizers and classify them in terms of nutrient source.
- Explain the factors affecting their transformation in soils and availability
- Use methods soil analysis for nutrient contents and fertilizer recommendations.
- Identify suitable fertilizer application methods and nutrient use efficiency.

Theory

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

Practical

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

Suggested Reading

Indian Society of Soil Science. (2012) (1995). Manures and Fertilisers. Agril. Publishing House, Nagpur
Samuel Tisdale, Nelson Werner L, Beaton James D and Havlin John L. 2005. Soil Fertility and Fertilizers: An Introduction to Nutrient Management, Macmillian Publishing Co., New York.
D. K. Das (2014). Introductory Soil Science. Kalyani Publishers, New Delhi

SAC-103 Problematic Soils and their Management (New) 2 (2+0)

Objective: To provide exposure to problematic soils and their distribution in relation their suitability for crop production.

Course outcome: Upon completion of the course students will be able to;

- Establish the natural distribution of problematic soils in the country and extent in an agro-climatic zones.

- Classify the problematic soils on the basis of their physical, chemical and biological properties that are not suitable for crop cultivation.
- Suggest suitable management practices to reclaim the problematic soils.

Theory

Soil quality and health, Distribution of Waste land and problem soils in India. 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 Agro-ecosystems.

Suggested Reading

Indian Society of Soil Science. (2012). Fundamentals of Soil Science, IARI, New Delhi.
 Das, D. K. (2015). Introductory Soil Science. 4th Edition, Kalyani publishers, New Delhi
 Soils of Andhra Pradesh, Monograph of I.V. Subbarao.

ENTOMOLOGY

AET-101 Fundamentals of Entomology 4 (3+1)

Objective: To provide basic knowledge on insect's morphology, taxonomy and pest control principles.

Course outcome: Upon completion of the course students will be able to;

- Know the morphology and physiology of a typical insect body.
- Acquaint with the basic principles of insect pest control.
- Gained insights on the insect taxonomy and classification of insects as economically beneficial and pests.

Part – I

History of Entomology in India. Major points related to dominance of Insecta in Animal kingdom. Classification of phylum Arthropoda into 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, secretory (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs like simple and compound eyes, chemoreceptor.

Part-II

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.

Part III

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

Part – IV

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, Saturniidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae. Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

Practical

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

Suggested Reading

- Chapman, R.F. (2013) *Insects: Structure and Function*. Ed by Simpson, S. J. and Douglas, A. C. Cambridge Univ. Press, UK.
- Richards, O.W. and Davies, R.G. (1977). *Imm's General Text Book of Entomology* (Vol. I and II). Chapman and Hall, London.
- Wigglesworth, V.B. (2013). *Insect Physiology*. Springer (Originally published by Chapman and Hall, London, 1974).
- Pant, N.C. and Ghai, S. (1988). *Insect Physiology and Anatomy*. ICAR, New Delhi.
- Kapoor, V.C. (2008). *Theory and Practice of Animal Taxonomy*. Oxford and IBH Publishing, New Delhi.
- Charles A Triplehorn and Norman F. (2005). *Borror and De Long's Introduction to the Study of Insects*. Johnson Thomson Brooks/Cole Publishing. U.S.A.
- Snodgrass, R.E. (2001). *Principles of Insect Morphology*. CBS Publishers & Distributors, Delhi.
- Timbhare, D.B. (2015). *Modern Entomology*, Himalaya Publishing House.

AET-102 Pests of Crops and Stored Grains and their Management 3 (2+1)

Objective: To gain knowledge about the insect pests of the cultivated crops and stored food products and their management practices.

Course outcome: Upon completion of the course students will be able to;

- Know about important insect and non-insect pests of field and horticultural crops and stored food materials and their management.
- Know integrated pest management tactics for important cultivated crops.

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 crop, vegetable crop, fruit crop, plantation crops, ornamental crops, spices and condiments. 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 Indian Storage Management and Research Institute, Hapur and Quality Laboratory, Department of Food., Delhi. Visit to nearest FCI godowns.

Suggested Reading

Vasantharaj David, B. and Rama Murthy V.V. (2016). Elements of Economic Entomology, Popular Book Depot, Coimbatore. 80
 Vasantharaj David, B and Aanathakrishnan, T.N. (2006). General and Applied Entomology. Tata McGraw-Hill Publishing House, New Delhi.
 Nair, M.R.G.K. (1986). Insects and Mites of crops in India. Indian Council of Agricultural Research New Delhi.
 Ramakrishna Ayyar, T.V. (1963). Handbook of Economic Entomology for South India. Government Press, Madras.
 Dennis S Hill (1987). Agricultural Insect Pests of tropics and their control, Cambridge Universtiy Press, New York
 Upadhyaya K.P. and Kusum Dwivedi. (1996). A Text Book of Plant Nematology. Aman Publishing House, Meerut.
 Khare, S.P. (1993). Stored Grain Pests and their Management. Kalyani Publishers, Ludhiana.
 Atwal, A.S. (1976). Agricultural Pests of India and South East Asia. Kalyani Publishers, Ludhiana.

AET 103 Management of Beneficial Insects 2(1+1)

Objective: To gain knowledge about rearing and management of beneficial insects.

Course outcome: Upon completion of the course students will be able to;

- Know the rearing of honeybees and developing an apiary.
- Know about the cultivation of lac culture and sericulture.
- Gained entrepreneurial abilities regarding apiculture, lac culture and sericulture.

Theory

Importance of beneficial Insects, Beekeeping and pollinators, 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. Role of pollinators in cross pollinated plants.

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. Identification of major parasitoids and predators commonly being used in biological control.

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

Practical

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

Suggested Reading

Chapman, R. F (2013) Insects: Structure and Function. Ed by Simpson, S. J. and Douglas, A. C. Cambridge Univ. Press, UK.

Richards, O.W. and Davies, R.G (1977). Imm's General Text Book of Entomology (Vol. I and II). Chapman and Hall, London.

AGRICULTURAL ECONOMICS

AEC 101 Fundamentals of Agricultural Economics 2 (2+0)

Objective: Expose students to basic principles of economics applicable in agricultural sector.

Course outcome: Upon completion of the course students will be able to:

- Develop ideas of the basic characteristics of Indian economy, its potential on natural resources, understanding agriculture as the foundation of economic growth and development.
- Understand factor of marketing, various types of investment analysis.
- Compute and assess real situation of economy and income pattern.
- Understand relationship between investment and savings.

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

diminishing marginal utility, equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Production: process, creation of utility, factors of production, input output relationship. *Laws of returns*: Law of variable proportions and law of returns to scale. *Cost*: concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, schedule, supply curve, determinants of supply, elasticity of supply. 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 program on population control. Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, supply, general price index, inflation and deflation. Banking: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy. 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.

Suggested Reading

Dewett, K.K. and Varma, J.D. (2003). Elementary Economic Theory. S. Chand and Co., New Delhi.
Dewett, K.K and Chand, A. (2009). Modern Economic Theory. S.Chand and Co., New Delhi.
Paul A. Samuelson and Nordhus. (2010). Economics. 19th Edition, Tata-Mc Graw Hill Education, New Delhi.
Jhingan, M.L. (1990). Advanced Economic Theory. Vikas Publishing House, New Delhi
Koutsoyiannis. (2015). Modern Microeconomics. Tata Mac-Graw Hill Publishers, New Delhi

AEC 102 Agricultural Finance and Co-Operation 3 (2+1)

Objective: To have general knowledge on various financial and marketing institutions.

Course outcome: Upon completion of the course students will be able to;

- Understand agriculture as the foundation of economic growth and development.
- Understands source of finance, both public and private.
- Demonstrate role of government to correct market failures and possible advantages of public financing.
- Understand conditions of financial markets and its impact in the economy.
- Understand role and significance of non-banking financial institutions, foreign exchange rate with its impact on various sector.

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.

Practical

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

Suggested Reading

- Johil S.S. and C.V. Moore. (1970). Essentials of Farm Financial Management. Today and Tomorrow Printers and Publishers, New Delhi.
- John, J. Hampton (1983). Financial Decision Making: Concepts, Problems and Cases, of India. New Delhi.
- Mamoria, C.B. and R.D. Saksena. (1973). Co-operatives in India. Kitab Mahal, Allahabad,
- Mamoria, C.B. and Saxena. Agricultural Problems in India. Kitab Mahal, Allahabad
- Mukhi, H R. (1983). Cooperation in India and Abroad. New Heights Publishers, New Delhi.
- Muniraj, R. (1987). Farm Finance for Development, Oxford & IBH Publishing Company Ltd., New Delhi,
- Subba Reddy, S. and P. Raghuram (2005). Agricultural Finance and Management. Oxford & Publishing Company Private Ltd., New Delhi,
- Subba Reddy, S., Raghu Ram., P., Sastry, T.V.N and Bhavani Devi, I. (2016). Agricultural Economics. Oxford & IBH Publishing Company Private Ltd., New Delhi.
- Pandey, U.K. Agricultural Finance in India.
- William, G. Murray and Nelson Aarson, G. Agricultural Finance. The Iowa State University Press, Ames, Iowa state University press Ames, IOWA.

AEC 103 Agricultural Marketing, Trade and Prices 3 (2+1)

Objective: To have basic knowledge on agricultural marketing, trade and prices.

Course outcome: Upon completion of the course students will be able to;

- Identify basic difference between inter regional and international trade.
- Demonstrate role of government to correct market failures and possible advantages of public financing.
- Understand conditions of financial markets and its impact in the economy
- Understand role and significance of non-banking financial institutions, foreign exchange rate with its impact on rural economy.

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.

Suggested Reading

S S Acharya and N L Agarwal. (2012). Agricultural Marketing in India. Oxford & IBH Publications Co. Pvt. Ltd., New Delhi.
S S Acharya and N L Agarwal. Agricultural Price: Analysis and Policy. Oxford & IBH Publications Co. Pvt Ltd., New Delhi.
Subba Reddy, S., P.Raghu Ram., Sastry, T.V.N and Bhavani Devi, I.(2016). Agricultural Economics. Oxford & IBH Publishing Company Private Ltd., New Delhi,
Kahlon, A.S and Tyagi.D S. (1983). Agricultural Price Policy in India. Allied Publishers Pvt. Ltd., New Delhi.
Mamoria, C.B. and Joshi. R L. (1995). Principles and Practices of Marketing in India. Kitab Mahal, Allahabad
Philip Kotler, Kevin Lane Keller, Abraham Koshy and Mithileswar Jha. 2009. Marketing Management: A South Asian Perspective. International 13th edition. Pearson Prentice Hall

AEC 104 Farm Management, Production and Resource Economics 2 (1+1)

Objective: This course designed to provide students with economic concepts that can be applied to management decisions using farm and ranch situations and to develop skills in planning, budgeting, financial analysis and investment analysis.

Course outcome: Upon completion of the course students will be able to;

- Implement decisions, rules to determine conditions that maximize profit.
- Use budgeting concepts to develop whole farm plants from enterprise budget
- Identify alternative business organization.

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 labour income and farm business income. Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. 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.

Suggested Reading

Bishop, C.E. and W. D. Tousaint. (1958). Introduction to Agricultural Economic Analysis. John Wiley and Sons, London.
Heady, Earl O. 1964. Economics of Agricultural Production and Resource Use. Prentice Hall of India, Private Limited, New Delhi
S.S. Johl, J.R. Kapur. 2006. Fundamentals of Farm Business Management. Kalyani Publishers, New Delhi.
Kahlon, A.S. and Karam Singh. 1965. Principles of Farm Business Management. Kalyani Publishers, New Delhi.
Raju, V.T. and D.V.S. Rao. 2006. Economics of Farm Production and Management. Oxford & IBH Publishing Co. Pvt. Limited, New Delhi

AGRICULTURAL ENGINEERING

AEG 101 Introductory Soil and Water Conservation Engineering 2 (1+1)

Objective: To provide insights on theory and concepts of engineering employed on soils and water conservation.

Course outcome: Upon completion of the course students will be able to;

- Visualize the importance of soil and water conservation.
- Explain the types of erosion and their impact on agricultural landscapes.
- Categorize the methods employed to control the erosion caused by various agents.

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.

Suggested Reading

Jagadishwar Sahay - Elements of Agricultural Engineering.
Surendra Singh. Farm Machinery - Principles and Applications.ICAR Publication.
S.C.Jain and C.R.Rai. Farm Tractor – Maintenance and Repair. Standard Publishers, 1705-B, Nai Sarak, Delhi – 110006
Ojha, T. P. and Michael, A.M. Principles of Agricultural Engineering, Vol. I, Jain Brothers, 16/893, East Park Road, Karol Bagh, New Delhi – 110005

AEG 102 Farm Machinery and Power 2(1+1)

Objective: Discussed detailed knowledge on various farm machineries and their functioning principles.

Course outcome: Upon completion of the course students will be able to;

- List types of farm machineries and their working principles.
- Repair and trouble-shooting of machineries
- Identify suitable tillage equipment's to be used with power operated machines.
- Gained analytical skills to analyze the cost of power usage in land preparation.

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.

Practical

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

Suggested Reading

Jagadishwar Sahay - Elements of Agricultural Engineering.
Surendra Singh. Farm Machinery - Principles and Applications.ICAR Publication.

S.C.Jain and C.R.Rai. Farm Tractor – Maintenance and Repair. Standard Publishers, 1705-B, Nai Sarak, Delhi – 110006
Ojha, T. P. and Michael, A.M. Principles of Agricultural Engineering. Vol. I, Jain Brothers, 16/893, East Park Road, Karol
Bagh, New Delhi – 110005

AEG 103 Renewable Energy and Green Technology 2 (1+1)

Objective: Comprehensively describe the non-renewable and renewable energy sources and their relevance in agriculture.

Course outcome: Upon completion of the course students will be able to;

- List energy sources relevant to agricultural needs.
- Understand the production of renewable energy sources and usage at various levels in agriculture.
- Technologies available for large scale production of renewable energy.
- Source the gadgets relevant to produce renewable energy.

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, bioalcohol, biodiesel and bio-oil production and their utilization as bioenergy resource, introduction of solar energy, collection and their application, Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application, introduction of wind energy and their application.

Practical

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

Suggested Reading

Rai, G.D. (2004). Non-conventional Energy Sources. Khanna Publishers, New Delhi.
Rajput, R. K. (2012). Non-conventional Energy Sources. S. Chand Publishers.
Ojha, T.P. and Michael, A.M. Principles of Agricultural Engineering. Vol. I, Jain Brothers, New Delhi.
Rathore, N.S., Mathur, A.N. and Kothari, S. Alternate Sources of Energy. ICAR
Publication.
Chakravarty, A. and Amalendu Chakraverty. 1989 Biotechnology and Other Alternative Technologies for Utilization of Biomass-Agricultural Wastes. 1st edition, Oxford and IBH. Publishers, New Delhi

AEG 104 Protected Cultivation and Secondary Agriculture 2 (1+1)

Objective: To provide insights on the protected cultivation and its importance in agriculture.

Course outcome: Upon completion of the course students will be able to;

- Explain the importance of protected cultivation in current scenario of agriculture.
- Explain the principle involved in protected cultivation.
- Identify the technologies available for protected cultivation.
- Identify crops suitable for cultivation using protected cultivation technologies.
- Understand the precision farming under protected cultivation.
- Gained knowledge on technology cost estimation and economic analysis.
- List the gadgets useful for remote monitoring of climate of protected cultivation technologies.

Theory

Green house technology: Introduction, Types of Green Houses; Plant response to Greenhouse environment, Planning and design of greenhouses, Design criteria of green house for cooling and heating purposes. Green house equipment's, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, typical applications, passive solar green house, hot air greenhouse 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. 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 greenhouses 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 greenhouse equipment's. Visit to various Post Harvest Laboratories. Determination of Moisture content of various grains by oven drying & infrared moisture methods. Determination of engineering properties (shape and size, bulk density and porosity of biomaterials). Determination of Moisture content of various grains by moisture meter. Field visit to seed processing plant.

Suggested Reading

Radha Manohar, K and Igathinathane. C. Greenhouse Technology and Management, 2nd Edition, BS Publications.
Tiwari, G.N. Greenhouse Technology for Controlled Environment. Narosa Publishing house Pvt.Ltd.
Singh Brahma and Balraj Singh.,(2014). Advances in Protected Cultivation, New India Publishing Company.
Sahay, K.M. and Singh, K.K. (1994). Unit operations of Agricultural Processing. Vikas Publishing house Pvt. Ltd. New Delhi.
Chakraverty, A. Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH publishing Co. Ltd., New Delhi.
Ojha, T.P and Michael, A.M. Principles of Agricultural Engineering, Vol. I, Jain Brothers, Karol Bag, New Delhi.

PLANT PATHOLOGY

PLP 101 Fundamentals of Plant Pathology 4(3+1)

Objective: Provide insights on basic theory, concepts and practices involved in crop protection against plant diseases.

Course outcome: Upon completion of the course students will be able to;

- Explain basic principles and concepts of plant pathology and familiarize students with basic vocabulary of plant disease management.
- List major groups of organisms that cause plant diseases and phenology of diseased plants.
- Explain the different infection, reproduction, survival mechanism and spread of different pathogens.
- Categorize different biotic and abiotic causes of diseases and different diseases caused due to them.
- Practice techniques involved in integrated disease management.

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. Causes / factors affecting disease development: disease triangle and tetrahedron and classification of plant diseases. Important plant pathogenic organisms, different groups: fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa,

phanerogamic parasites and nematodes with examples of diseases caused by them. 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, structure, replication and transmission. Study of phanerogamic plant parasites.

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

Growth and reproduction of plant pathogens. Liberation / dispersal and survival of plant pathogens. Types of parasitism and variability in plant pathogens. Pathogenesis. Role of enzymes, toxins and growth regulators in disease development. Defense mechanism in plants. Epidemiology: Factors affecting disease development. Principles and methods of plant disease management. Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.

Practical

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

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

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

Suggested Reading

- Dube, H. C. (2013). An Introduction to Fungi. 4th (Edition). Scientific Publishers, Jodhpur, India.
Webster, J. (1989). Introduction to fungi. Cambridge Univ. Press (for life cycles of Fungi)
Dasgupta, M. K. (1987). Principles of Plant Pathology. Allied Publ. Pvt Ltd. p985. (for rust life cycles)
Alexopoulos, Mims and Blackwell Introductory Mycology (4th Edition)
Agrios, G. N. 2006. Plant Pathology. Elsevier Publishers, New Delhi.
Chaube, H.S. and Ramji Singh. (2001). Introductory Plant Pathology. International Book Distribution Co., Lucknow.
Mehrotra, R.S. (1980). Plant Pathology. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
Singh, R.S. (2002). Introduction to Principles of Plant Pathology. Oxford & IBH Publ. Co. Pvt. Ltd., New Delhi.

PLP 102 Diseases of Field & Horticultural Crops & their Management-I 3 (2+1)

Objective: Provide insights on basic theory, symptoms and practices involved diseases of field and horticultural crops and their management.

Course outcome: Upon completion of the course students will be able to;

- Differentiate different diseases of field and horticultural crops.
- Identify the diseases and diagnose its management.
- Explain the different symptoms, pathogens, disease cycle and management of different diseases of field and horticultural crops.

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

Suggested Reading

Rangaswami, Gand K. Mahadevan. (2001). Diseases of crop plants in India. Prentice Hall of India Pvt. Ltd, New Delhi.
Singh, R.S. (2005). Plant Diseases. Oxford & IBH Publications, New Delhi

PLP 103 Diseases of Field & Horticultural Crops & their Management-II 2 (1+1)

Objective: Provide insights on basic theory, symptoms and practices involved diseases of field and horticultural crops and their management.

Course outcome: Upon completion of the course students will be able to;

- Differentiate different diseases of field and horticultural crops.
- Identify the diseases and diagnose its management.
- Explain the different symptoms, pathogens, disease cycle and management of different diseases of field and horticultural crops.

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; Peach: leaf curl.

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.

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

Suggested Reading

Rangaswami, G & Mahadevan, K. (2001). Diseases of crop plants in India, Prentice Hall of India Pvt.Ltd, New Delhi
Singh, R.S. (2005). Plant Diseases. Oxford & IBH Publications, New Delhi
Pathak, V.N. (2001). Diseases of Fruit crops. Oxford & IBH Publications, New Delhi
Singh, R.S. (1999). Diseases of Vegetable crops. Oxford & IBH Publications, New Delhi
Chaube, H.S and V.S. Pundhir (2012). Crop Diseases & Their Management. PHI Pvt.Ltd, New Delhi

PLP 104 Principles of Integrated Pest and Disease Management 3 (2+1)

Objective: Provide insights on basic principles and procedure of integrated pest and disease management.

Course outcome: Upon completion of the course students will be able to;

- Explain the various concepts, principles and tools of IPM.
- Explain the methods for detection and diagnosis of insect pest and diseases and to calculate the dynamics of economic injury level.
- Gained competency to survey and forecast different insect pest and diseases.
- Gained skills to develop and validate different modules of IPM

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. Survey surveillance and forecasting of Insect pest and diseases. Development and validation of IPM module. Implementation and impact of IPM (IPM module for Insect pest and disease. Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM program. Case histories of important IPM program.

Practical

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

Suggested Reading

- Dhaliwal, G. S. and Ramesh Arora .(2001). Integrated pest management: Concepts and approaches, Kalyani Publishers Ludhiana.
- Metcalf, R. L .and Luckman, W. H. (1982). Introduction to insect pest management. Wiley inter science publishing, New York.
- Larry P Pedigo (1991). Entomology and pest management, Prentice Hall of India Private Ltd., New Delhi.
- Venugopala Rao, N., Umamaheswari, T., Rajendraprasad, P., Naidu, V.G and Savithri, P. (2004). Integrated Insect Pest Management. Agrobios (India) Limited, Jodhpur.
- Chaube, H.S. and Ramji Singh.(2001). Introductory Plant Pathology. International Book Distribution Co., Lucknow.
- Mehrotra, R.S. (1980). Plant Pathology. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- Singh, R.S. (2002). Introduction to Principles of Plant Pathology. Oxford & IBH Publ.Co.P. Ltd., New Delhi.
- Vidyasekharan, P. (1993). Principles of Plant Pathology. CBS Publishers and Distributors, New Delhi.
- Y. L. Nene and P.N. Thaplial, (1993)., Fungicides in Plant Disease Control. Oxford and IBH Publishing Co.

HORTICULTURE

HRT 101 Fundamentals of Horticulture (NEW) 2 (1+1)

Objective: Provide insights on basic theory, concepts and practices involved in production practices of horticultural crops.

Course outcome: Upon completion of the course students will be able to;

- Explain the several practices involved in cultivation and management of various horticultural crops.
- Identify various horticultural crops like fruits, vegetable, flower seeds, plant types in their natural existence.
- Categorize crops grown in different agro-climatic conditions with their classification according to various physiological and morphological features.
- Practice techniques involved in management of different horticultural crops.

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; Seed dormancy, Seed germination, principles of orchard establishment; Principles and methods of training and pruning, juvenility and flower bud differentiation; unfruitfulness; pollination, pollinizers and pollinators; fertilization and parthenocarpy; medicinal and aromatic plants; importance of plant bio-regulators in horticulture. Irrigation – methods, Fertilizer application in horticultural crops.

Practical

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

Suggested Reading:

Prasad and Kumar, 2014. Principles of Horticulture 2nd Edn. Agrobios (India).
Neeraj Pratap Singh, 2005. Basic concepts of Fruit Science 1st Edn. IBDC Publishers.
Gardner/Bardford/Hooker. J.R., 1957. Fundamentals of Fruit Production. Mac Graw Hill Book Co., New York.
Edmond, J.B, Sen, T.L, Andrews, F.S and Halfacre R.G., 1963. Fundamentals of Horticulture. Tata Mc Graw Hill Publishing Co., New Delhi.
Kumar, N., 1990. Introduction to Horticulture. Rajyalakshmi publications, Nagarcoil, Tamilnadu
Jitendra Singh, 2002. Basic Horticulture. Kalyani Publishers, Hyderabad.
Denisen E.L., 1957. Principles of Horticulture. Macmillan Publishing Co., New York.
Chadha, K.L. (ICAR), 2002, 2001. Handbook of Horticulture. ICAR, New Delhi
K.V. Peter, 2009. Basics Horticulture. New India Publishing Agency
Kausal Kumar Misra and Rajesh Kumar, 2014. Fundamentals of Horticulture. Biotech Books.
D.K. Salunkhe and S.S. Kadam, 2013. A handbook of Fruit Science and Technology. CRC Press.
S. Prasad and U. Kumar, 2010. A handbook of Fruit Production. Agrobios (India).
Jitendra Singh, 2011. Basic Horticulture. Kalyani Publications, New Delhi.
Randhawa G.S. and Mukhopadhyaya, A. 1994. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi
Kumar N. 1997. Introduction to Horticulture. Rajyalakshmi Publications, Nagarcoil, Tamilnadu.
Dhilon WS and Bhat ZA. Fruit Tree Physiology. Narendra Publishing house, J&K
Sharma RR, Fruit Production; Problems and Prospects, International Book Distributing Co.

HRT 102 Production Technology for Fruit and Plantation Crops 2 (1+1)

Objective: Provide insights on basic theory, concepts and practices involved in production practices of fruit and plantation crops.

Course outcome: Upon completion of the course students will be able to;

- Explain the several practices involved in cultivation and management of different fruit and plantation crops.
- Identify different seeds of fruit and plantation crop with their plant types in their natural existence.
- Classify different fruit and plantation crops according to their agro-climatic requirement, physiological and morphological features.
- Practice techniques involved in management of different fruit and plantation crops.

Theory

Importance and scope of fruit and plantation crop industry in India; Importance of rootstocks; Production technologies for the cultivation of major fruits-mango, banana, citrus, grape, guava, litchi, papaya, sapota, apple, pear, peach, walnut, almond and; minor fruits- date, ber, 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. Description and identification of fruit. Preparation of plant bio regulators and their uses, Important pests, diseases and physiological disorders of above fruit and plantation crops, Visit to commercial orchards.

Suggested Reading:

Bose, T.K. and Mitra, S.K. 1990. Fruits – Tropical and Sub-tropical. Naya Prakashan, Calcutta.
Chattopadhyaya, P. K. Year. Text Book on Pomology (Fundamentals of Fruit Growing). Kalyani Publishers, Ludhiana.
Bijendra Singh. 2012. Horticulture at a Glance. Kalyani Publishers, Ludhiana

Parthasarathy, V. A., P.K.Chattopadhyay and Bose, T.K. 2006. Plantation Crops. Vol I and II. Parthasankar basu Naya Udyog, Kolkata.

Kumar, N., Abdul Khader, J.B.M, Rangaswamy, P. and Irulappan, I. 2004. Introduction to Spices, Plantation crops, Medicinal and Aromatic Crops. Oxford and IBH publishing Co, New Delhi.

HRT 103 Production Technology for Vegetable and Spices 2 (1+1)

Objective: Provide insights on basic theory, concepts and practices involved in production practices of vegetable and spice crops.

Course outcome: Upon completion of the course students will be able to;

- Explain the several practices involved in cultivation and management of different vegetable and spice crops.
- Identify different seeds of vegetable and spice crops with their plant types in their natural existence.
- Classify different vegetable and spice crops according to their agro-climatic requirement, physiological and morphological features.
- Practice techniques involved in management of different vegetable and spice crops.

Theory

Importance of vegetables & spices in human nutrition and national economy, kitchen gardening, brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders, of important vegetable and spices (Tomato, Brinjal, Chilli, Capsicum, Cucumber, Melons, Gourds, Pumpkin, French bean, Peas; Cole crops such as Cabbage, Cauliflower, Knol-khol; Bulb crops such as Onion, Garlic; Root crops such as Carrot, Raddish, Beetroot; Tuber crops such as Potato; Leafy vegetables such as Amaranth, Palak. Perennial vegetables).

Practical

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

Suggested Reading:

Pranab Hazra, A. Chattopadhyay, K. Karmakar and S. Dutta. 2010. Modern Technology in Vegetable Production. New India Publishing Agency, New Delhi.

Neeraj Pratap Singh, .2007. Basic Concepts of Vegetable Science. International Book Distributing Co. New Delhi. Academic Press, New Delhi.

Nempal Singh, Singh, D.K., Singh, Y.K. and Virendra Kumar. 2006. Vegetable Seed Production Technology. International Book Distributing Co. Lucknow.

Prem Singh Arya and S. Prakash 2002. Vegetables Growing in India. Kalyani publishers, New Delhi

Bose, T. K, Kabir, J., Maity T. K., Parthasarathy V. A., and Som M. G., 2002. *Vegetable Crops* Vol. II & III Naya Prokash, Kolkata.

Shanmugavelu, K.G., N. Kumar and K.V. Peter 2005. *Production Technology of Spices and Plantation Crops*. Agrobios (India), Jodhpur.

HRT 104 Production Technology for Ornamental Crops, MAPs and Landscaping 2 (1+1)

Objective: Provide insights on basic theory, concepts and practices involved in production practices of Ornamental crops, Medicinal and aromatic plants with different style and features of landscape designing.

Course outcome: Upon completion of the course students will be able to;

- Explain the several practices involved in cultivation and management of different ornamental crops, medicinal and aromatic plants.
- Identify different ornamental crops, medicinal and aromatic plants seed with their plant types in their natural existence.
- Classify different ornamental crops, medicinal and aromatic plants according to their agro-climatic requirement, physiological and morphological features.
- Practice techniques involved in management of different ornamental crops, medicinal and aromatic plants
- Go through different styles and features of landscaping with computer aided designing of landscape (CAD) and turf management.

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, liliun 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 ashwagandha, asparagus, aloe, costus, Cinnamomum, periwinkle, isabgol and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver. Processing and value addition in ornamental crops and MAPs produce.

Practical

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

Suggested Reading:

Bose, T.K. 1999. Floriculture and Landscaping. Naya Prakash, Kolkatta.
 Bose, T.K. and Yadav, L.P. 1992. Commercial Flowers. Naya Prakash, Kolkatta.
 Randhawa, G.S. and Mukhopadhyaya, A. 1994. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi
 Chattopadhyay, S.K. 2007. Commercial Floriculture. Gene-Tech Books, New Delhi
 Srivastava, H.C. 2014. Medicinal and Aromatic Plants. ICAR, New Delhi.
 Kumar, N., Abdul Khader, J.B.M, Rangaswamy, P and Irulappan, I. 2004. Introduction to Spices, Plantation Crops, Medicinal and Aromatic Crops. Oxford and IBH publishing Co, New Delhi.

HRT 105 Post-harvest Management and Value Addition of Fruits and Vegetables 2 (1+1)

Objective: Provide insights on basic theory, concepts and practices involved in Post-Harvest Management and Value Addition of Fruits and Vegetables.

Course outcome: Upon completion of the course students will be able to;

- Explain the several practices involved in Post-Harvest Management and Value Addition of Fruits and Vegetables.
- Practice techniques involved in Post-Harvest Management and Value Addition of Fruits and Vegetables
- Prepare different processed product of fruit and vegetable.
- Know about different standards and guideline, specification for preparation of different processed product from fruits and vegetables.

Theory

Importance of post-harvest processing 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; 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.

Suggested Reading:

Rathore, N.S., Mathur, G.K., Chasta, S.S. 2012. Post-harvest Management and Processing of Fruits and Vegetables. ICAR, New Delhi.
Srivastava, R.P. and Sanjeev Kumar. 2002. Fruit and Vegetable Preservation: Principles and Practices. International Book Distribution Company, Lucknow.
Giridharilal, G.S., Siddappa and Tondon, G.L. 2007. Preservation of Fruits and Vegetables. ICAR, New Delhi.
Mitra, S.K. 2005. Post Harvest Physiology and Storage of Tropical and Subtropical Fruits. CABI Publishers, Kolkata.

FOOD SCIENCE & TECHNOLOGY

FSN 101 Principles of Food Science and Nutrition 2 (2+0)

Objective: Provide insights on the science of food and nutrition

Course outcome: Upon completion of the course students will be able to;

- Understand the nutritional value of food items.
- Gained knowledge on food spoilage and microorganism's involved in food spoilage.
- Gained knowledge on food processing and preservation methods.
- Explain mal nutrition due to imbalanced food habits.

Theory

Concepts of Food Science (definitions, measurements, density, phase change, pH, osmosis, surface tension, colloidal systems etc.); Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bio-actives, important reactions); Food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods, Production of fermented foods); Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying etc.); Food and nutrition, Malnutrition (over and under nutrition), nutritional disorders; Energy metabolism (carbohydrate, fat, proteins); Balanced/ modified diets, Menu planning, New trends in food science and nutrition.

Suggested Reading:

Sumati R. Mudambi, Shalini M. Rao and M.V. Rajagopal. 2006. Food Science, 2nd Ed New Age International (P) Limited, New Delhi.

Martin Eastwood. 2003. Principles of Human Nutrition. Blackwell Science Ltd., Oxford.

Norman N. Potter. 1998. Food Science, 5th Ed. Springer Science+ Business Media, New York.

Michael J. Pelczar Jr., E.C.S. Chan and Noel R. Krieg. 1998. Microbiology, 5th Ed. Tata McGraw-Hill Education, New Delhi.

William C. Frazier and & Dennis C. Westhoff. 1987. Food Microbiology, 4th Ed. Tata McGraw-Hill Education, New Delhi.

L.E. Casida Jr. 1968. Industrial Microbiology. New Age International Publishers, New Delhi.

P. Fellows. 2000. Food Processing Technology: Principles and Practice, 2nd Ed. CRC Press, Boca Raton, FL, USA.

Marcus Karel and Darvl B. Lund.2003. Physical Principles of Food Preservation, 2nd Ed. Marcel Dekker, Inc., NY, USA.

Gerald Wiseman. 2002. Nutrition and Health. Taylor & Francis, London.

An Introduction to Nutrition, v. 1.0

AGRICULTURAL EXTENSION AND COMMUNICATION

AEX 101 Fundamentals of Agricultural Extension Education 3 (2+1)

Objective: This course is intended to orient students with the concepts of extension education and its importance in agriculture development and also to expose the students with various rural development program aimed at poverty alleviation and analysis. Besides the students will be learning about new innovations and transfer through agricultural extension in India.

Course outcome: Upon completion of the course students will be able to;

- Explain the concepts of extension.
- Define community development program.
- List the extension system of SAUs and ICAR.
- Understand the market-led-extension.
- Gained knowledge on cyber extension, farming situation based extension.
- Acquired skills to examine the rural leadership and PRA survey.

Theory

Education: Meaning, definition & Types; Extension Education- meaning, definition, scope and process; objectives and principles of Extension Education; Extension Program planning- Meaning, Process, Principles and Steps in Program 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 program 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 program launched by Govt. of India. Community Dev.-meaning, definition, concept & principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension program; transfer of technology: concept and models, capacity building of extension personnel; extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and Social Media), media mix strategies; communication: meaning and definition; Principles and Functions of Communication, models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

Practical

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

Suggested Reading

Adivi Reddy, A. 2006. Extension Education. Sree Lakshmi Press, Bapatla.
Dahama, O.P. and Bhatnagar, O.P. 1999. Extension and Communication for Development. Oxford & IBH Private Limited, New Delhi/Mumbai.
Ganesh, R., Mohammad Iqbal and Ananda Raja. 2003. Reaching the Unreached – Basics of Extension Education. Associate Publishing Company, New Delhi.
Jalihal, K.A. and Veerabhadraiah, V. 2007. Fundamentals of Extension Education and Management in Extension. Concept Publishing House, New Delhi.
Ray, G.L. 2006. Extension Communication and Management. NayaProkash/Kalyani Publishers, Kalkatta/Ludhiana.

AEX 102 Rural Sociology & Educational Psychology 2 (2+0)

Objective: Provide insights on basic theory, concept of rural society and different types of social groups, social institutions, social change and development.

Course outcome: Upon completion of the course students will be able to;

- Understand the rural society and its significance.
- Analytical ability to examine various social institutions and its role.
- Understand the personality development traits.

Theory

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

Suggested Reading:

Adivi Reddy, A. 2006. Extension Education. Sree Lakshmi Press, Bapatla
Chitamber, J. B. 1997. Introductory Rural Sociology. Wiley Eastern Limited, New Delhi
Daivadeenam, P. 2006. Educational Psychology in Agriculture. Agrotech Publishing Academy, Udaipur
Mangal, S. K. 2000. Educational Psychology. Prakash Brothers, Ludhiana.
Ray, G. L. 2006. Extension Communication and Management. Naya Prokash/ Kalyani Publishers, Ludhiana
VidyaBhushan and Sach Dev. D. R. 1998. An Introduction to Rural Sociology. Kitab Mahal Agencies Allahabad.

AEX 103 Communication Skills and Personality Development 2 (1+1)

Objective: In this course students will learn about the concept, meaning and process of communication and various methods. Students will also learn various communication skills and about personality development

Course outcome: Upon completion of the course students will be able to;

- Explain various communication methods and communication skills.
- Acquired competency to write the technical articles.
- Understand various personality traits.
- Gained the competency to organize seminars and conferences.

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.

Suggested Reading:

Dangi K.L., S.S. Sisoda, Pravesh Singh Chauhan and Yogita Ranavat. A Text Book of Communication Skills. Agrotech Publications.

Mangal S.K. 2016. Essentials of Educational Psychology. PHI Learning Private Ltd., New Delhi.

Nirajkumar. 1997. A Genesis of Behavioural Science. Gyan Publishing House, New Delhi.

Eric Berne. 1964. Games People Play-The Psychology of Human Relationship. Grove Press Publishers.

Thomas Anthony Harris. 1967. I am Ok You are Ok. Harper Publishers.

Scott Bill. 1981. Skills of Negotiating.

Goleman Daniel. 1995. Emotional Intelligence.

Ratan Reddy B and Supriya Reddy. Soft Skills for Professional Excellence.

Shivkhera. 2002. You can win. MacMillan Publishing Company. New Delhi Shivaraman K. 2009. Communication Skills.

APH publications.

AEX 104 Entrepreneurship Development and Business Communication 2 (1+1)

Objective: The first part of the course is intended to provide overall picture of planning and development of enterprises for extending sustainable livelihoods for rural people. The second part of the course is structured to help the students to gain knowledge and skills in different concepts and techniques of communication and management in extension organizations.

Course outcome: Upon completion of the course students will be able to;

- Explain concepts of Entrepreneurship, Entrepreneur and Enterprises
- List opportunities of Agri-enterprises
- Gained managerial skills and business communication skills

Theory

Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs; SWOT Analysis & achievement motivation, Government policy and programs and institutions for entrepreneurship development, Impact of economic reforms on Agribusiness/Agri-enterprises, Entrepreneurial Development Process; Business Leadership Skills; Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation), Developing

Managerial skills, Business Leadership Skills (Communication, direction and motivation Skills), Problem solving skill, Supply chain management and Total quality management, Project Planning Formulation and report preparation; Financing of enterprise, Opportunities for agri-entrepreneurship and rural enterprise.

Practical

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

Suggested Reading:

Anil Kumar, S., Poornima, S. C., Mini, K., Abraham and Jayashree, K. 2003 Entrepreneurship Development. New Age International Publishers, New Delhi
Bhaskaran, S. 2014. Entrepreneurship Development & Management. Aman Publishing House, Meerut
Gupta, C.B. 2001. Management: Theory and Practice. Sultan Chand and Sons, New Delhi
Indu Grover 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Publishing Academy, Udaipur
Khanka, S.S. 1999. Entrepreneurship Development. S. Chand and Co., New Delhi
Mary Coulter 2008. Entrepreneurship in Action. Prentice Hall of India Pvt. Ltd., New Delhi
Mohanty, S.K. 2009. Fundamentals of Entrepreneurship. Prentice Hall of India Pvt. Ltd., New Delhi
Prasad, R. 2003. Entrepreneurship - Concepts and Cases. I C F A I Publications, Hyderabad
Sagar Mondal and Ray, G. L. 2003. Text Book of Entrepreneurship and Rural Development. Kalyani Publishers, Ludhiana
Singh, D. 1995. Effective Managerial Leadership. Deep and Deep Publications, New Delhi
Vasanta Desai. 1997. Small Scale Industries and Entrepreneurship. Himalaya Publishing House, New Delhi
Vasanta Desai. 2000. Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House, New Delhi

BIOCHEMISTRY/ PHYSIOLOGY/ MICROBIOLOGY/ ENVIRONMENTAL SCIENCES

PBB 101 Fundamentals of Plant Biochemistry and Biotechnology 3 (2+1)

Objectives: Provide insights on basic theory, principles, certain biochemical process and technology used for development of transgenic variety.

Objectives: Upon completion of the course students will be able to;

- Acquainted with chemistry of biological phenomenon.
- Know the r-DNA technology for development of transgenic variety.
- Acquire knowledge about how the principles of totipotency useful for plant development.
- Understand the development of complete plant through tissue culture.

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 Poly saccharides. 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.

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

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. Sterilization techniques. 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.

Suggested Reading:

David L. Nelson, Michael M.Cox; W.H. Freeman.Lehninger Principles of Biochemistry, 6th Edition
Dr.U.Satyanarayana, Dr.U. Chakrapani, Biochemistry, Books and Allied (P) Ltd, Kolkata
S.N.Gupta,Biochemistry, Rastogi Publications, First Edition, 2011
HS Chawla, Introduction to Plant Biotechnology by (3rd Edition), Oxford & IBH Publishing Co. Pvt Ltd., New Delhi.

FCP 102 Fundamentals of Crop Physiology 2 (1+1)

Objective: Provide insights on basic theory and concept related to plant biochemistry

Course outcome: Upon completion of the course students will be able to;

- Understand different process involved in different physiological process found in plants responsible for its growth
- Accumulate knowledge on different metabolisms found in plants.
- Knowledge about different growth regulators and different aspects of growth and development of major crops.

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 Infrared Gas Analyser (IRGA).

Suggested Readings:

Taiz, L. and Zeiger, E. 2010. Plant Physiology 5th edition, Sinauer Associates, Sunderland, MA, USA.
Gardner, F.P., Pearce, R.B., and Mitchell, R.L. 1985. Physiology of Crop Plants. Scientific Publishers, Jodhpur.
Noggle, G.R. and Fritz, G.J., 1983. Introductory Plant Physiology. 2nd Edition. Prentice Hall Publishers, New Jersey, USA.

AMB 103 Agricultural Microbiology 2 (1+1)

Objective: Provide insights on basic theory on microorganisms: Beneficial and harmful to crop plants.

Course outcome: Upon completion of the course students will be able to;

- Understand the milestones in the history of microbiology leading to discovery of microorganisms.
- Know about different artificial methods of culturing the microorganisms and different sterilization methods.
- Gained knowledge on different plant growth promoting microorganisms.
- Knowledge on mushrooms and their cultivation.

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 asymbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere. Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste.

Practical

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

Suggested Reading:

Pelczar, J.r., M.J.E.C.S.Chan and Krieg, N.R. 2015. Microbiology. (5th Ed.) McGraw Hill Publishers, New York.
Prescott, L.M., Harley, J.P. and Klein, D.A. 2014. Microbiology. (9th Ed.) McGraw Hill Publishers, New York.
Madigan, M., Martinko, J.M and Parker, J. Brock 2015 Biology of Microorganisms (14Ed.) Prentice hall of India Pvt Ltd., New Delhi.
Subba Rao, N.S. 2014. Soil Microbiology: (4th Ed.) Oxford and IBH Publishing Company Pvt. Ltd., New Delhi.
James, C and Natile, S. 2014. Microbiology A Laboratory Manual: (10th Ed.) Pearson India Education Services Pvt. Ltd., South Asia.
Aneja, K.R. 2011. Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International (P) Ltd., Publishers, New Delhi

ENS 104 Environmental Studies and Disaster Management 3 (2+1)

Objective: To get an insight into various environmental components including ecosystem, ecological succession and disaster management.

Course outcome: Upon completion of the course students will be able to;

- List various types of energy sources (renewable and non-renewable).
- Describe various components of an ecosystem.
- Explain various types of pollution sources and their management.
- Gained knowledge on various kinds of disasters and their management.

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

Practical

Pollution case studies. 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.

Suggested Reading:

Bharucha, E. 2005. Text book of Environmental Studies for undergraduate courses. University Grants Commission, New Delhi.

Anjaneyalu, Y. 2004. Introduction to Environmental Science. BS Publications, Hyderabad, A.P. India.

IFR 105 Introduction to Forestry (New) 2 (1+1)

Objective: To acquire some basic knowledge on silviculture and their management.

Course outcome: Upon completion of the course students will be able to;

- Able to know about basic components of silviculture.
- Analytical skills on forest mensuration and tending operations.
- Know about the basics of agroforestry.

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.

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

hypometer. Volume measurement of logs using various formulae. Nursery lay out, seed sowing, vegetative propagation techniques. Forest plantations and their management. Visits of nearby forest based industries.

Suggested Reading:

Dwivedi, A.P.1980. Forestry in India, Jugal Kishore and Company, DehraDun
Negi, S.S.1999. Agroforestry hand book, International book distributor, DehraDun.
Ram Prakash and Drake Hocking.1986. Some favourite trees for fuel and fodder, International book distributor, Dehradun.
Singh, S.P. 2009. Tree farming-. Agrotech Publishing academy, Udaipur.
Singh, S.P. 2010. Favourite Agroforestry trees, Agrotech Publishing academy, Udaipur.
Troup, T.S.1986. Silviculture of Indian trees (Vol. II & III)- International book distributor, Dehradun.

STATISTICS, COMPUTER APPLICATION AND IPR

AST 101 Statistical Methods 2 (1+1)

Objective: To understand the types of data, basic methods used in data analysis and computer based software's used in data collection, management and interpretation of data.

Course outcome: Upon completion of the course students will be able to;

- Explain the data and data classification.
- Organize data in excel sheet for analysis and interpretation using various statistical methods.
- Perform sampling, data collection and analysis to apply test of significance.
- Develop field scale testing design and collect the primary empirical data.
- Use of computer based statistical software to analyze a set of data.

Theory

Introduction to Statistics and its Applications in Agriculture, Graphical Representation of Data, Measures of Central Tendency & Dispersion, 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). Correlation & Regression Analysis. Application of One Sample t-test. Application of Two Sample Fisher's t-test. Chi-Square test of Goodness of Fit. Chi-Square test of Independence of Attributes for 2×2 contingency table. Analysis of Variance One Way Classification. Analysis of Variance Two Way Classification. Selection of random sample using Simple Random Sampling.

Suggested Reading:

Nageswara Rao, G 2007. Statistics for Agricultural Sciences. B S Publications, Hyderabad
Rangaswamy, R 1995. A Text Book of Agricultural Statistics. New Age International (P) Limited, Hyderabad.
Chandel SRS, Hand Book of Agricultural Statistics. Achal Prakashan Mandir publications, New Delhi.
Agrawal, B. L. Programmed Statistics. 2nd Edition, New Age International Publishers, Hyderabad.

AGI 102 Agri-Informatics 2 (1+1)

Objective: To provide exposure to the computer based MIS and data relevant to agriculture and interactive software's.

Course outcome: Upon completion of the course students will be able to;

- Explain importance of ICT in agriculture.
- Use of agriculture related database to develop analytics.
- Develop interactive apps. to provide services.
- Develop decision making process to support agricultural activities.
- Develop database of all aspects of agriculture.

Theory

Introduction to Computers, Operating Systems, definition and types, Applications of MS-Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, uses of DBMS in Agriculture, World Wide Web (WWW): Concepts and components. Introduction to computer programming languages, concepts and standard input/output operations. e-Agriculture, concepts and applications, Use of ICT in Agriculture. Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc; Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting Farm decisions. Preparation of contingent crop-planning using IT tools.

Practical

Study of Computer Components, accessories, practice of important DOS Commands. Introduction of different operating systems such as windows, Unix/ Linux, Creating, Files & Folders, File Management. Use of MS-WORD and MS Powerpoint for creating, editing and presenting a scientific Document. MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data. MS-ACCESS: Creating Database, preparing queries and reports, demonstration of Agri-information system. Introduction to World Wide Web (WWW). Introduction of programming languages. Hands on Crop Simulation Models (CSM) such as DSSAT/Crop-Info/CropSyst/ Wofost; Computation of water and nutrient requirements of crop using CSM and IT tools. Introduction of Geospatial Technology for generating valuable information for Agriculture. Hands on Decision Support System. Preparation of contingent crop planning.

Suggested Reading:

John Walkenbach, Herb Tyson, Michael R. Groh, Faithe Wempen, Microsoft Office 2010 Bible
Bangia, Learning Ms Office 2010
Prof. Satish Jain and M. Geetha, MS-Office 2010 Training Guide
Kate Shoup, Microsoft Office 2010
Melanie Gass, It's All about You! Office 2010
Nancy Conner and Matthew MacDonald, Office 2010: The Missing Manual

IPR 103 Intellectual Property Rights 1 (1+0)

Objective: To provide insights on importance of IPR and governing institutions

Course outcome: Upon completion of the course students will be able to;

- Explain the importance of IPR in agriculture.
- Categorize types of IPR and licensing procedure.
- Gained expertise on process of application for IPR for an agricultural produce.
- Explain the importance of biodiversity and obtaining the IPR.

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 breeder's 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.

Suggested Reading:

Acharya, N.K. 2014. Text book of Intellectual Property Rights. Asia Law House, Hyderabad.
Loganathan, E.T. 2012. Intellectual Property Rights. New Century Publications, New Delhi.
Rosedar, S.R.A. 2016. Intellectual Property Rights. Lexis Nexis (2nd Ed.), Nagpur.

ANIMAL PRODUCTION

ASC 101 Livestock & Poultry Management 4 (3+1)

Objective: To understand the different components of the animal husbandry practices in relation to agriculture

Course outcome: Upon completion of the course students will be able to;

- Explain what is animal husbandry and its components.
- Gained knowledge on types of farm animals, fodder types and animal improvement.
- How to organize the poultry production on farm?
- Gained knowledge on animal health management and medication to protect animals from diseases.

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 equipment's. Management of chicks, growers and layers. Debeaking, dusting and vaccination. Economics of cattle, buffalo, sheep, goat, swine and poultry production.

LANGUAGE

ENG 101 Comprehension and Communication Skills in English 2 (1+1)

Objective: Train in use of English as communication language and writing technical content.

Course outcome: Upon completion of the course students will be able to;

- Effectively speak and use English in conversation in an academic environment.
- Reliably demonstrated the ability to use the conventions of grammar when creating paragraphs.
- Effective in comprehension of a technical writing, develop manuscripts and reports.

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.

Suggested Reading:

Balasubramanian, T. 1989. A Text Book of Phonetics for Indian Student, Orient Longman, New Delhi.
Balasubramanyam, M. 1985. Business Communication. Vani Education Books, New Delhi.
Jean Naterop, B. and Rod Revell. 1977. Telephoning in English. Cambridge University Press, Cambridge.
Krishna Mohan and Meera Banerjee. 1990. Developing Communication Skills. Mc Millan India Ltd. New Delhi.

Krishanswamy, N and Sriraman, T. 1985. Current English for Colleges. Mc Millan India Ltd., Madras.
Narayanaswamy V R. 1979. Strengthen Your Writing. Orient Longman, New Delhi.
Sharma R C and Krishna Mohan. 1978. Business Correspondence. Tata Mc Graw Hill Publishing Company, New Delhi.

REMEDIAL COURSES

AGH 101 Agricultural Heritage (New Course) 1 (1+0)

Objective: To provide insights on ancient and traditional methods of farming activities

Course outcome: Upon completion of the course students will be able to;

- Gained the knowledge on how agriculture was practiced in the ancient times.
- Classify the types of crop management practices- cultivation, traditional varieties, diseases, soil and water management.
- List types traditional fertilizers and their importance in crop production.
- Explain the timeline of process of migration and introduction of HYV vis-à-vis traditional varieties.

Theory

Introduction of Indian agricultural heritage; Ancient agricultural practices, Relevance of heritage to present day agriculture; Past and present status of agriculture and farmers in society; Journey of Indian agriculture and its development from past to modern era; Plant production and protection through indigenous traditional knowledge; Crop voyage in India and world; Agriculture scope; Importance of agriculture and agricultural resources available in India; Crop significance and classifications; National agriculture setup in India; Current scenario of Indian agriculture; Indian agricultural concerns and future prospects.

Suggested Reading:

Choudary S.L, Sharma, G.S, and Nene, Y.L (eds). 2000. Ancient and Medieval History of Indian agriculture and its relevance to sustainable agriculture in the 21st century; Proceedings of the summer school held from 28 May to 17 June 1999. Rajasthan college of Agriculture, Udaipur 313001.
Nene, Y.L (Ed). 2005. Agricultural Heritage of Asia proceedings of the international conference, 6-8 December 2004, Asian-Agri history Foundation, Secunderabad- 500009, Andhra Pradesh, India.
Nene, Y.L 2007. Glimpses of Agricultural heritage of India. Asian- Agri- History Foundation, 47 – ICRISAT Colony-1 Brig sayeed Road, Secunderabad -500009 A.P India 901PP ISBN-81-903963-0-7.

IBL 101 Introductory Biology (New) 2 (1+1)

Objective: To sensitize students about the basics of biology in special reference to botany.

Course outcome: Upon completion of the course students will be able to;

- Know about the various parts of an angiospermic plant.
- Know about the evolutionary process and binomial classification.
- Explain 3 important families such as, Brassicaceae, Fabaceae and Poaceae.

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.

Suggested Reading:

Biology – Raven P, Mason Johnson G B, Losos J. B, Singer. S.S, 10th edition, 2014. McGraw Hill Publications.
M.G. Simpson, 2006. Plant systematics. Elsevier Publications
H. C. Gangulee 1972 College Botany 4th edition.
A. C. Dutta 1964 A class book of Botany Botany for Degree Students, Oxford University Press, Calcutta.
N. T. Gill. 1966. Agricultural Botany. 2nd edition.

EMT 101 Elementary Mathematics (New) 2 (2+0)

Objective: To introduce basic mathematical theories useful to understand the mathematical approaches used in agriculture.

Course outcome: Upon completion of the course students will be able to;

- Explain the mathematical functions.
- Apply general form of equations in calculations.

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.

Suggested Reading:

MVSL DN Raju and Dr. K .V. Ramana – Engineering Mathematics-1
MVSL DN Raju and Dr. K .V. Ramana – Engineering Mathematics-2

Text Book for A.P Intermediate Mathematics – Paper (IA & IIB).

NON-GRADIAL COURSES

PYE 101 Physical Education & Yoga Practices 2 (0+2)

Objective: To introduce the students to yogic asanas and health improving physical exercises.

Course outcome: Upon completion of the course students will be able to;

- Realize the importance the physical exercises and yogic asanas.
- Practice various yogic asanas
- Spread awareness on the utilities of yoga.

Health, hygiene and sanitation: Definition needs and scope of health education; role of food, nutrition, safe drinking water, water born diseases and sanitation (Swachh Bharat Abhiyan) for health; national health program and reproductive health. Youth health, lifestyle, HIV AIDS and first aid, Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid

Youth and yoga: History, philosophy, concept, myths and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method, yogic asanas and practices.

Practical:

Teaching of skills of Football – demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit)

Teaching of different skills of Football – demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit)

Teaching of advance skills of Football – involvement of all the skills in game situation with teaching of rules of the game

Teaching of skills of Basketball – demonstration, practice of the skills, correction of skills, involvement in game situation

Teaching of skills of Basketball – demonstration, practice of the skills, involvement in game situation

Teaching of skills of Basketball – involvement of all the skills in game situation with teaching of rule of the game

Teaching of skills of Kabaddi – demonstration, practice of the skills, correction of skills, involvement in game situation

Teaching of skills of Kabaddi – demonstration, practice of the skills, correction of skills, involvement in game situation

Teaching of advance skills of Kabaddi – involvement of all the skills in game situation with teaching of rule of the game

Teaching of skills of Ball Badminton – demonstration, practice of the skills, correction of skills, involvement in game situation

Teaching of skills of Ball Badminton – involvement of all the skills in game situation with teaching of rule of the game

Teaching of some of Asanas – demonstration, practice, correction and practice

Teaching of some more of Asanas – demonstration, practice, correction and practice

Teaching of skills of Table Tennis – demonstration, practice of skills, correction and practice and involvement in game situation

Teaching of skills of Table Tennis – demonstration, practice of skills, correction and practice and involvement in game situation

Teaching of skills of Table Tennis – involvement of all the skills in game situation with teaching of rule of the game

Teaching – Meaning, Scope and importance of Physical Education

Teaching – Definition, Type of Tournaments

Teaching – Physical Fitness and Health Education

Construction and laying out of the track and field (*The girls will have Tennikoit and Throw Ball).

Teaching of skills of Hockey – demonstration practice of the skills and correction.

Teaching of skills of Hockey – demonstration practice of the skills and correction. And involvement of skills in games situation

Teaching of advance skills of Hockey – demonstration practice of the skills and correction. Involvement of all the skills in games situation with teaching of rules of the game

Teaching of skills of Kho-Kho – demonstration practice of the skills and correction.

Teaching of skills of Kho-Kho – demonstration practice of the skills and correction. Involvement of the skills in games situation

Teaching of advance skills of Kho-Kho – demonstration practice of the skills and correction. Involvement of all the skills in games situation with teaching of rules of the game

Teaching of different track events – demonstration practice of the skills and correction.

Teaching of different track events – demonstration practice of the skills and correction.

Teaching of different track events – demonstration practice of the skills and correction with competition among them.

Teaching of different field events – demonstration practice of the skills and correction.

Teaching of different field events – demonstration practice of the skills and correction.

Teaching of different field events – demonstration practice of the skills and correction.

Teaching of different field events – demonstration practice of the skills and correction with competition among them.

Teaching of different asanas – demonstration practice and correction.

Teaching of different asanas – demonstration practice and correction.

Teaching of different asanas – demonstration practice and correction.

Teaching of different asanas – demonstration practice and correction.

Teaching of weight training – demonstration practice and correction.

Teaching of circuit training – demonstration practice and correction.

Teaching of calisthenics – demonstration practice and correction.

HME 101 Human Value and Ethics 1 (1+0)

Objective: To inculcate the principles and moral values of human existence and philosophy.

Course outcome: Upon completion of the course students will be able to;

- Practice ethical approach to life.
- Treat people with compassion and selflessly offer service.
- Be self-aware of spiritualism and its importance in mindfulness.
- Carry balanced mind and positive attitude.

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.

Suggested Reading

Gaur RR, Sanga IR and Bagaria GP. 2011. A Foundation Course in Human Values and Professional Ethics. Excel Books.

Mathur SS. 2010. Education for Values, Environment and Human Rights. RSA International.

Sharma RA. 2011. Human Values and Education – Axiology, Incultation and Research. R. Lall Book Depot.

Sharma RP and Sharma M. 2011. Value Education and Professional Ethics. Kanishka Publishers.

Srivastava S. 2011. Human Values and Professional Ethics. S K Kataria and Sons.

Srivastava S. 2011. Environmental Science. S K Kataria & Sons.

Tripathi A.N. 2009. Human Values. New Age International (P) Ltd Publishers.

R.S. Nagarajan. Text Book on Professional Ethics & Human Values.

D.R. Kiran. Professional Ethics & Human Values

Veerendra Kumar. Human Values and Professional Ethics.

M.Govindarajan. Engineering Ethics.

Course Title: Educational Tour 2 (0+2)

Objective: To explore the education and research institutions promoting agriculture

Course outcome: Upon completion of the course students will be able to;

- Know various education and research institutions involved in agriculture.
- Gained an informed knowledge on regional scale awareness on agricultural institutions.
- Appreciate the research and development activities on agriculture.
- Understand the working set-up and responsibilities of scientists.

ELECTIVE COURSES**ABM 201 Agri-business Management 3 (2+1)**

Objective: To provide insights on the principles business management applicable to agriculture industry.

Course outcome: Upon completion of the course students will be able to;

- Appreciate the policies involved in building agribusiness
- Examine the role and activities of organization/institutions controlling the agribusiness.
- Gained knowledge on capital management and building agribusiness project development.
- Understand the retail marketing and consumer behaviour.
- Acquainted examine the agri-business distribution system and business models.

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

Practical

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

Suggested Reading:

Aswathappa, K and Sridhar K. Production and Operations Management.
David Downey, and John Ericson. Agribusiness Management
Gitterger Price, J. 1989. Economic Analysis of Agricultural Projects. John Hopkins University Press, London.
Harsh, S.B. Conner, U.J. and Schwab G.D. 1981. Management of the Farm Business. Prentice Hall Inc., New Jersey, USA.
Joseph, L. Massie. 1995. Essentials of Management. Prentice Hall of India Pvt. Ltd., New Delhi.
Omri Rawlins, N. 1980. Introduction to Agribusiness. Prentice Hall of India Pvt. Ltd., New Delhi
Pandey, I M. Financial management
Philip Kotler, Kevin Lane Keller, Abraham Koshy and Mithileswar Jha. 2009.
Marketing Management: A South Asian Perspective. International 13th edition. Pearson Prentice Hall.

AGC 201 Agrochemicals 3 (2+1)

Objective: To educate on the common agro-chemical used in agriculture for plant protection.

Course outcome: Upon completion of the course students will be able to;

- Explain the principals involved in the chemical function of agrochemicals
- Explain the process of manufacturing of agrochemicals.
- List various categories of agro-chemicals and safety measures.
- List categorize the bio-pesticides and their importance in sustainable agriculture.

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 oxychloride.

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

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

Suggested Reading:

Vasantharaj David, B and Ramamurthy V V. 2016. Elements of Economic Entomology. Np Namuratha Publications, Chennai.

Vasantharaj David, B and Aanathakrishnan, T.N. 2006. General and Applied Entomology. Tata McGraw-Hill Publishing House, New Delhi.

Srivastava R P and Saxena R C 1989. A text book of Insect toxicology. Himanshu Publications, Udaipur

S Sriramulu 1979. Methods of Pesticide analysis. Oxford IBH, New Delhi

Nene YL and Thapliyal PN. Fungicides in Plant Disease Control. Oxford IBH, New Delhi

Gupta, O. P. 2007. Modern weed management. Dr Upadesh Purohit for Agro Bios, Jodhpur–

Das, T. K. 2008 Weed Science - Basics and Applications. Jain Brothers, New Delhi

Choudary, J.P., 1995. Fertilizers and Mannures. Rama Publishing House, Meerut, U.P.

Yawalkar, K.S., Agarwal, J.P. and Bokde, S. 1992. Mannures and Fertilizers, Agri Horticultural Publishing House, Nagpur

Sita raman, S., Biswal, B.C., Maheswari, S and Yadav, D.S. 1996. Hand book on fertilizer usage. The Fertilizer Association of India, New Delhi

HCL Gupta. 1999. Insecticides Toxicology & Uses. Agrotech Publishing Academy, Udaipur

GPB 201 Commercial Plant Breeding 3 (1+2)

Objective: To provide pragmatic knowledge on the methods employed in production of varieties and superior phenotypes.

Course outcome: Upon completion of the course students will be able to;

- Explain and employ stages of production of varieties.
- Practice production quality field crops seeds and horticultural seeds.
- Explain the basis of seed certification and quality control.

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.

Suggested Reading:

Agarwal, R.L. 2015. Seed Technology. Oxford and IBH Publication Co., New Delhi.

Khare, Dharendra and Bhala, M.S. 2014. Seed Technology second revised edition. Scientific Publishers. Jodhpur.

Phundan Singh, 2014. Essentials of Plant Breeding. Kalyani Publishers, New Delhi.

Singh, B.D. 2015. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.

HRT 201 Landscaping 3 (2+1)

Objective: To provide practical knowledge on gardening and principals involved landscaping.

Course outcome: Upon completion of the course students will be able to;

- Plan a landscape gardening.
- Categorize indoor and outdoor plants suitable gardening.
- Categorize annual and perennial flowering plants.
- Develop a cost estimate proposal for a landscaping project.
- Practice landscaping as a business model.

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) and designing of conservatory and lathe house. Use of computer software, visit to important gardens/ parks/ institutes.

Suggested Reading:

Bhattacharjee, S. K. 2004. *Landscape Gardening and Design with plants*. Aavishkar Publishers and Distributors, Jaipur.
Bose, T.K. 1999. *Floriculture and Landscaping*. Naya Prakash, Kolkatta.
Chadha K.L and Choudhary, B. *Ornamental Horticulture in India*. ICAR, New Delhi.
Randhawa, G.S. and Mukhopadhyaya, A. 1998. *Floriculture in India*. Allied Publishers Pvt. Ltd., New Delhi
Chattopadhyay, S.K. 2007. *Commercial Floriculture*. Gene-Tech Books, New Delhi
Bose T.K., B. Chowdhury and S.P. Sharma 2001. *Tropical garden plants in colour*. Horticulture and Allied Publishers, Kolkata.
.Veena Amarnath, 2012. *Nursery and Landscaping*. AGROBIOS, Jhodpur.

FSN 201 Food Safety and Standards 3 (2+1)

Objective: To provide insights food quality control and standards of quality control.

Course outcome: Upon completion of the course students will be able to;

- Explain the food safety standards and types of hazards.
- Gained knowledge on safe disposal of spoilage food and recycling process.
- Explain the laws of relevance to food and regulatory regimes.
- Acquainted with quality control of organic food and safe food products.

Theory

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

Practical

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

Suggested Reading:

Inteaz Ali.2004. Food Quality Italics Assurance: Principles and Practices. CRC Press, Boca Raton, Ronald, H. Schmidt and Gary E. Rodrick. 2003. Food Safety Handbook. John Wiley & Sons, Inc., Hoboken. New Jersey, USA
 Hester, R.E. and Harrison R.M. 2001. Food Safety and Food Quality. Royal Society of Chemistry, Cambridge, UK.
 Michael, M. Cramer. 2013. Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices. CRC Press, Boca Raton, FL, USA.
 Norman, G. Marriott, and Robert, B. Gravani. 2006. Principles of Food Sanitation, 5th Ed. Springer Science+Business Media, Inc., NY, USA.
 Hui, Y.H. Bernard L. Bruinsma, J. Richard Gorham, Wai-Kit Nip, Phillip S. Tong and Phil Ventresca. 2003. Food Plant Sanitation. Marcel Dekker, Inc., NY, USA.
 Singh, B.D. 2014. Biotechnology - Expanding Horizons. Kalyani Publishers, New Delhi.
 Pepper I.L. and Gerba C.P. 2005. Environmental Microbiology. Laboratory Manual, 2nd Ed. Elsevier Academic Press, Amsterdam.

AMB 201 Biopesticides & Biofertilizers 3 (2+1)

Objective: To provide knowledge on renewable source of biopesticides and biofertilizers.

Course outcome: Upon completion of the course students will be able to;

- Realize the importance renewable sources of nutrients and plant protection methods.
- Categorize types of biopesticides and biofertilizers and their specific utilities.
- Gained skills on commercial production of biopesticides and biofertilizers.
- Explain the technologies used in manufacturing and quality control, marketing.

Theory

History and concept of biopesticides. Importance, scope and potential of biopesticide. Definitions, concepts and classification of biopesticides viz. pathogen, botanical pesticides, and biorationals. 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

Isolation and purification of important biopesticides: *Trichoderma*, *Pseudomonas*, *Bacillus*, *Metarhizium* etc. and its production. Identification of important botanicals. Visit to biopesticide laboratory in nearby area. Field visit to explore naturally infected cadavers. Identification of entomopathogenic entities in field condition. Quality control of biopesticides.

Isolation and purification of *Azospirillum*, *Azotobacter*, *Rhizobium*, P-solubilizers and cyanobacteria. Mass multiplication and inoculum production of biofertilizers. Isolation of AM fungi -Wet sieving method and sucrose gradient method. Mass production of AM inoculants.

Suggested Reading:

BS Parmar and C. Deva Kumar 1993. Botanical and Bio pesticides. West Will Publishing House, New Delhi pp 199
Srivastava, K. P. and Dhaliwal, G.S 2015. Applied Entomology. Vol I & II, Kalyani Publishers, New Delhi
Kannaiyan, S., K. Kumar and K. Govindarajan (eds.) (2004). Biofertilizers Technology (Scientific Pub., Jodhpur).
Motsora, M.R., P.Bhattacharya and Beena Srivastava (1995). Biofertilizer Technology, Marketing and Usage- A Source Bookcum-Glossary (FDCO, New Delhi).
Subbarao, N.S. 1993. Biofertilizers in Agriculture and Forestry (Oxford and IBH Pub. Co., New Delhi)

HRT 203 Protected Cultivation 3 (2+1)

Objective: To provide broad knowledge on fundamentals of protected cultivation and suitable technologies.

Course outcome: Upon completion of the course students will be able to;

- Explain the fundamentals of climate controlled protected cultivation practices and suitable crops.
- Understand the structural components of the protected cultivation and technologies available.
- Ability to differentiate between polyhouse, greenhouse and nethouse.
- List precision technologies used in climate control, irrigation, fertigation
- Employ the method of production of crops using protected cultivation technologies.

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, Intercultural operations, Soil EC and pH measurement, Regulation of irrigation and fertilizers through drip, fogging and misting.

Suggested Reading:

Vilas M. Salone and Ajay K. Sharma.2012. Greenhouse Technology and Applications. Agrotech Publishers. New Delhi.
S. Prasad and U. Kumar. 2012. Greenhouse Management of Horticultural Crops. Second edition, Agrobios. New Delhi
Joe.J.Hanan. 1998. Green houses: Advanced Technology for Protected Horticulture, CRC Press, LLC. Florida.
K.Radha Manohar and C. Igathinathane, 2013. Greenhouse Technology and Management BS Publications.
Paul V. Nelson. 1991. Green House Operation and Management. Ball publishing USA.

MPT 101 Micro propagation Technologies 3(1+2)

Objective: To introduce to technologies and methods employed in micro-propagation of plants

Course outcome: Upon completion of the course students will be able to;

- Explain the importance of micropropagation to produce superior plant types.
- List the methods employed in micropropagation of plants.
- Identification suitable equipment's, hormonal treatment, selection of explants for propagation.
- Understand the production limitation associated with micro-propagation.

Theory

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

Practical

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

Suggested Reading:

Gamborg, O.L. and Phillips, G.C. 1995. Plant Cell Tissue Organ Culture : Fundamental Methods. Springer, Berlin.

Keshavachandran, R. and Peter, K.V. 2008. Plant Biotechnology: Methods in Tissue Culture and Gene Transfer. Universities Press, Hyderabad.
Smith, R.H., 2013. Plant Tissue Culture : Techniques and Experiments. 3rd ed. Academic Press, San Diego, CA, USA.
Bhojwani, S.S. and Razdan, M.K. 1996. Plant Tissue Culture, Theory and Practice. Elsevier, Netherlands.
Bhojwani, S.S. and Dantu, P.K. 2013. Plant Tissue Culture: An Introductory Text. Springer, India, New Delhi.

HRT 301 Hi-tech. Horticulture 3 (2+1)

Objective: Broadly introduce to the technologically advanced methods of cultivation of horticultural crops.

Course outcome: Upon completion of the course students will be able to;

- Accumulated the skills to cultivate horticultural crops in polyhouse.
- Ability to source and use of precision technologies suitable for hi-tech horticulture.
- Acquired skills to optimize the growth conditions using remotely controlled gadgets.

Theory

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

Practical

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

Suggested Reading:

Prasad, S. And Kumar, U. 2012. Greenhouse Management of Horticultural Crops. 2nd edition, Agribios publishers, New Delhi.
Singh, H.P., Singh, G., Samuel, J.C., and Pathak, R.K.. 2003. Precision Farming in Horticulture. NCPAH, MOA, PFDC, CISH, Lucknow
Srivasthava, K.K.. 2007. Canopy Management of Fruit Crops. International book distributing co., Lucknow
Sahu, K.C. 2008. Text Book of Remote Sensing and Geographical Information Systems. Atlantic publishers & Distributors

AGR 201 Weed Management 3(2+1)

Objective: To provide insights on agronomic practices involved in management of weeds in agricultural fields.

Course outcome: Upon completion of the course students will be able to;

- Able to identify and classify the weeds.
- Able to identify suitable herbicides and bio-herbicides to control the weeds.
- Ability to employ suitable agronomic practices to control the weeds.

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 agro-chemicals and their application. Integration of herbicides with non-chemical methods of weed management. Herbicide Resistance and its management.

Practical

Techniques of weed preservation. Weed identification and their losses study. Biology of important weeds. Study of herbicide formulations and mixture of herbicide. Herbicide and agro-chemicals study. Shift of weed flora study in long term experiments. Study of methods of herbicide application, spraying equipment's. Calculations of herbicide doses and weed control efficiency and weed index.

Suggested Reading:

Gupta, O.P. 2012. Modern Weed Management (4th edition), Agrobios (India) Ltd, Jodhpur
Rao, V.S. 1992. Principles of Weed Science (2nd edition), Oxford & IBH Publishing Co. Pvt Ltd, New Delhi.
Ross, M.A and Lembi, C.A. 1999. Applied Weed Science. (2nd edition), Prentice Hall of India Pvt Ltd, New Delhi
Saraswat, V.N., Bhan, V.M. and Yaduraju, N.T. (eds.).1998. Weed management –ICAR Publication.

SSA 101 System Simulation and Agro-advisory 3 (2+1)

Objective: To provide knowledge on recent development in system approaches to manage agricultural environments using mechanistic models and provide insights on enabling technologies.

Course outcome: Upon completion of the course students will be able to;

- Understand the concepts and theoretical consideration in mechanistic model development.
- Acquired the skills to collect environmental data and use in mechanistic models.
- Ability to forecast environmental parameters of agricultural landscapes.
- Acquired the competency to develop agro-advisory and dissemination of traditional practices of crop management using weather data.

Theory

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

Practical

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

Suggested Reading:

John Walkenbach, Herb Tyson, Michael R. Groh, Faithe Wempen, Microsoft Office 2010 Bible
Bangia, Learning Ms Office 2010
Prof. Satish Jain and M. Geetha, MS-Office 2010 Training Guide
Johnson, Microsoft Office 2010.....on Demand
Kate Shoup, Microsoft Office 2010
Melanie Gass, It's All about You! Office 2010
Nancy Conner and Matthew MacDonald, Office 2010: The Missing Manual

AGJ 101 Agricultural Journalism 3 (2+1)

Objective: To provide the analytical skill sets identify the problems and report it with journalistic ability.

Course outcome: Upon completion of the course students will be able to;

- Able to understand and differentiate between newspaper journalism and agricultural journalism.
- Pragmatically approach reporting issues relevant agriculture in newspapers/magazine.
- Ability to write an issue based article, edit, proofread and publish.

Theory

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

Practical

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

Suggested Reading:

Ray, G.L. and Mondal S. 2005. *Journalism*. KalyaniPublishers, Kalkatta/Ludhiana
Jana, B.L. and Mitra. 2010. *Farm Journalism*. Agrotech Publishing Academy, Udaipur

AnandarajaN ,Chandrakandan K and Ramasubramaniam. 2008. *Extension of Technologies from Labs to Lands*. New India Publishing Agency, New Delhi

BSE 106 Biosafety and Bio-ethics 1 (1+0)

Objective: Provide insights on various aspects of biosafety regulations and bio-ethical concerns arising from the commercialization of products and process developed utilizing biotechnological tools.

Course outcome: Upon completion of the course students will be able to;

- Explain the difference between bio-safety and bioethics.
- Develop a method to safely handle hazardous biological materials in the laboratory.
- Understand the rules and regulation and governing bodies involved in biosafety and bio-ethics.
- Gained a detailed knowledge on biosafety issue related GM crops in agriculture.
- Gained knowledge on the national biosafety rules and regulatory framework, policies.

Theory

Introduction to bio-safety, Biosafety and risk assessment issues; Regulatory framework; National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety, Cross border movement of germplasm; Risk management issues - containment.

General principles for the laboratory and environmental biosafety; Health aspects; toxicology, allergenicity, antibiotic resistance, etc. Impact on environment: gene flow in natural and artificial ecologies; Sources of gene escape, tolerance of target organisms, creation of super weeds/super viruses, etc.

Biosafety: Definition, Biosecurity: Definition, Bio weapons, Definition of Biohazard, Application to Use Biohazardous Materials, Laboratory Safety protocols, Classification of pathogens by risk group, Containment, Safe handling of biological spills, Sterilization and disinfection in the laboratories

Challenges in Animal Biosecurity, Poultry Biosecurity Issues, An awareness of trade issues and their relevance to agricultural biosecurity, An understanding of the foundation principles and basic practices of pest exclusion, eradication, and management tactics for invasive species, An appreciation of early detection and correct identification of new and emerging pest problems, An awareness of news and developments reported in the popular and scientific media, An awareness of the importance of insect vectors to animal and human health, An awareness of the importance of exotic animal disease threats to agriculture.

National Biosafety rules, Applications of National Biosafety rules, Establishment of National Biosafety rules, Functions of National Biosafety committee, Functions of technical advisory committee, Functions of institutional Biosafety committee, Prohibition and license requirement, Confidential information, Risk assessment and risk management, Decision making and communication of decision, Grant of license, Application of re-examination, Special requirement for import and export of living modified organisms, Agriculture pathogen biosafety, Integrated pest management.

Introduction to Ethical analysis of genetic modification, Genetic modification and risk factors, Possible misuse of genetic modification, Nanobiotechnology, Cybernetics, Applications of genetic modification and their ethical issues, Ethical issues related to genetically modified food, Risk factors of GM food, Genetic modifications of animals and their uses, Genetic modifications of animals and their ethical issues. Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Benefits of transgenics to human health, society and the environment.

Personal protective equipment and clothing, plans for emergency preparedness and response, Introduction to the transport of infectious materials, Biosafety and recombinant DNA technology, Hazardous Chemicals, Safety checklist, first aid, Overview of Biosecurity risk assessment methodology, Evaluate the pathogens and toxins, Occupational Health

The WTO and other international agreements; Intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications, etc. Protection of plant variety and farmers right act; Indian patent act and amendments, patent filing; Convention on biological diversity; Implications of intellectual property rights on the commercialization of biotechnology products.

Suggested Readings

Shomini Parashar, Deepa Goel 2013. IPR, Biosafety and Bioethics

Singh BD. 2007. Biotechnology: Expanding Horizon. Kalyani.

<http://patentoffice.nic.in>

www.wipo.org

www.dbtindia.nic.in

www.dbtbiosafety.nic.in

