Discipline wise courses

- **Syllabus**
- **Teaching Schedules**
- **Suggested readings**

B. Sc. (Hons) Agriculture

Agronomy

- **Syllabus**
- **Teaching Schedule**
- **Suggested Readings**

B. Sc. (Hons) Agriculture

Departmentwise list of courses

Agronomy

Sr. No.	Semester	Course No.	Credits	Course Title
1	I	AGRO 111	2(1+1)	Fundamentals of Agronomy-I
2	I	AGRO 112	2(1+1)	Introductory Agro-meteorology and Climate change
3	II	AGRO 123	2(1+1)	Fundamentals of Agronomy-II
4	III	AGRO 234	2(1+1)	Crop Production Technology-I (Kharif crops)
5	III	AGRO 235	2(1+1)	Rainfed Agriculture and Watershed Management
6	IV	AGRO 246	2(1+1)	Crop Production Technology-II (Rabi crops)
7	IV	AGRO 247	1(1+0)	Farming System and Sustainable Agriculture
8	IV	AGRO 248	2(1+1)	Principles of Organic Farming
9	V	AGRO 359	1(0+1)	Practical Crop Production-I (Kharif crops)
10	V	ELE AGRO 3510	3(2+1)	Weed Management
11	VI	AGRO 3611	1(0+1)	Practical Crop Production-II (Rabi crops)
12	VI	AGRO 3612	2(1+1)	Geo-informatics and Nano-technology and Precision Farming
13	VIII	ELM AGRO 4813	10(0+10)	Organic Farming Production Technology
14	VIII	ELM AGRO 4814	10(0+10)	Commercial production of organic inputs (Proposed)
		Total Credits	**42(11+31)**	

Course :	AGRO 111	Credit:	2(1+1)	Semester-I
Course title:	Fundamentals of Agronomy-I			

Syllabus

Theory: Agronomy, its scope and relationship with other sciences, Tillage and tilth, Seeds and sowing. Crop density and geometry, Crop nutrition, Manures and fertilizers.Nutrient use efficiency.Growth and development of crops.Plant ideotypes.Crop rotation and its principles.Study of crop adaptation and its distribution.Harvesting, threshing and Storage of field crops. Weeds - characteristics and classification. Crop - weed competition. Concept of weed management. Herbicides – Classification, selectivity and resistance of herbicide, allelopathic effect of weed.

Practical: Identification of seeds and crop plants at different growth stages. Study of different tillage implements Identification of fertilizers and pesticides. Identification of weed flora in different field crops.Agro climatic zones of Maharashtra and India Operational tillage viz., primary, secondary, inter-tillage. Sowing, harvesting, harvesting implements and working with them. Calculation of Plant Population, Seed rate, fertilizer and herbicide dose for different field crops. Methods of seed germination and viability test. Practice of seed treatments in different field crops. Computation of weed indices Application of manures and fertilizer in important field crops.Application of herbicides in different field crops. Yield contributing characters and yield estimation in different field crops.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Agronomy, its definition, scope, role of Agronomist and relationship of Agronomy with other sciences.	4
2	Tillage, its definition, objects of tillage, types of tillage, tillage implements and factors affecting tillage, Effect of tillage on soil and crop growth.	8
3	Tilth: its definition, characteristics and ideal tilth, Modern concepts of tillage, minimum, zero and stubble mulch tillage, importance of puddling.	6
4	Seed, its definition, characteristics of quality seed, seed treatment and its objectives seed dormancy, causes of seed dormancy and multiplication, stages of seed.	8
5	Methods of sowing seed and sowing implements.	4
6	Effect of plant population on growth and yield, Planting geometry viz., solid, paired and skipped row planting	6
7	Role of plant nutrients in crop production, Importance of manures and fertilizers and its classification.	6
8	Methods and time of application of manures, fertilizers and green manuring.	6
9	Nutrient use efficiency, meaning and factors affecting nutrient use efficiency.	6

Lecture	Topic	Weightage (%)
10	Growth and development, its definition, growth curve and factors affecting growth and development.	6
11	Plant ideotypes, its definition and types of ideotypes.	6
12	Crop rotation, its definition, principles and advantages of crop rotation.	6
13	Study of crop adaptation and its distribution	4
14	Weeds, its definition, characteristics of weeds, merits and demerits of weeds, classification of weeds, meaning of crop weed competition and its period in different crops.	6
15	Principles and methods of weed management viz., cultural, mechanical, chemical, biological weed control methods and integrated weed management.	6
16	Classification of herbicides, its selectivity and resistance, Allelopathic effect of weed.	6
17	Crop harvesting, signs of maturity in different field crops, Physiological and crop maturity, Methods of threshing crops, Cleaning, Drying and Storage of field crops.	6

b) Practical

Experiment	Topic
1	Identification of seeds and crop plants at different growth stages.
2	Identification of different tillage implements.
3	Identification of fertilizers and pesticides.
4	Identification of weed flora in different field crops.
5	Study of agro climatic zones of Maharashtra and India.
6 & 7	Operational tillage viz., primary, secondary,, inter-tillage, sowing, harvesting, harvesting implements, Working with them.
8 & 9	Calculation of Plant Population, Seed rate, fertilizer and herbicide dose for different field crops.
10	Determination of purity and germination percentage of seed, Methods of seed germination.
11	Study of viability test and practice of seed treatments in different field crops.
12	Preparation methods of FYM and compost. (Delet) Computation of weed indices
13	Preparation methods of vermicompost and green manuring. (Delet)
14 & 15	Study of different methods of manures and fertilizer application and their application practice in important field crops.
16	Methods of application of herbicides in different field crops.
17	Study of yield contributing characters and yield estimation in different field crops.

Suggested Readings:

1) Chhidda Singh, Modern techniques of raising field corps. Oxford and IBH Publishing Co. Ltd., Bangalore.

2) Gopal Chandra De. 1980., Fundamentals of Agronomy. Oxford and IBH Publishing Co. Ltd., Bangalore.

3) Hand book of Agriculture, ICAR Publication.

4) Palaniappan, S.P., Cropping Systems in the tropics – Principles and Practices.Willey Eastern Ltd., New Delhi.

5) Panda, S.C., 2006.Agronomy Agribios Publication, New Delhi.

6) Reddy, S.R. Principles of Agronomy Kalyani Publishers, Ludhiana, India.

7) Sankaran, S and SubbiahMudliyar, V.T., 1991. Principles of Agronomy. The Bangalore Printing and Publishing Co. Ltd., Bangalore.

8) Vaidya, V.G., Sahasrabuddhe, K.R. and Khuspe, V.S. Crop production and field experimentation. Continental Prakashan, Vijaynagar, Pune.

9) Rao V.S. (2006), Principles of Weed Science. Oxford and IBH Publishing Co., New Delhi, India.

10) Gupta, O.P. (2008), Modern Weed Management Agribios India Publication.

Course :	AGRO 112	Credit:	2(1+1)	Semester-I
Course title:	Introductory Agro-meteorology and Climate change			

Syllabus

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

Teaching Schedule/ Lesson plan

a) Theory

Lecture	Topic	Weightage (%)
1	Meaning and scope of agricultural meteorology	4
2	Earth's atmosphere - its composition, extent and structure ; Atmospheric weather variables	9
3	Atmospheric pressure – its variation with height	2
4	Wind-types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze	8

Lecture	Topic	Weightage (%)
5	Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, long wave and thermal radiation, net radiation, albedo	8
6	Atmospheric temperature - temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Energy balance of earth	8
7	Atmospheric humidity - concept of saturation, vapour pressure, process of condensation, formation of dew, fog, mist, frost, cloud	8
8	Precipitation –process of precipitation, types of precipitation such as rain, snow, sleet and hail	8
9	Cloud formation and classification	6
10	Artificial rainmaking ; Monsoon mechanism and importance in Indian agriculture	4
11	Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold wave	8
12	Agriculture and weather relations	5
13	Modifications of crop microclimate	4
14	Climatic normals for crop and livestock production	4
15	Weather forecasting - types of weather forecast and their uses	4
16	Climate change , climatic variability, global warming , causes of climate change and its impact on regional and national Agriculture	10

b) Practical

Experiment	Topic
1	Visit of Agrometeorological Observatory.
2	Site selection of observatory, exposure of instruments and weather data recording.
3	Measurement of air temperatures, its tabulation and variation.
4	Measurement of soil temperature.
5	Measurement of rainfall.

Experiment	Topic
6 & 7	Measurement of wind speed and wind direction.
8 & 9	Measurement of evaporation with the help of open pan evaporation.
10	Measurement of evapotranspiration.
11	Measurement of sunshine duration using Campbell Stokes sunshine recorder.
12	Measurement of solar radiation.
13	Measurement of Atmospheric pressure.
14	Measurement of Relative Humidity with the help of Assmann'spsychrometer
15	Determination of Vapour pressure, RH and dew point temperature using hygrometric table
16	Preparation of Synoptic charts.
17	Study of Automatic Weather Station

Suggested Readings

1) Agricultural Meteorology- G.S.L.H.V. Prasad Rao, Kerala Agricultural University Publications.
2) Text book of Agricultural Meteorology – M. C. Varshneya and P. BalkrishnaPillai.
3) Introduction to Agro-meteorology- H. S. Mavi
4) Our Atmosphere- SmitaBhutani
5) Atmosphere, weather and climate – Barry R. G. and Charley R. J. The English Language Book Society and Mathuen and Co. Ltd., Sultolk.
6) Climate, weather and crops in India – D. Lenka.
7) Meteorology – S. R. Ghadekar

Course :	AGRO 123	**Credit:**	2(1+1)	**Semester-II**
Course title:	Fundamentals of Agronomy -II			

Syllabus

Theory: Water Resources of India and Maharashtra and Development Water Management - Role of water in plants. Irrigation scheduling criteria and methods.Quality of irrigation water.Crop water requirement.Water use efficiency, Soil - water–plant relationship.Classification of Soil Water, Soil Moisture Constants, Soil Moisture characteristic curve. Volume Mass Relationship, retention of soil water .Water absorption. Rooting characteristics of plants and moisture extraction patterns and SPAC.Water requirement of different Agronomic crops. Evaporation, Transpiration, Evapo-transpiration, Potential-evapotranspiration, effective raifall and consumptive use of water. Water Use efficiency, Irrigation Efficiencies. Water logging and Management of water logged soils. Crop water management techniques in problematic areas.

Practical: Estimation of soil moisture. Determination of Bulk and Particle Density, Determination of Field Capacity. Determination of PWP. Study of Soil moisture Measuring Devices and its installation, Determination of Infiltration. Estimation of Gross water requirement, Net water requirement, Irrigation Interval, Available Soil Moisture, Scheduling of Irrigation . Methods of surface irrigation, Irrigation Layouts, Study of Drip and Subsurface irrigation Systems and their components, Installation of drip Irrigation system in field, Fertigation , Care and Maintenance of Drip system, Sprinkler, Rain gun, Installation of various measuring devices and Measurement of Irrigation water, Visit to Atomized Irrigation Unit, Visit to ill-drained fields. Study of Drainage systems.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Definition of Irrigation and Water Management, its Objectives and Role of water in plants.	8
2	Water Resources of India and Maharashtra and Development	6
3& 4	Soil- water–plant Relationship, Soil Water, Movement of soil water, Infiltration, permeability, percolation, seepage.	12
5	Volume Mass Relationship, retention of soil water and factors affecting it.	6
6	Classification of Soil Water, Soil Moisture Constants, Soil Moisture characteristic curve	8
7	Water absorption, factors affecting absorption, rooting characteristics, Moisture extraction patterns and SPAC	6
8 & 9	Water requirement, Irrigation Requirement, Gross Irrigation, Net Irrigation, Irrigation interval and Methods of estimation of water requirement and factors affecting it	12

Lecture	Topic	Weightage (%)
10	Water requirement of different Agronomic crops	6
11 & 12	Evaporation, Transpiration, Evapo-transpiration Potential-evapotranspiration, effective raifall and consumptive use of water and factors affecting it.	12
13	Water Use efficiency, Irrigation Efficiencies and factors affecting it.	6
14	Criteria for scheduling of irrigation, Methods of irrigation, advantages, disadvantages.	6
15	Water Quality parameters, Water logging, Causes of water logging, Management of water logged soils.	6
16	Crop management techniques in problematic areas i.e. saline, alkaline, acidic soils.	6

b) Practical

Experiment	Topic
1	Estimation of soil moisture by different methods
2	Determination of Bulk and Particle Density.
3	Determination of Field Capacity by field method and by pressure plate membrane apparatus
4	Determination of PWP by sunflower method and by pressure plate membrane apparatus
5	Study of Soil moisture Measuring Devices and its installation.
6	Determination of Infiltration by Double Ring Infiltrometer.
7	Estimation of Gross water requirement, Net water requirement, Irrigation Interval, Available Soil Moisture.
8	Scheduling of Irrigation by different methods.
9	Methods of surface irrigation, Irrigation Layouts.
10	Study of Drip and Subsurface irrigation Systems and their components.
11	Installation of drip Irrigation system in field.
12	Study of Drip System, Fertigation, Care and Maintenance of Drip system.
13	Study of Pressurized irrigation system, Sprinkler, Rain gun.
14	Installation of various measuring devices and Measurement of Irrigation water.
15	Visit to Atomize Irrigation Units.
16	Visit to ill-drained fields and study of Drainage systems.

Suggested Readings:

1) Principles of Agronomy by S. R. Reddy
2) Crop production and Management by Y. B. Morachand
3) Principles of Agronomy by Sankaran S and V. T. SubbiahMudliyar
4) Principles of Agronomy by T. Yellamanda Reddy and G. H. Sankara Reddy
5) Irrigation Water Managemnt by Dilip Kumar Muzumdar
6) Principles and Practices of Water Management by A. M. Michel
7) Irrigation and Drainage by Lenka D.
8) Soil Management and organic farming By S.C. Panda Agrobios

Course :	AGRO 234	**Credit:**	2(1+1)	**Semester-III**
Course title:	Crop Production Technology-I (Kharif crops)			

Syllabus

Theory: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices **Intercropping, pest and disease management** and yield of *Kharif*crops. Cereals – rice, maize, sorghum, pearl millet and finger millet, **Small millets*** pulses-pigeonpea, mungbean, urdbean, **Cowpea, kidney bean and horse gram***; oilseeds- groundnut, soybean, **Sesame** and **Niger***; fibre crops- cotton & Jute; forage crops-sorghum, cowpea, cluster bean, napier, **pearlmillet and maize***, Grasses - **marvel***.

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

(Note: * new inclusion)

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1 - 5	Cereals – Rice, maize, *kharif*, sorghum, pearl millet and minor millet	35
6 -9	Pulses – Pigeon pea, mungbean, urdbean, cowpea, kidney bean and horse gram	20
10 - 12	Oilseeds – Groundnut, sesame, soybean and Niger	20
13-15	Fiber crops – cotton and jute	15
16-18	Forage crops – Sorghum, cowpea, pearl millet and maize: Grasses–Napier and Marvel	10

b) Practical

Experiment	Topic
1	Rice nursery preparation, transplanting of Rice
2	Sowing of soybean, pigeonpea and mungbean. maize, groundnut and cotton,
3	To study the effect of seed size on germination and seedling vigour of kharif season crops,
4	Effect of sowing depth on germination of kharif crops
5	Calculations of plant population, seed rate and fertilizers doses.
6	Identification of weeds in kharif season crops.

Experiment	Topic
7&8	Top dressing and foliar feeding of nutrients
9&10	Study of yield contributing characters and yield calculation of kharif season crop
11	Study of crop varieties and important agronomic experiments at experimental farm
12&13	Study of forage experiments
14	Morphological description of kharif season crops,
15	Harvesting and threshing of cereals, pulses, oil seeds and cash crops.
16	visit to research centres of related of related crop

Suggested Readings:

1. Modern technique of raising field crops by Chiddasingh
2. Agronomy of field crop by S.R. Reddy
3. Hand book of Agriculture, ICAR New Delhi

Course :	AGRO 235	**Credit:**	2(1+1)	**Semester-III**
Course title:	Rainfed Agriculture and Watershed Management			

Syllabus

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.

Teaching Schedule

a) Theory

Lecture	**Topic**	**Weightage (%)**
1	Rainfed agriculture: Introduction, types, History of rainfed agriculture and watershed in India	6
2-3	Problems and prospects of rainfed agriculture in India	8
4	Soil and climatic conditions prevalent in rainfed areas	8
5	Soil and water conservation techniques	10
6-7	Drought: types, effect of water deficit on physio- morphological characteristics of the plants	10
8-9	Crop adaptation and mitigation to drought	8
10-11	Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices	10
12	Management of crops in rainfed areas	8
13-14	Contingent crop planning for aberrant weather conditions	10
15	Concept, objective, principles and components of watershed management	8
16	Factors affecting watershed management	8

b) Practical

Experiment	Topic
1	Studies on Agro-climate zones of India
2	Studies on Agro-climate zones of Maharashtra
3-4	studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons
5	Studies on cropping pattern of different rainfed areas in the country
6	Demarcation of rainfed area on map of India
7	Studies on interpretation of meteorological data (rainfall, temperature, humidity etc.)
8-9	Studies on critical growth stages of different crops and irrigation scheduling for survival of crops
10	Studies on drought, its classification and effect on crop growth
11	Study on effective rainfall and its calculations
12-13	Studies on different soil and moisture conservation practices for mitigating moisture stress
14	Studies on watershed, its characteristics and delineation of model watershed
15	Studies on field demonstration on soil and moisture conservation measures
16	Studies on field demonstration on water harvesting studies
17	Visit to rainfed research station/ watershed areas

Suggested Readings:

1) Sustainable Development of Dryland Agriculture in India – R. P Singh
2) Dry Farming Technology in India – P. Rangaswamy
3) Dryland resources and Technology – Vol. 8 L.L Somani, K.W. Kaushal
4) Physiological Aspect of Dryland Farming – U.S Gupta
5) Principles of Agronomy S.R. Reddy
6) Dryland Technology – M.L. Jat, S.R. Bhakar, S.K. Shrma , A. K. Kothri
7) Climate, Weather and Crops in India – D. Lenka

Course :	AGRO 246	**Credit:**	2(1+1)	**Semester-IV**
Course title:	Crop Production Technology-II (Rabi crops)			

Syllabus

Theory : Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops; cereals –wheat and barley, **Rabi Sorghum* and maize*,** pulses-chickpea, lentil, peas, **French bean*** oilseeds-rapeseed, mustard and sunflower; **Safflower*, linseed*** sugar crops-sugarcane; **Sugar beet*,** medicinal and aromatic crops-mentha, lemon grass and citronella, Forage crops-berseem, Lucerne, oat., m**aize* and sorghum* and other crops –Tobacco* and sweet potato***

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. **Mechanization in crop cultivation of *kharif*crops.***

(Note: * new inclusion)

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1 - 5	Cereals – Wheat, sorghum, barley and maize (grain corn, sweet corn and baby corn)	30
6-8	Pulses – Chickpea, lentil, pea, French bean	15
9-12	Oilseeds – Sunflower, safflower mustard and linseed	25
13	Sugar crop – Sugarcane and sugar beet	10
14-15	Other crops – Potato, tobacco and sweet potato	10
16-18	Forage crops – Lucerne, berseem, maize, oat and sorghum	10

b) Practical

Experiment	Topic
1	Sowing methods of wheat
2	Sowing method of sugarcane,
3	Identification of weeds in rabi season crops,
4&5	Study of morphological characteristics of rabi crops
6	Calculations of plant population, seed rate and fertilizers doses.
7&8	Study of yield contributing characters of rabi season crops
9	Study of yield and juice quality analysis of sugarcane
10 & 11	Study of important agronomic experiments of rabi crops at experimental farms.

Experiment	Topic
12	Study of rabi forage experiments
13 &14	Oil extraction of medicinal crops
15	Visit to research stations of related crops.

Suggested Readings:

1. Modern technique of raising field crops by Chiddasingh
2. Agronomy of field crop by S.R. Reddy
3. Hand book of Agriculture, ICAR New Delhi

Course :	AGRO 247	**Credit:**	1(1+0)	**Semester-IV**
Course title:	Farming System and Sustainable Agriculture			

Syllabus

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.

Teaching Schedule

Theory

Lecture	Topic	Weightage (%)
1-2	Farming systems – Definition, scope, concept and objective of Farming Systems,.	8
3	Classification of Farming systems and factors affecting it.	4
4	Study of different components of Farming System and their maintenance	8
5-6	Definition of Cropping systems, cropping pattern, Multiple cropping systems and its classification, advantages and disadvantages.	8
7	Study of efficient Cropping systems and allied enterprises.	4
8& 9	Assessment tools for determining production and efficiencies in cropping systems and farming systems (Based on land use efficiency, biological potential and economic criteria).	12
10 & 11	Sustainable Agriculture: Definition, Principles, Goals, Problems and its importance in Agriculture, Sustainability Index and Conservation Agriculture	10
12	Impact of LEIA (Low External Input Agriculture) and HEIA (High External Input Agriculture) on crop productivity and sustainable agriculture.	8
13	Integrated Farming System, historical background, characteristics, objectives, components and its advantages.	10

Lecture	Topic	Weightage (%)
14	Development of site specific IFS models for different Agro climatic zones, its resource use efficiency and optimization technique	10
15	Farming systems in relation to environment, its resource cycling and flow of energy	10
16	Visit to various IFS models.	8

Suggested Readings:

1) Cropping systems Theory and Practice -Chatterjee B.N. and Maiti S.

2) Cropping Systems in Tropics – Principles and practices. -Palanniappan S.P.

Course :	AGRO 248	**Credit:**	2(1+1)	**Semester-IV**
Course title:	Principles of Organic Farming			

Syllabus

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

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

Teaching Schedule

a) Theory

Lecture	**Topic**	**Weightage (%)**
1	Organic Farming, Definition, Principles and its Scope in India and world	9
2 &3	Initiative taken by Govt, NGO and Organizations for promotion of Organic Agriculture	10
4	Organic ecosystem and their concepts	7
5	Organic nutrient, resources and its fortification	8
6	Restriction to Nutrient use in Organic Farming	8
7	Choice of Crops and Varieties in Organic Farming	8
8 & 9	Fundamentals of insect pest and disease management under organic mode of production	7
10	Weed Management in Organic mode of Production	8
11	Operational structure of NPOP	5
12 & 13	Certification process and Standards of Organic Farming	10
14 & 15	Processing, Labeling and Economic consideration and its viability in Organic production	10
16	Export potential of Organic products	10

b) Practical

Experiment	Topic Details
1.	Visit to Organic Farm to study the various components and their utilization
2.	Study of Preparation methods for Enriched compost.
3.	Study of Preparation methods for Vermicompost and vermiwash.
4.	Study of biofertilizers and bio-inoculants
5.	Study of preparation of Biodynamic compost and cow pat pit
6.	Study of quality analysis of compost and vermicompost.
7.	Study of crop residue management and green manuring
8 & 9.	Study of indigenous technology knowledge (ITK) for nutrient, insect, disease and weed management.
10.	Study the method of preparation and Production cost of *Panchagavya, Beejamrut*and *Jeevamrut*in Organic farming
11.	Study the method of preparation and Production cost of *Dashparni, Neem Seed extract,* in Organic farming
12&13.	Study of post-harvest management in Organic Farming.
14 & 15.	Study of Quality aspects : Grading, Packing, Handling.
16.	Visit to Biocontrol Laboratory and Biofertilizer and vermicompost Unit

Suggested Readings:

1) Organic Farming for Sustainable Agriculture by Dahama A. K. Agrobios Publication.
2) Organic Farming: Theory and Practices by Palanippan, S.P. and Anaadurai, K.
3) Organic Farming in India, Problems and Prospects byThapa, U. and Tripathi, P.
4) Trends in Organic Farming in India by Agrobios Publication
5) Handbook of Organic Farming.
6) Recent Developments in Organic farming by Gulati and Barik

Course :	AGRO 359	**Credit:**	1(0+1)	**Semester-V**
Course title:	Practical Crop Production-I (Kharif crops)			

Syllabus

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.**Study of farm inventories and records*,**

(To get practical oriented knowledge to the student, 2 R area per student will be allotted for raising *kharif*crop of the region. The student has to raise the crop from sowing to harvesting threshing, drying, winnowing, storage and preparation of produce for marketing. Also he has to study the cost of cultivation, net return per student as well as per team of a group of students.*)

(Note: * new inclusion)

Teaching Schedule

Practical

Ex. No.	Topic
1	Introduction, aims and objectives of practical crop production – Allotment of plot and its history.
2	Study of seed production of *kharif* crops
3	Study of mechanization and resource conservation of *kharif* crops
4	Study of physical and chemical properties of the allotted plot to the students.
5	Study of package of practices for growing *kharif* crop (timely, late and rainfed).
6	Study of farm inventories and records
7	Preparation of calendar of operation for *kharif* crop.
8	Study of preparatory, secondary tillage and seed bed preparation for *kharif* crop.
9	Sowing and seed treatment of *kharif* crop.
10	Study of integrated nutrient management of *kharif* crop.
11	Study of water management to *kharif* crop.
12	Determination of germination/emergence count of *kharif* crop.
13	Study of growth and yield contributing characters of *kharif* crop.
14	Study of interculturing and weed management in *kharif*crop.
15	Study of integrated insect pest and diseases management in *kharif* crop
16	Study of crop maturity signs and harvesting of*kharif crops*
17	Threshing, drying, winnowing, storage and preparation of produce for marketing of *kharif* crop.
18	Study of cost of cultivation and working out net returns per student
19	Study of post harvest technology of *kharif* crop.
20	Summary report of practical crop production
21	Study of weekly weather record for *kharif*season.

Note:

To get practical oriented knowledge to the student, 2 R areas per student will be allotted for raising *kharif*crop of the region. The student has to raise the crop from sowing to harvesting threshing, drying, winnowing, storage and preparation of produce for marketing. Also he has to study the cost of cultivation, net return per student as well as per team of a group of students

Suggested Readings:

1. Modern technique of raising field crops by Chiddasingh
2. Agronomy of field crop by S.R. Reddy
3. Hand book of Agriculture, ICAR New Delhi

Course :	ELE AGRO 3510	**Credit:**	3(2+1)	**Semester-V**
Course title:	Weed Management (Elective)			

Syllabus

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.

Teaching Schedule

a) Theory

Lecture	**Topic**	**Weightage (%)**
1-2	Introduction and importance of weeds	6
3-4	Characteristics of weeds	6
5-6	Harmful and beneficial effects of weeds on ecosystem.	8
7-8	Classification of weeds, Shift of weed flora	6
9-10	Reproduction and dissemination of weeds	8
11	Classification of herbicides	6
12-13	Concept of adjuvant and surfactants	6
14	Herbicide formulation and their use	4
15-16	Introduction to mode of action of herbicides	6
17	Introduction to herbicide selectivity	4
18-19	Allelopathy and its application in weed management	8
20-21	Bio herbicides and their application in Agriculture	8
22-23	Concept of herbicide mixture and its utility in Agriculture	6
24-25	Herbicide compatibility with Agrochemicals	4
26	Herbicide compatibility with fertilizers	2
27-28	Integration of herbicides with non chemical methods of weed management	6
29-30	Herbicide resistance and its management	6
	Total	**100**

b) Practical

Experiment	Topic
1-2	Identification of weeds
3	Techniques of weed preservation
4	Study of losses caused by weeds
5 - 6	Biology of important weeds
7	Study of herbicide formulation and herbicide mixtures
8	Study of herbicide in relation to Agrochemicals
9	Phyto-toxicity symptoms on crops and its measurement
10	Methods of herbicide application
11-12	Herbicides application equipments and their calibration
13	Calculation of herbicide dose
14	Computation of different weed indices
15	Visit to weed management experiments

Suggested Readings:

1) Aldrich, R.J. and Kramer R.J. (1997), Principles in Weed Management.
2) Gupta O.P. (2007), Weed management Principles and Practices.
3) Gupta, O.P. (2008), Modern Weed Management
4) Gupta, O.P. 1984. Scientific Weed Management Today and Tomorrows.
5) Jayakumar, R. And Jagannathan, R. (2007). Weed Science Principles.
6) Mandal R.C. (1999), Weed, Weedicides and Weed control Principles and Practices.
7) Rao V.S. (2006), Principles of Weed Science.

Course :	AGRO 3611	**Credit:**	2(0+2)	**Semester-VI**
Course title:	Practical Crop Production-II(Rabi crops)			

Syllabus

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.

(To get practical oriented knowledge to the student, 2 R area per student will be allotted for raising *rabi*crops of the region. The student has to raise the crop from sowing to harvesting threshing, drying, winnowing, storage and preparation of produce for marketing. Also he has to study the cost of cultivation, net return per student as well as per team of a group of students.*)

(Note: * new inclusion)

Teaching Schedule

Practical

Experiment	**Topic**
1	Introduction, aims and objectives of practical crop production – Allotment of plot and its history.
2	Study of seed production of *rabi* crops
3	Study of mechanization and resource conservation of *rabi* crops
4	Study of physical and chemical properties of the allotted plot to the students.
5	Study of package of practices for growing *rabi* crop (timely, late and rainfed).
6	Preparation of calendar of operation for *rabi* crop.
7	Study of preparatory, secondary tillage and seed bed preparation for *rabi* crop.
8	Sowing and seed treatment of *rabi* crop.
9	Study of integrated nutrient management of *rabi* crop.
10	Study of water management to *rabi* crop.
11	Determination of germination/emergence count of *rabi* crop.
12	Study of growth and yield contributing characters of *rabi* crop.
13	Study of interculturing and weed management in *rabi*crop.
14	Study of integrated insect pest and diseases management in *rabi* crop
15	Study of crop maturity signs, harvesting of *rabi* crop
16	Threshing, drying, winnowing, storage and preparation of produce for marketing of *rabi* crop.
17	Study of cost of cultivation and working out net returns per student

Experiment	Topic
18	Study of post harvest technology of *rabi* crop
19	Summary report of practical crop production
20	Study of weekly weather record for *rabi*season.

Note:

To get practical oriented knowledge to the students, 40 R area per batch will be allotted for raising *rabi*crop of the region, viz., land preparation, sowing to harvesting, threshing, drying, winnowing, storage and preparation of produce for marketing. Study of cost of cultivation, net return and B : C ratio**.**

Suggested Readings:

1. Modern technique of raising field crops by Chiddasingh
2. Agronomy of field crop by S.R. Reddy
3. Hand book of Agriculture, ICAR New Delhi

Course :	AGRO 3612	**Credit:**	2(1+1)	**Semester-VI**
Course title:	Geo-informatics and Nano-technology and Precision Farming			

Syllabus

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

Teaching Schedule

a) Theory

Lecture	**Topic**	**Weightage (%)**
1	Precision agriculture: concepts and techniques; their issues and concerns referencefor Indian agriculture	4
2	Geo-informatics system- Definition, concepts, tool and techniques; their use in Precision farming.	7
3	Crop discrimination and Yield monitoring	4
4	soil mapping; fertilizer recommendation using geospatial technologies	5
5	Spatial data and their management in GIS	8
6	Remote sensing concepts and application in agriculture	8
7	Image processing and interpretation	8
8	Global positioning system (GPS), components and its functions	9
9	Introduction to crop Simulation Models	5

Lecture	Topic	Weightage (%)
10	Uses of crop simulation models for optimization of Agricultural Inputs	7
11	STCR approach for precision agriculture	5
12	Nanotechnology- Definition, concepts and techniques	7
13	Brief introduction about nanoscale effects, nano-particles	5
14	Nano-pesticides, nano-fertilizers, nano-sensors	7
15	Use of nanotechnology in seed & water for scaling-up farm productivity.	6
16	Use of nanotechnology in fertilizer & plant protection for scaling up farm productivity	5

b) Practical

Experiment	Topic
1	Introduction to GIS software, spatial data creation and editing
2	Introduction to image processing software
3	Visual and digital interpretation of remote sensing image by software
4	Generation of spectral profiles of different objects
5	Supervised and unsupervised classification and acreage estimation
6	Multispectral remote sensing for soil mapping
7	Soil fertility map by GIS
8	Creation of productivity and management zone by GIS
9	VRT technique for fertilizer recommendation
10	STCR technique for fertilizer recommendation for targeted yield
11	Calculation of crop stress geospatial technique
12	Agricultural Survey by GPS and DGPS
13	Formulation and characterization of nanoparticles
14	Applications of nanoparticles in agriculture
15	Projects related by precision farming.

Suggested Readings:

1) GIS : Fundamentals, Applications & Implementations – Dr. K Elangovan New India publishing Agency, New Delhi.

2) Remote sensing , GIS and wet land management - ErTasneemAbbasi& Prof. S.A. Abbasi

B. Sc. (Hons) Agriculture

Agricultural Botany

- **Syllabus**
- **Teaching Schedule**
- **Suggested Readings**

B. Sc. (Hons) Agriculture

Department wise list of courses

Botany (Genetics and Plant Breeding, Physiology and Seed Technology)

Sr. No.	Semester	Course No.	Credits	Course Title
1	II	GPB 121	3(2+1)	Fundamentals of Genetics
2	II	BOT 121	2(1+1)	Fundamentals of Crop Physiology
3	III	GPB 232	2(1+1)	Fundamentals of Plant Breeding
4	IV	GPB 243	3(2+1)	Principles of Seed Technology
5	IV	ELE GPB 244	3(2+1)	Commercial Plant breeding
6	IV	ELE BOT 242	3(1+2)	Micropropogation Technologies
7	V	GPB 355	2(1+1)	Crop Improvement – I (Kharif Crops)
8	V	BOT 353	1(1+0)	Intellectual Property Right
9	VI	GPB 366	2(1+1)	Crop Improvement – II (Rabi crops)
10	VIII	ELM BOT 481	10(0+10)	Seed production and Technology
11	VIII	ELM.BOT 482	10=0+10	Tissue culture Technologies

Course :	GPB 121	**Credit:**	3(2+1)	**Semester-II**
Course title:	Fundamentals of Genetics			

Syllabus

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.

Teaching Schedule

A) Theory

Lecture	Topic	Weightages (%)
1	**Pre and post Mendelian concepts of heredity:** **Pre Mendelian concepts: (500 BC -1850 A.D.)** 1.Pre formation Theory 2.Theory Epigenesis 3.Theory of Acquired characters 4.Theory of Pangenes 5.Germplsm theory Other contributions during pre-Mendelian era **Mendelian Era:(1850 -1900):**Contributions during Mendelian era **Post Mendelian concepts:** Contributions during Post-Mendelian era and recent advances after 1900. Role of different disciplines in the advancement of Genetics. Impact of Genetics and its applications in different disciplines (Role in Agriculture)	2
2	**Mendelian principles of heredity:**	3

Lecture	Topic	Weightages (%)
	Laws of Mendel, Reasons of Mendel's success Mendelian deviations or exceptions or anomalies	
3 & 4	**Cell division: Mitosis, Meiosis:** Cell: Ultra structure, Cell organells & their functions. Types of Cell, Difference between animal cell and plant cell. **Stages of mitosis & meiosis.** Significance of mitosis & meiosis Difference between mitosis & meiosis.	4
5	**Dominance relationships:** Different patterns of dominance relationship like Complete dominance, Incomplete dominace, Co-dominance, Overdominance and Lethal gene action.	2
6, 7 & 8	**Gene interaction, Epistasis interactions with examples:** Difference and similarities between epistasis and dominance. 1.Recessive epistasis (Supplementary gene action) 2.Dominant epistasis (Simple epistasis) 3. Dominant Inhibitory epistasis (Inhibitory gene action) 4. Duplicate recessive epistasis (Complementary gene action) 5. Duplicate dominant epistasis (Duplicate gene action) 6. Polymeric gene action 7.Typical dihybrid ratio	8
9	**Multiple alleles:** Important features of multiple alleles Examples of multiple alleles 1) Fur colour in a rabbit, 2) ABO blood group in man	3
10	Pleiotropism , pseudo-alleles, penetrance and expressivity	2
11 & 12	**Sex determination and sex linkage, Sex limited and sex influenced traits.** Introduction, Importance of Sex determination, Difference between autosomes and allosomes. Allosomal sex determination: 1.XX-XY System 2. XX-XO System 3.XO-XX System 4. ZW-ZZ (XY-XX) System Sex linked characters: (Colour blindness in human being) Difference between Sex limited and sex influenced traits:	6
13	**Linkage and its estimation:** Introduction, Features of Linkage, Phases of Linkage, Types of Linkage, Linkage and pleiotropy, Significance of Linkage.	4
14	**Crossing over mechanisms:** Introduction; main features of crossing over; Types of crossing over; Molecular Mechanism of Crossing over; Factors affecting crossing over, Interference and Coincidence; Differences between crossing over and linkage; Significance of Crossing over.	4
15	**Probability and Chi-square :** Definition of Probability and Chi-square; The application and requirement of Chi-square test.	2

Lecture	Topic	Weightages (%)
16	**Chromosome mapping:** Definition and Concept.	2
17	**Structural changes in chromosome:** Introduction; Types of Structural chromosome changes; Genetic effects and Significance.	4
18 &19	**Mutation**: Introduction; Characteristics of Mutation;classification of Mutation; Kinds of Mutation, Mutagenic agents and induction of mutation; Application in crop improvement.	8
20	**Qualitative & quantitative traits, Polygenes and continuous variations:** Introduction; Characteristics of Qualitative & quantitative traits; Examples of Qualitative & quantitative traits.	4
21	**Multiple factor hypothesis:** Introduction; Concept of multiple factor hypothesis by Nilsson – Ehle in Wheat.	4
22	**Cytoplasmic inheritance:** Introduction; Characteristics of Cytoplasmic inheritance; Difference between mendelian inheritance and Cytoplasmic inheritance; classes of cytoplasmic inheritance; Plastid and mitochondrial inheritance; Significance of Cytoplasmic inheritance in crop improvement.	3
23	**Genetic disorders:** Introduction; Gene action in man, diseases caused by metabolic disorders like Alkaptonuria, Phenyl ketonuria, Albinism, tyrosinosis and Goitrosus Cretinism, Sickel cell anemia.	3
24 & 25	**Nature, structure & replication of genetic material:** Introduction; DNA as a genetic material, Structure of DNA; Replication of DNA- Dispersive, Conservative, Semi-Conservative. Difference between DNA and RNA	8
26 & 27	**Protein synthesis, Transcription and translational mechanism of genetic material:** Introduction; Transcription; mechanism of transcription; Translational; mechanism of translational; Difference between transcription and translational.	8
28 & 29	**Gene concept** : Gene structure, fine structure of gene, Classical and modern concept of gene, Benzer concept of fine structure of gene., Citron, Recon, Muton	8
30, 31 & 32	**Gene function and gene regulations, Lac and operons:** Introduction; Mechanism of gene regulation 1. Negative regulation 2. Positive regulation The Operon Model	8
	Total	**100**

B) Practical

Exercise	Topic
1	Study of microscopes
2	Study of cell structure
3	Preparation of microscopic Slides of mitosis - onion root tips
4	Preparation of microscopic Slides of meiosis – tradescantia /onion /Wheat inflorescence
5.	Methods of finding out the gametes and gametic recombination
6.	Problems on monohybrid ration and its modification
7	Problems on dihybrid ratio and its modification
8	Experiments on test cross and back cross
9	Gene interaction – I Gene interaction without modification of F_2 ratio (comb-shape) and complementary gene interaction.
10	Gene interaction – II Gene interaction with modification of F_2 ratio: supplementary factor, epistatis factor, inhibitory factor
11	Gene interaction – III Gene interaction with modification of F_2 ratio: Additive factor, duplicate factor and lethal factor
12	Problems on probability and Chi-square test
13	Chi-square test Problems on
14	Determination of linkage and cross over analysis (though two point test cross and three point test cross data)
15	Study on sex linked inheritance in Drosophila
16	Study of models on DNA and RNA structure

Suggested Reading:

Sr. No	Title of Book	Author/Authors	Publisher
1.	Principle of Genetics	E. J. Gardner , M. J. Simmons, D. P. Snustad	Wiley India (P) Ltd.
2.	Genetics	P. K. Gupta	Restogi publication Meerut - (p)
3.	Fundamentals of Genetics	B. D. Singh	Kalyani Publication, New Delhi.
4.	Genetics	M.W. Strickbearger	Peerson education, Inc.
5.	Elements of Genetics	Phundansingh	Kalyani Publication, New Delhi
6.	Genetics	Sushant Elrod and William Stansfield	McGraw Hill Publishing company Limited, New Delhi.

Course :	BOT 121	**Credit:**	2(1+1)	**Semester-II**
Course title:	Fundamentals of Crop Physiology			

Syllabus

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 CO_2 assimilation by Infra Red Gas Analyser (IRGA).

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Introduction to Crop Physiology and its importance in Agriculture	5
2	Plant cell- structure, cell organelles and their role	5
3-4	Absorption of water and path of water. Ascent of sap and theories of ascent of sap	10
5	Transpiration- Definition, types , structure of stomata, physiology of stomata, factors affecting transpiration, Water use efficiency & factors affecting W.U. E.	5
6	Mineral nutrition of plants. Classification of mineral element, criteria of essentiality. General and specific role of mineral element and deficiency symptoms, mechanism of mineral element uptake.	10
7-8	Photosynthesis : Definition pigment involved, structure of chloroplast, light reaction- Photolysis of water, Emersion effect, Cyclic and non cyclic electron transfer, Significance of light reaction.	10
9	Dark reaction- C_3, C_4 and CAM plants factors affecting photosynthesis, Photorespiration	5
10	Respiration- Definition, types, glycolsis TCA cycle and electron transport chain	10
11	Fat metabolism- fatty acid synthesis and break down	5
12	Plant Growth Regulators, Definition, types , physiological role and Agricultural uses of PGRS.	10

Lecture	Topic	Weightage (%)
13	Growth : Definition, types of growth, measurement of growth, growth analysis	5
14-15	Physiological aspects of growth and development of important cereals, pulses and oil seed crops	15
16	Photoperiodism- Definition, types, SDP, LDP and Day neutral plants- Induction a flowering and florigene concept	5
Total		**100**

b) Practical

Experiment	Topic
1	Study of plant cell
2	Study of imbibitions
3	Study of osmosis
4	Study of plasmolysis
5	Study of root pressure
6	Measurement of rate of transpiration
7	Study of structure and distribution of stomata
8	Estimation of relative water content of tissue
9	Study of separation of photosynthetic pigment through paper chromatography
10	Measurement of rate of photosynthesis by different methods
11	Study of respiration and respiratory quotient
12	Rapid tissue tests for macro-elements
13	Rapid tissue tests for micro-elements
14	Study of use of PGR in fruit ripening
15	Effect of osmotic pressure on seed germination.
16	Measurement of Plant growth.

Suggested Readings:

Sr. No.	Name of Book	Author	Publisher
1	A Text Book Plant Physiology*	Dr. V. Verma	Emkay Publisher, Delhi-110 051
2	Plant Physiology*	S. N. Pandey& B. K. Sinha	Vikas Publishing House, New Delhi-110 014
3	Practical Plant Physiology*1967	Amar Singh	Kalyani Publisher, Ludhiana
4	Plant Physiology*2005	C. P. Malik	Kalyani Publisher, Ludhiana
5	Plant Physiology@	K. N. Dhumal, T. N. More and M. R. Munnali	Niraliprakashan, Pune
6	Plant Physiology	Robert M. Devlin & Francis H. Witham	CBS Publisher & Distributors, Delhi-110 032
7	Plant Physiology@	H. S. Shrivastava	Rustogi Publications, Meerut-250 002
8	Crop Physiology*	C. N. Chore, S. R. Ghadekar& R. K. Patil	Agromet Publisher, Nagpur-440 010
9	Plant physiology 2005@	S. Mukharji and A. K. Ghosh	New central book agency, Kolkatta
10	Plant physiology*2010	Taiz&Zeiger, E	Sinaurasso.Inc,USA
11	Introductory Plant physiology* 2013	G. Roy Noggle& George friz	PHI learning pvt ltd, N. Delhi
12	A Text Book Plant Physiology* 2005	c. P. Malik & A. K. Srivastava	Kalyani publisher, Ludhiyana
13	Plant Physiology@1993	S. Chandra Datta	Wiley Eastern ltd, Daryaganj, N. Delhi
14	Experiment in Plant Physiology –A Lab. Manual * 1998	DayanandBajracharya	Narosa publishing house, panchshil park, N. Delhi
15	Plant Physiology – fundamentals & applications @2005	Arvindkumar& S. S. Purohit	Agrobios (India), Jodhpur
16	Modern Plant physiology 2007@	R. K. Sinha	Narosa publishing house, panchshil park, N. Delhi

*Text book & practical book
@Reference book

Course :	GPB 232	Credit:	2(1+1)	Semester-III
Course title:	Fundamentals of Plant Breeding			

Syllabus

Theory

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

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1.	**Objective and Concept-** of plant breeding**,** **Nature-** Art, science or technology**,** **Definitions** of plant breeding, and **Role of plant breeding-** in crop improvement **Historical development-** significant landmarks made in the history of plant breeding	3
2.	**Historical development-** Contribution of Indian plant breeders **Major achievements-** Semi-dwarf wheat and rice, nobalisation of sugarcane, hybrid millets, hybrid cotton, etc. **Future prospects-** Crop improvement through plant breeding for current situations like climate change, improving nutritional status	

Lecture	Topic	Weightage (%)
	of crop plant, multiple resistance, improving yield per unit area, etc. by using tissue culture, genetic engineering and molecular techniques **Genetics in relation to plant breeding-** Awareness of science of genetics for deciding appropriate breeding approaches for developing plants with desired combination of traits	
3	**Self incompatibility-** Definition, classification, heteromorphic SI, its features, distyly, tristyly, homomorphic SI, its types i.e. gametophytic SI and sporophytic SI, its features, mechanism of SI, utilization of Self incompatibility in plant breeding	6
4	**Male sterility-** Definition, Classification/types, Genetic MS, Thermosensitive Genetic MS, Photosensitive Genetic MS, Transgenic MS, Cytoplasmic MS, Cytoplasmic Genetic MS, Chemical Hybridizing Agents	
5	**Male sterility-** maintenance of MS, diversification of MS and Restorer **Genetic consequences-** genetic consequences of MS **Cultivar options-** development of hybrid by using MS	
6	**Domestication-** Definition, concept, changes under domestication **Acclimatization-** Definition, concept, factors affecting acclimatization	5
7	**Introduction-** Definition, purpose, types i.e. primary and secondary introduction, advantages and disadvantages, Gene pool concept **Centre of origin / diversity-** Definition, concept, list of main and sub centres of origin and crop diversity found, types of centres of diversity i.e. primary, secondary and micro-centres of diversity	
8	**Components of genetic variation-**, Classification, definition and features of additive, dominance and epistatic variance, gene action	4
9	**Heritability-** Definition, types-narrow and broad sense heritability **Genetic advance-** Definition, factors affecting genetic gain under selection	
10	**Genetic basis and breeding methods in self - pollinated crops:** Definition of plant breeding method, factors affecting choice of plant breeding method, general and special methods of breeding, list of plant breeding methods for self pollinated crops **Pure line selection-** Definition, detailed procedure of development of pure line	5
11	**Pure line selection-** uses of pure line, merits, demerits, achievements **Mass selection-** Definition, genetic basis, main features, positive and negative selection, detailed procedure of development of variety by mass selection, its merits, demerits, achievements	
12	**Hybridization techniques-** Definition, aim and objectives, types of hybridization, steps and procedure of hybridization programme **Handling of segregating population through Pedigree method-** definition of pedigree, pedigree record, application of pedigree method	8
13	**Handling of segregating population through Pedigree method-** detailed procedure of pedigree method, its merits, demerits, achievements	

Lecture	Topic	Weightage (%)
	Handling of segregating population through shuttle breeding method- concept of shuttle breeding, detailed procedure of shuttle breeding method, its comparison with pedigree method	
14	**Handling of segregating population through Bulk method-** Concept of bulk method, short term, long term, its application, procedure of bulk method, its merits, demerits, achievements	
15	**Handling of segregating population through Single seed descent method-** concept of SSD method, its application, detailed procedure of SSD method, its merits, demerits, achievements **Back cross method-** Definition of backcross, its objective, requirements and applications of backcross method, procedure for transfer of dominant gene	6
16	**Back cross method-** procedure for transfer of recessive gene, merits, demerits, achievements of backcross method **Multiline concept-** concept, procedure for development of multiline, its merits, demerits, achievements	
17	**Concepts of population genetics-** Definition and concept of population genetics, random mating population, gene and genotypic frequency **Hardy-Weinberg law-** Law, its validity, factors affecting gene frequency	2
18	**Genetic basis-** Genetic basis of breeding cross pollinated crops **Methods of breeding cross pollinated crops-** list of plant breeding methods for cross pollinated crops **Modes of selection-** Progeny selection, ear-to-row method, modified ear-to-row method	6
19	**Modes of selection-** Recurrent selection, its types and its procedure	
20	**Heterosis-** Definition, heterosis and hybrid vigour, effects and estimation of heterosis, genetic basis/theories of heterosis, fixation of heterosis, effects of heterosis **Inbreeding depression-** Definition, types and effects of inbreeding depression	8
21	**Development of inbred lines-** Selfing heterozygous population, DHLs, evaluation of inbred lines **Hybrids-** Definition of hybrid variety, main features of hybrids, production of hybrid seeds, merits and demerits of hybrid breeding	
22	**Composite and synthetic varieties-** Definition, steps for development of composites and synthetics, procedure of developing composites and synthetics, its merits, demerits and achievements	5
23	**Breeding methods in asexually propagated crops:** List of breeding methods for asexually propagated crops. **Clonal selection-** Definition, features of asexually propagated crops, procedure of clonal selection, its merits and demerits **Hybridization and Clonal Selection-** steps and procedure of hybridization in clonal crops	6
24	**Wide hybridization-** Definition, types, main features, interspecific and intergeneric hybridization, its examples, incompatibility barriers for wide hybridization, techniques for overcoming incompatibility barriers, achievements	5

Lecture	Topic	Weightage (%)
	Pre-breeding- Definition; concept of pre-breeding, primary, secondary and tertiary gene pool and its utilization	
25	**Polyploidy in relation to plant breeding-** Definition of haploid, monoploid, diploid, polyploid, genome, heteroploidy, annuploidy, euploidy, types of annuploidy its application in crop improvement, types of polyploidy (natural occurring and artificial) and its role in crop improvement, effects of polyploidy, its application in crop improvement and limitation	5
26	**Mutation breeding method and its uses –** Definition of mutation breeding, conditions in which mutation is rewarding, procedure of mutation breeding for seed and vegetatively propagated crops, applications, its merits, demerits and achievements	6
27	**Breeding for important biotic & abiotic stresses :** Definition of stress, biotic and abiotic stress **Biotic stresses-** Types/nature of disease resistance, types of genetic resistance i.e. vertical, horizontal, cytoplasmic and systemic acquired resistance, gene-for-gene concept,	12
28	**Biotic stresses-** mechanism and sources of disease resistance, methods of breeding for disease resistance, achievements Mechanism of insect resistance i.e. antibiosis, antixenosis, tolerance, basis of insect resistance i.e. morphological, physiological, biochemical; genetics of insect resistance, sources of insect resistance, methods of breeding for insect resistance, screening techniques, advantages and disadvantages of resistance breeding	
29	**Abiotic stresses-** Types of abiotic stresses, definition of drought resistance, mechanism of drought resistance, basis of drought resistance i.e. morphological traits and physiological factors, sources of drought resistance, methods of breeding and measures of drought resistance	
30	**Abiotic stresses-** Temperature stress-heat, chilling, freezing; nature and effects of heat stress, mechanism of heat tolerance, selection criteria Cold tolerance- Definition, features, selection criteria Salinity tolerance- Effects of salinity, mechanism of salinity resistance, Breeding approaches for salinity resistance	
31	**Biotechnological tools-DNA markers :** Meaning and short description of RFLP, AFLP, RAPD, CAPS, SSR, SNP, HA, **Marker assisted selection-** Definition and background, pre-requisite of MAS, various types of breeding population used for MAS i.e. NILs, BSA, ILs, main features and procedure of MAS, its merits, demerits and achievements	4
32	**Participatory plant breeding-** what is PPB, its objectives, activities of PPB, impact of PPB **Intellectual Property Rights-** Definition of IPR, types of IPR Patenting- Definition of patent, short description **Plant Breeders and Farmer's Rights-** Definitions and main features	4
Total		100

b) Practical

Experiment	Topic
1	Plant Breeder's kit
2	Study of germplasm of various crops
3	Study of floral structure of self pollinated crops
4	Study of floral structure of cross pollinated crops
5	Emasculation and hybridization techniques in self pollinated crops : Green gram, Black gram, Rice, Wheat, Groundnut, Soybean,
6	Emasculation and hybridization techniques in self pollinated crops : Sesame, Chickpea, Okra, Tomato, Brinjal, Chilli,
7	Emasculation and hybridization techniques in cross pollinated crops : Maize, Bajra, Sunflower, Papaya, Sugarcane,
8	Emasculation and hybridization techniques in often cross pollinated crops : Cotton, Sorghum, Pigeonpea,
9	Consequences of inbreeding on genetic structure of resulting populations
10	Study of male sterility system
11	Handing of segregation populations
12	Methods of calculating mean, range, variance, standard deviation, heritability
13	Designs used in plant breeding experiment
14	Analysis of Rondomized Block Design
15	To work out the mode of pollination in a given crop and extent of natural out crossing
16	Prediction of performance of double cross hybrids

Suggested Readings:

Sr. No	Title of Book	Authors	Publisher
1.	Plant Breeding Principles and Methods	B. D. Singh	Kalyani Publication New Delhi.
2.	Essentials of Plant Breeding	Phundansingh	Kalyani Publication New Delhi
3.	Principles and Practices Plant Breeding	J. R. Sharma	McGraw Hill Publishing company Limited, New Delhi.
4.	Plant Breeding Theory and Practices	V. L. Chopra	Oxford and IBH. Publishing Company, New Delhi.
5.	Introduction to Plant Breeding	R. C. Choudhary	Oxford and IBH. Publishing Company, New Delhi.
6.	Elementary Principles of Plant Breeding	R. C. Choudhary	Oxford and IBH. Publishing Company , New Delhi.

Course :	GPB 243	**Credit:**	3(2+1)	**Semester-IV**
Course title:	Principles of Seed Technology			

Syllabus

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.

Teaching Schedule

a) Theory

Lecture	**Topic**	**Weightages (%)**
1	Seed and seed technology : introduction, definition and importance	5
2	Deterioration causes of crop varieties and their control & Maintenance of genetic purity during seed production	5
3	Seed quality : definition. Characters of good quality seed	4
4	Different classes of seed.	4
5	Foundation and certified seed production of important cereals **(Wheat, Sorghum, Maize, Rice &Bajara)**	5
6	Foundation and certified seed production of important pulses **(Pigeon Pea, Green Gram, Black Gram & Chick Pea)**	5
7	Foundation and certified seed production of important oil seeds **(Soybean, Sunflower, Safflower ,Groundnut and Cotton)**	5
8	Foundation and certified seed production of important fodder crops **(Fodder Sorghum, Lucern, Berseem,)**	5
9	Foundation and certified seed production of important vegetable crops **(Tomato, Brinjal, Chilli, Onion & Okra)**	5

Lecture	Topic	Weightages (%)
10	Seed certification, phases of certification, procedure for seed certification, field inspection	4
11	Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds control order 1983.	5
12	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.**	15
13	Seed drying, processing and their steps. Seed testing for quality assessment.	5
14 & 15	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	14
16	Seed marketing : structure and organization, sales generation activities ,promotional media. Factors affecting seed marketing, Role of WTO and OECD in seed marketing.	14
	Total	100

b) Practical

Experiment	Topic
1	Seed production in major cereals : Wheat and Rice
2	Seed production in : Sorghum and Bajara
3	Seed production in : Maize.
4	Seed production in major pulses : Green gram and Black gram
5	Seed production in pulses : Pigeonpea and Lentil
6	Seed production in pulses : Gram and Field pea
7	Seed production in major oil Seeds : Soybean, Rapeseed & Mustard
8	Seed production in major vegetable crops: Brinjal and Tomato.
9	Seed production in vegetable crops: Chilli and Okra.
10	Seed production in vegetable crops : Onion
11	Seed production in : Pumpkin, Bottle gourd
12	Seed production in : Bitter gourd, Ridge gourd, Sponge gourd
13	Seed sampling and testing procedure
14	Physical purity test
15	Seed moisture test
16	Germination test – types of germination
17	Germination test – different methods of germination
18	Seed viability test
19	Seed and seedling vigour test
20	Genetic purity test : Grow Out Test
21	Genetic purity test : Electrophoresis
22	Seed certification : Procedure

Experiment	Topic
23	Field inspection, preparation of field inspection report
24	Visit to seed production farms of cereal crops
25	Visit to seed production farms of oilseed crops
26	Visit to seed production farms of pulse crops
27	Visit to seed production farms of fiber crops
28	Visit to seed testing laboratories
29 & 30	Visit to seed processing plant

Suggested Readings:

Sr. No	Title of Book	Author/Authors	Publisher
1.	Seed Technology	R. L. Agrawal	Oxford and IBH. Publishing Company, New Delhi.
2.	Seed Science and Technology	SubirSen N Ghosh	Kalyani Publication New Delhi
3.	Principles of Seed Technology	Phundan Singh	Kalyani Publication New Delhi.
4.	Seed Science and Technology	N. C. Singhal	Kalyani Publication New Delhi.
5.	Seed Technology	DhirenderKhare and Mohan Bhale	Scientifice Publishers, JodhaPur
6.	Vegetable Seed Production	Nempal Singh, D.K. Singh, Y.K. Singh and Virendirekumar	International Book Distribution Company, Lucknow.

Course :	ELE GPB 244	**Credit:**	3(1+2)	**Semester-IV**
Course title:	Commercial Plant Breeding			

Syllabus

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.

Teaching Schedule

a) Theory

Lecture	Topics to be covered	Weightage (%)
1.	Types of Crop: Classifications of crops.	4
2-3	Male sterility-Definition, Transfer of MS to a new strain, maintenance of MS, Production of hybrid seed and limitations in using male sterility systems.	12
4-5	Hybrid varieties & features, Development of hybrid varieties: Development and evaluation of inbred lines, selection of productive inbred lines & production of hybrid seeds. Maintenance of nucleus & breeder seed in self and cross pollinated crops, Maintenance of pre-released or newly released varieties; Breeder seed of established varieties, Maintenance of nucleus & breeder seed of inbred lines.	14
6	Genetic purity test of commercial hybrids: Maintenance of genetic purity and safeguards for maintenance of genetic purity, Factor affecting genetic purity.	6
7-9	Advances in hybrid seed production of Rice, Sorghum, Maize, Perl-millet, Sunflower, Cotton, Pigeon-pea, etc. Steps and factor affecting	20

Lecture	Topics to be covered	Weightage (%)
	hybrid seed production.	
10	Principles of quality seed production of vegetables crops under open and protected environment	6
11	Development of parental lines and cultivars: Haploid production by anther and pollen culture.	8
12	IPR issue in commercial plant breeding	2
13-14	DUS testing -The Protection of Plant Varieties and Farmer's Right Act, 2001 (PPVFR, 2001): Main objective, Power and duties of PPV & FR Authority, Criteria for protection, Registration, Plant varieties qualifying for registration and Compulsory licensing. DUS testing centers.	10
15	Variety testing, release and notification major steps in India, General procedure for variety testing. Central Variety Release Committee, State Variety Release Committee. Seed production organizations; NSC, MSSC.	10
16	Genetic and Agronomic principles of quality seed production and its characteristics	8
Total		**100**

b) Practical

Experiment	Title
1.	Floral Biology in self pollinated species
2.	Floral Biology in cross pollinated species
3	Selfing techniques in different crops
4.	Crossing techniques in different crops
5.	Learning techniques in hybrid seed production using male-sterility in fields crops
6.	Techniques of seed production using A, B and R systems in self pollinated crops.
7.	Techniques of seed production using A, B and R systems in cross pollinated crops.
8	Techniques of seed production using two line systems in self and cross pollinated crops.
9	Problems in hybrid seed production.
10	Tools and Techniques for optimizing hybrid seed production
11	Multiplication and purification of line in hybrid seed production
12	Rouging concept in seed production plot
13	Role of pollinators in hybrid seed production
14-17	Hybrid seed production techniques in field crops: Sorghum, pearl-millet, maize,

Experiment	Title
	rice, sunflower, pigeon-pea, cotton crops.
18-20	Hybrid seed production techniques in vegetable crops: Okra, Brinjal, Onion, Chilli, tomato etc.
21	Seed sampling.
22	Physical purity test and detection of spurious seed.
23	Genetic purity test under field and laboratory conditions.
24	Seed drying
25	Storage structure in quality seed management
26	Seed screening techniques during seed processing: Seed grading
27	Seed screening techniques during seed processing :Seed packaging
28-29	Visit to public / private seed production plots
30-31	Visit to public / private seed processing plants
32	Economics of commercial seed production

Suggested Readings:

1) Hybrid Seed Production in Field Crops: Principles and Practices by N. C. Singhal, 2003,
a. Kalyani publication, Delhi
2) Principles of Seed Technology by P.K. Agrawal, 2002, Oxford
3) Seed Production of Vegetables. By Prabhakar Singh and B. S. Asati
4) Seed Technology, 1996, Agarwal R L, Oxford
5) Plant Breeding; Principles and Methods by B.D. Singh, 2006, Kalyani publication, Delhi
6) Genetics 2002 by P. K. Gupta, Rastogi publication
7) An Introduction to Seed Technology by Thomson J.R.
8) Seed science and technology laboratory manual, 1997 by M. B. Mdonald and L.O.
9) Copeland, Chapman & hill.
10) Seed Technology by DhirendraKhare and Mohan S. B. Bhale, 2005
11) Principles and practices of plant breeding by Sharma J. R.1984, Tata McGraw –Hill.
12) Practical plant breeding by Gupta S. K. 2004, Agribios publication
13) Principles of Vegetable Seed Production by Prem Narayan
14) Principles Plant Breeding, 1981 by Allard R W, Jhon Willy and sons
15) Fundamentals of Plant Breeding, 2005 Kalyani publication, Delhi
16) Fundamentals of Plant Breeding & hybrid seed production, 1996, Agarwal R L, Oxford

Course :	ELE BOT 242	**Credit:**	3(1+2)	**Semester-IV**
Course title:	Micro-propagation Technologies			

Syllabus

Theory

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

Practical

Identification and use of equipments in tissue culture Laboratory, Nutrition media composition, sterilization techniques for media, containers and small instruments, sterilization techniques for 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.

Teaching Schedules

a) Theory

Lecture	**Topic**	**Weightages (%)**
1 & 2	Meaning and concept of *in vitro* culture and micro-propagation, Historical milestones.	05
3	Tissue culture methodology: Sterile techniques	10
4	Synthetic and natural media components, growth regulators, environmental requirement.	10
5	Totipotency, dedifferentiation;genetic control of regeneration;	05
6	Plant regeneration pathways - Organogenesis and Somatic embryogenesis;	10
7	Organogenesis- Purpose, methods and requirements for organogenesis, indirect and direct organogenesis;	10
8, 9 & 10	Somatic embryogenesis- Procedures and requirements for organogenesis, indirect and direct embryogenesis; Differences between somatic and gametic embryogenesis,	15
11, 12 & 13	Micro-propagation- Definition, methods, stages of micro-propagation and its significance; Advancement and future prospects of micro-propagation.	20
14 & 15	Micropropagation - Axillary bud proliferation approach- Shoot tip and meristem culture;	10
16	Synthetic seed- Concepts, necessity, procedure and requirements for production of synthetic seeds.	5
	Total	**100**

b) Practical

Experiment	Topic
1	Laboratory organization of Plant Tissue Culture Laboratory
2	Safety Measures in Laboratory
3, 4, 5	Sterilization techniques: Common Contaminant in Laboratory, Sterilization of glassware, Working of Laminar air flow cabinet
6, 7	Culture Media: Definition, Components of Media, Stock Solution, Working Solution, Sterilization of Media.
8, 9	Preparation and sterilization of growth regulators/thermolabile compounds.
10,11	Preparation of working medium
12,13	Experimentation on determining optimum concentration of growth regulators.
14	Sterilization techniques for explants.
15, 16, 17, 18	Callus induction from different parts of plants
19, 20, 21, 22	Regeneration of whole plants from induced callus using different parts of plants.
23, 24	Induction of somatic embryos.
25, 26	Experiments of synthetic seeds production and testing storability and germination efficiency.
27, 28, 29, 30, 31 ,32	Direct regeneration into whole plants using bud, node and other tissues.

Suggested readings:

1) Plants from Test Tubes: An introduction to Micropropagation (Fourth Edition) – Lydiane Kyte, John Kleyn, Holly Scoggins and Mark Bridgen (Timber Press)
2) Introduction top Plant Tissue Culture- M. K. Razdan (Science Publisher)
3) Somatic Embryogenesis: Fundamental Aspects and Application – Loyola-Vargas, Victor, Ochoa-Aleja, Neftali (Springer)
4) Plant Tissue Culture, Techniques and Experiment – Robert H Smith (AP)
5) Plant Tissue Culture- Protocols in Plant Biotechnology - M.C. Gayatri and R. Kavyashree (Narosa Publishing)
6) Practical biotechnology and Plant Tissue Culture- Prof. Santosh Nagar, Dr. Madhavi Adhav (S Chand)

Course :	GPB 355	**Credit:**	2(1+1)	**Semester-V**
Course title:	Crop Improvement –I *(Kharif Crops)*			

Syllabus

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, Seasame, Caster, Cotton, Cowpea, Tobacco, Brinjal, Okra and Cucurbitaceous crops. Maintenance breeding of different *kharif* crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seeds production in *Kharif* crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops.

Teaching Schedule

a) Theory

Lecture	**Topic**	**Weightages (%)**
1	Centre of origin, Distribution of species, wild relative in different crops **Cereals**- Rice, Maize, Sorghum, Pearl millet, Ffinger millet. **Pulses**-Pigeonpea, Urdbean, Black gram, Mung bean, Cowpea, Soybean. **Oil seed**- Groundnut, Castor, Sesame, Sunflower.	4
2	**Fodder:** Berseem, Lucerne, rice bean. **Cash crops:** Cotton, Tobacco. **Vegetable:** Ridge gourd, bottle gourd, Snake gourd, Bitter gourd. **Horticultural crop**- Mango, Cashewnut, Citrus, Pomegranate, Guava.	4
3	Definition of PGR, Gene pool, Kinds of germplasm, gene pool concept, Genetic erosion, Germplasm collection and conservation, Types and methods.	10
4 &5	Floral Biology- Emasculation and mode of pollination (Definition and Types) Study of genetics of qualitative and quantitative characters- Inheritance of qualitative characters, pleiotrophy, Penetrance and Expressivity, Threshold character and modifying genes. Inheritance of quantitative character- Multiple factor hypothesis,	10

Lecture	Topic	Weightages (%)
	Transgenic segregation, Role of environment of quantitative inheritance, Difference between quantitative and qualitative character	
6'7 &8	Major Specific Breeding objective, Conventional Breeding methods- Introduction, Mass selection, pure line selection, Pedigree method, Bulk method and backcross method along with examples of varieties. Modern innovative approaches- somatic Hybridization, transgenic breeding and marker assisted selection.	20
9& 10	**Biotic stress tolerance: Breeding for disease and insect resistance** **Disease resistance**: Introduction, mechanism of disease resistance genetic resistance type of genetic resistance, gene for gene hypothesis, Genetics of resistance sources of resistance breeding methods and practical achievement. **Insect resistance**: Introduction, mechanism of insect resistance basis of insect resistance, Genetics of insect resistance sources of insect resistance, breeding methods, practical achievement.	12
11 & 12	**Breeding for Abiotic stress:** **Drought resistance-** Drought introduction, Drought resistance, Mechanism of drought resistance, Basis of drought resistance sources of drought resistance, breeding method. **Salinity:** Breeding for salt tolerance, breeding approaches, screening techniques, practical achievements. **Breeding for quality:** Introduction, Quality traits, Nutrition and nutrients, Nutritional quality of cereals and pulses, Genetic of nutritional traits, Sources of nutritional quality, Breeding methods, screening techniques, Breeding for low toxic substance, practical achievements.	12
13	**Seed production technology in self pollinated crops-** Rice wheat, Cross pollinated -Maize, Sorghum Vegetatively propagated crop. Potato, Sugarcane	8
14	Hybrid seed production of Maize, Rice Sorghum, Pigeonpea and Pearl millet.	8
15 & 16	Ideotype concept in crop improvement- Introduction, Types of ideotype, characteristics of Ideotype, Major steps in Ideotype breeding, Ideotype of Rice, wheat, Sorghum, practical achievements, merits and demerits. Characteristics of climate resilient crops Viz. Wheat, Sorghum, maize, soybean, cotton,	12
	Total	**100**

b) Practical

Experiment	Topic
1	Emasculation and hybridization techniques in different crop species : Rice, Maize
2	Emasculation and hybridization techniques in Sorghum & Pearl Millet
3	Emasculation and hybridization techniques in Ragi&Pigeonpean
4	Emasculation and hybridization techniques in Urdbean&Mungbean, Soybean
5	Emasculation and hybridization techniques in Groundnut, Seasame& Sunflower
6	Emasculation and hybridization techniques in Caster, Cotton
7	Emasculation and hybridization techniques in Cowpea & Tobacco
8	Maintenance breeding of different Kharif crops
9	Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods
10	Study of field techniques for seed production and hybrid seeds production in Kharif crops
11	Estimation of heterosis, inbreeding depression and heritability
12	Layout of field experiments
13	Study of quality characters, donor parents for different characters
14	Visit to seed production plots
15	Visit to AICRP plots of pulse & sorghum
16	Visit to AICRP plots of oilseed & cotton

Suggested Reading:

Sr. No	Title of Book	Author/Authors	Publisher
1.	Crop Breeding and Biotechnology	HariHar Ram	Kalyani Publication New Delhi.
2.	Breeding of Asian Field crops	D. A. Sleper J.M. Poehlman	Blackwell Publishers
3.	Principle and Procedures of Plant Breeding Biotechnological and Conventional Approach	G. S. Chahal S. S. Gosla	Narosa Publishers House. New Delhi.
4.	Plant Breeding Principle and Methods.	B. D. Singh	Kalyani Publication New Delhi.

Course :	BOT 353	**Credit:**	1(1+0)	**Semester-V**
Course title:	Intellectual Property Right			

Syllabus

Theory

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

Types of Intellectual Property and legislations covering IPR in India:-Patents, Copyrights,

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

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

Convention on Biological Diversity, International treaty on plant genetic resources for food and agriculture (ITPGRFA). Indian Biological Diversity Act, 2002 and its salient features access and benefit sharing.

Teaching Schedule

Lecture	Topic	Weightage (%)
1-2	Introduction and meaning of intellectual property, brief introduction to GATT, WTO, TRIPs and WIPO	**10**
3	Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc.	**5**
4-5	Types of Intellectual Property and legislations covering IPR in India:-Patents, Copyrights, Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets.	**15**
6-7	Patents Act 1970 and Patent system in India, patentability, process and product patent, filing of patent, patent specification, patent claims, Patent opposition and revocation,	**12**
8	Penalties for infringement, Compulsory licensing, Patent Cooperation Treaty, Patent search and patent database.	**4**
9-10	**UPOV**- Origin and history including a brief introduction to UPOV for protection of plant varieties, Protection of plant varieties under UPOV	**14**
11-12	PPV&FR Act of India, Plant breeders rights, Registration of plant varieties under PPV&FR Act 2001	**14**
13-14	Researcher and farmers rights, Traditional knowledge-meaning and rights of TK holders.	**12**

Lecture	Topic	Weightage (%)
15-16	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	**14**
	Total	**100**

Suggested Readings:

1) Introduction to Intellectual Property Rights by H.S. Chawla, Oxford & IBH Publishing Co. Pvt. Ltd. 113-B ShahpurJat, 2nd Floor, *Asian Games Village side* New Delhi 110 049, India
2) Encyclopedia of Intellectual Property rights Volume No. 1 to 10 by Priyanjan Trivedi (2008)
3) Plant Breeding by B.D. Singh (2006), Kalyani Publication
4) Intellectual Property Right under Golbalization by Tawar S. Serials Publication, New Delhi.

Course :	GPB 366	**Credit:**	2(1+1)	**Semester-VI**
Course title:	Crop Improvement- II *(Rabi crops)*			

Syllabus

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

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Cereals –Wheat, oat and barley - Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	10
2	Pulses –Chickpea- Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	8
3	Oilseeds –Sunflower and Safflower- Centers of origin, Distribution of species, Wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	10
4	Oilseeds –Linseed, Rapeseed and Mustard- Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and	8

Lecture	Topic	Weightage (%)
	modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	
5	Fodders –Napier, Bajra, Sorghum, Maize and Berseem- Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	5
6	Cash -Sugarcane - Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	6
7	Vegetable-Potato- Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	5
8	Vegetable-Field pea- Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	5
9	Horticultural crops-Mango, Aonla and Guava- Centers of origin, Distribution of species, wild relatives, Floral biology, Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	8
10-11	Plant genetic resources, its utilization and conservation	8
12	Adaptability and stability	5
13- 14	Hybrid seed production technology in Rabi crops -Sunflower, Safflower, Castor, Rabi Sorghum	12
15 - 16	Ideotype concept and climate resilient crop varieties for future- Wheat, Rice, Maize, Sorghum and Cotton	10
	Total	**100**

b) Practical

Experiment	Exercise
1	Emasculation and hybridization techniques in wheat, oat & barley
2	Emasculation and hybridization techniques in chickpea & lentil
3	Emasculation and hybridization techniques in field pea, rapeseed & mustard
4	Emasculation and hybridization techniques in sunflower
5	Emasculation and hybridization techniques in potato &berseem
6	Emasculation and hybridization techniques in sugarcane & cowpea
7	Emasculation and hybridization techniques in safflower
8	Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods
9	Study of field techniques for seed production and hybrid seeds production in Rabi crops
10	Estimation of heterosis, inbreeding depression and heritability
11	Layout of field experiments
12	Study of quality characters, study of donor parents for different characters
13	Visit to seed production plots
14	Visit to AICRP plots of Safflower & Chickpea
15	Visit to AICRP plots of Sunflower & Rabi sorghum

Suggested Readings:

Sr. No	Title of Book	Author/Authors	Publisher
1.	Crop Breeding and Biotechnology	HariHar Ram	Kalyani Publication New Delhi.
2.	Breeding of Asian Field crops	D. A. Sleper J.M. Poehlman	Blackwell Publishers
3.	Principle and Procedures of Plant Breeding Biotechnological and Conventional Approach	G. S. Chahal S. S. Gosla	Narosa Publishers House. New Delhi.
4.	Plant Breeding Principle and Methods.	B. D. Singh	Kalyani Publication New Delhi.

B. Sc. (Hons) Agriculture

Agricultural Entomology

- **Syllabus**
- **Teaching Schedule**
- **Suggested Readings**

B. Sc. (Hons) Agriculture

Departmentwise list of courses

1) Agril. Entomology

Sr. No.	Semester	Course No.	Credits	Course Title
1	II	ENTO 121	2(1+1)	Fundamentals of Entomology
2	III	ENTO 232	2(1+1)	Insect Ecology and Integrated pest Management
3	IV	ENTO 243	2(1+1)	Pest of Horticultural Crops and their Management
4	V	ENTO 354	2(1+1)	Pests of Crops and Stored Grain and their Management
5	VI	ENTO 365	2(1+1)	Management of Beneficial Insects
5	VIII	ELM ENTO 486	10(0+10)	Mass Production of Bioagents and Biopesticides
6	VIII	ELM ENTO 487	10(0+10)	Commercial Bee Keeping
7	VIII	ELM ENTO 488	10(0+10)	Silkworm Cocoon Production Technology
		Total		

Course :	ENTO 121	Credit:	2(1+1)	Semester-II
Course title:	Fundamentals of Entomology			

Syllabus

Theory

Part-I

Introduction and History of Entomology in India. Definitions: Insect, Entomology, Agricultural Entomology. Classification of phylum Arthropoda up to classes. Relationship of class Insecta with other classes of Arthropoda. Insect Dominance. Economic importance of insects: Harmful, Beneficial and productive insects. Premier institutes concerned with Entomology. **Morphology:-** Insect integument: structure and functions. Cuticular appendages and processes. Moulting: Definition and steps in moulting. Body segmentation: Structure of head, thorax and abdomen. Insect head capsule: Important sclerites and sutures. Positions of head. Structure and modifications of insect antennae, mouth parts, legs and wings (wing venation, wing coupling apparatus). Structure of thorax and abdomen: segmentation, appendages and processes, pregenital and post genital appendages and structure of male and female genital organ. Metamorphosis: Definition and types of metamorphosis with examples and its significance. Insect Diapause: Definition and example, Seasonal adaptations in insects: aestivation, hibernation and quiescence: Definitions; Insect egg: General structure, types of egg with examples (at least one). Types of larva and pupa with examples. Structure and functions of digestive, nervous, circulatory, respiratory, excretory, secretary and reproductive systems in insects. Types of reproduction in insects. Sensory organs sound producing organs in insects

Part-II

Systematics: Definitions: Taxonomy, Systematics, Binomial nomenclature, Order, Family, Genus, Species, Subspecies, Biotype. Binomial nomenclature: Definition and Rules. Classification of Class Insectaupto Orders. Important orders: Important distinguishing/taxonomic characters of orders with families of agricultural importance with examples.Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Aleurodidae, Pseudococcidae, Lophopidae, Lacciferidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturniidae, Bombycidae;Coleoptera:Coccinellidae,Chrysomelidae,Cerambycidae,Curculionidae,Bruchidae,Scarabaeidae;Hymenoptera:Tenthridinidae,Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

Practical:

Methods of collection and preservation of insects. External features of Cockroach. Types of insect antennae, mouthparts (dissection) and legs. Wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae. Dissection of digestive system, Central nervous system, male and female reproductive systems in insects (Cockroach/Grasshopper). Distinguishing/taxonomic characters of orders: Orthoptera,

Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance with examples.

Teaching Schedules

a) Theory

Lecture	Topic	Weightage (%)
1-2	• Introduction and history of entomology in India including contribution of scientists in brief. Definitions: Insect, Entomology and Agril. Entomology. • Classification of phylum Arthropoda up to classes. • Relationship of class Insecta with other classes of Arthropoda. • Insect dominance. • Economic importance of insects: Harmful, beneficial and productive insects. • Premier institutes concerned with Entomology: IARI (Indian Agricultural Research Institute), CAB (Commonwealth Agricultural Bureau), IOBC (International Organization of Biological Control), IIIP (International Institute of Insect Physiology), NBAIR (National Bureau of Agriculture Insect Resources), NIPHM (National Institute of Plant Health Management), IINRG (Indian Institute of Natural Resins and Gums), CIB & RC (Central Insecticide Board and Registration Committee), CSB (Central Silk Board), NRCIPM (National Research Centre for Integrated Pest Management), IGSMRI (Indian Grain Storage Management and Research Institute), etc	**10**
3-4	• Insect Integument: Structure and functions.Cuticular appendages and processes. Moulting: Definition and steps in moulting. • Body segmentation: Structure of head, thorax and abdomen.	**10**
5-6	• Insect head capsule: Important sclerites and sutures. Positions of head. • Structure and modifications (with examples) of insect antennae, mouth parts, legs and wings (wing venation, wing coupling apparatus with examples). • Structure of thorax and abdomen: segmentation, appendages and processes, pregenital and post genital appendages and structure of male and female genital organ.	**20**
7-8	• Metamorphosis: Definition and types of metamorphosis with examples and its significance. Insect diapause: Definition and example, Seasonal adaptations in insects: Aestivation, Hibernation and quiescence: Definitions • Insect egg: General structure, types of egg with examples (at	**10**

Lecture	Topic	Weightage (%)
	least one) • Types of larva and pupa with examples. • Sensory organs like Mechanoreceptors(Trichoidsensillacampaniformsensilla, chordotonal organ), chemo receptors (gustatory/olfactory), audio receptors: Johnston's organ and tympanum, photoreceptors- Compound eyes and simple eye, thermo/hygro receptors • Sound producing organs in insects	
9-12	• Structure and functions of digestive, nervous, circulatory, respiratory, excretory, secretary and reproductive system in insects. Types of reproduction in insects.	**20**
13	**Systematics:** • Definitions: Taxonomy, Systematics, Binomial nomenclature, Order, Family, Genus, Species, Subspecies, Biotype. • Binomial nomenclature: Definition and Rules. • Classification of Class Insecta up to Orders.	**10**
14	• Study of important insect orders: Important distinguishing taxonomic characters of orders. Families of agricultural importance with examples. Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae.	**20**
15-16	• Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Aleurodidae, Pseudococcidae, Lophopidae, Lacciferidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturniidae, Bombycidae.	
17-18	• Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae, Braconidae, Trichogrammatidae, lchneumonidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, TephritidaeSyrphidae.	
	Total	**100**

b) Practical

Experiment	Topic
1.	Methods of collection and preservation of insects including immature stages
2.	External features of typical insect (e.g. Cockroach) structure of head, thorax and abdomen/General body organization of insect
3.	Structure of antennae and its modifications along with examples.
4.	Study and dissection of chewing and biting type of mouthparts.
5.	Study and dissection of chewing and lapping type of mouthparts.
6.	Study and dissection of piercing and sucking type of mouthparts.
7.	Study and dissection of sponging type of mouthparts.
8.	Structure of typical leg and modifications of legs.
9.	Study of insect wings: Structure, wing venation, types of wings and wing coupling apparatus along with examples.
10.	Types of larva and pupa.
11.	Study and dissection of digestive system of cockroach.
12.	Study and dissection of central nervous system of cockroach
13.	Study and dissection of female reproductive system of cockroach
14.	Study and Dissection of male reproductive system of Cockroach
15.	Study of distinguishing taxonomic characters of orders and families of agricultural importance: Odonata, Orthoptera, Dictyoptera.
16.	Study of distinguishing taxonomic characters of orders and families of agricultural importance: Isoptera, Thysanoptera and Hemiptera.
17.	Study of distinguishing taxonomic characters of orders and families of agricultural importance: Neuroptera, Lepidoptera and Hymenoptera.
18.	Study of distinguishing taxonomic characters of orders and families of agricultural importance: Diptera and Coleoptera.

Assignment: Each student should collect at least 100 insect specimens belonging to the aforesaid orders.

Distribution of Marks: Practical

Particular		**Marks**
Collection	**:**	**05**
Practical Manual	**:**	**05**
Dissection (System)	**:**	**12**
Mouth part dissection	**:**	**08**
Spotting	**:**	**16**
Viva-voce	**:**	**04**
Total marks		**50**

Suggested Readings:

1) Chapman, R. F. – The Insects : Structure and Functions
2) David, B. V. and T. Kumarswami – Elements of Economic Entomology
3) Marc J. Klowden- Physiological Systems in Insects
4) Pant N.C. and SwarajGhai – Insect Physiology and Anatomy
5) Nayar, K. K.; Anathkrishanan T.N. and B.V.David – General and Applied Entomology
6) Richards O.W. and R.G. Davies – Imms' General Text Book of Entomology –Vol.I& II
7) Patton R.L.- Introductory Insects Physiology
8) Wigglesworth – Principles of Insects Physiology
9) Metcalf and Flint – Destructive and Useful Insects; their habits and control.

Course :	ENTO 232	Credit:	2(1+1)	Semester-III
Course title:	Insect Ecology and Integrated Pest Management			

Syllabus

Theory

Part I: Insect Ecology: Definition, scope, environment and its components. Effect of abiotic factors – temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors – food competition, natural and environmental resistance. Concepts of balance of life in nature, biotic potential and environmental resistance and causes for outbreak of pests in agro-ecosystem.

Part II: Pest surveillance, its types and pest forecasting. Categories of pests. Natural and applied pest control. IPM – Introduction, Importance, Scope, Concepts, Principles, Tools and Limitations of IPM. Host plant resistance, cultural, mechanical, physical and legislative methods of pest control. Biological- parasitoids, predators and transgenic plant pathogens such as bacterial, fungi and viruses. Chemical control– importance, hazards and limitations. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Examples of important insecticide groups - botanical insecticides – Neem based products. Cyclodienes, Organophosphates, Carbamates, Synthetic pyrethroids, Novel insecticides, Pheromones, Nicotinyl insecticides, Chitin synthesis inhibitors, Phenyl pyrazoles, Avermectins, Macrocyclic lactones, Oxadiazines, Thioureaderivaties, Pyridine azomethines, Pyrrolesetc, Nematicides, Rodenticides, Acaricides and Fumigants. Insecticides Act 1968-important provisions. Application techniques of spray fluids. Phytotoxicity of insecticides. Symptoms of poisoning, first aid and antidotes. Recent methods of pest control. Repellants, antifeedants, hormones, attractants, gamma radiation and genetic control.

Practical:

Visit to meteorological observatory / automatic weather reporting station. Terrestrial and pond ecosystems of insects. Behaviour of insects and orientation (repellency, stimulation, deterancy). Distribution patterns of insects, sampling techniques for the estimation of insect population and damage. Pest surveillance through light traps, pheromone traps and field incidence. Practicable IPM practices- Mechanical and physical methods, Cultural and biological methods. Chemical control – Insecticides and their formulations. Pesticide appliances, insecticide application techniques, calibration of plant protection appliances, Calculation of doses/concentrations of insecticides. Compatibility of pesticides and Phytotoxicity of insecticides IPM case studies–Cotton, Sugarcane, Mango/ Citrus/Pomegranate. Identification of common phytophagous mites and their morphological characters Identification of rodents, bird pests, their damage and management. Vermiculture – visit to vermiculture unit,Biopesticides used in IPM with mass multiplication of NPV and Entomopathogenic fungi.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Definition of Insect Ecology, Scope, Environment and its components.	25
2	Effect of abiotic factors – temperature and moisture, humidity, rainfall, light, atmospheric pressure and air currents.	
3	Effect of biotic factors – food competition, natural and environmental resistance	
4	Concepts of balance of life in nature, biotic potential and environmental resistance and causes for outbreak of pests in agro-ecosystem.	
5	Pest surveillance and it's types and pest forecasting. Categories of pests.	10
6 & 7	Natural and Applied pest control. IPM – Introduction, Importance, Scope, Concepts, Principles, tools and limitations of IPM.	30
8	Host plant resistance and cultural methods of pest control	
9	Mechanical, Physical and Legislative methods of pest control.	
10	Biological- parasitoids, predators and transgenic plant pathogens such as bacterial, fungi and viruses.	
11 & 12	Chemical control – importance, hazards and limitations. Classification of insecticides, toxicity and formulations	25
13 & 14	Examples of important insecticide groups - Botanical insecticides – Neem based products. Cyclodienes, Organophosphates, Carbamates, Synthetic pyrethroids, Novel insecticides, Pheromones, Nicotinyl insecticides, Chitin synthesis inhibitors, Phenyl pyrazoles, Avermectins, Macrocyclic lactones, Oxadiazines, Thioureaderivaties, Pyridine azomethines, Pyrrolesetc, Nematicides, Rodenticides, Acaricides and Fumigants. Insecticides Act 1968-important provisions.	
15 & 16	Application techniques of spray fluids. Phytotoxicity of insecticides. Symptoms of poisoning, first aid and antidotes.	
17 & 18	Recent methods of pest control. Repellants, Antifeedants, hormones, attractants, gamma radiation and genetic control.	10
	Total	**100**

b) Practical

Experiment	Topic
1.	Visit to meteorological observatory / automatic weather reporting station
2.	Study of terrestrial and pond ecosystems of insects.
3.	Studies on behaviour of insects and orientation (repellency, stimulation, deterancy).
4.	Study of distribution patterns of insects, sampling techniques for the estimation of insect population and damage.
5.	Pest surveillance through light traps, pheromone traps and field incidence.
6.	Practicable IPM practices- Mechanical and Physical methods
7.	Practicable IPM practices – Cultural and Biological methods
8.	Chemical control – Insecticides and their formulations
9.	Pesticide appliances, insecticide application techniques, calibration of plant protection appliances
10.	Calculation of doses/concentrations of insecticides
11.	Compatibility of pesticides and phytotoxicity of insecticides
12.	IPM case studies -Cotton
13.	IPM case studies – Sugarcane
14.	IPM case studies – Mango/ Citrus/Pomegranate
15.	Identification of common phytophagous mites and their morphological characters
16.	Identification of rodents and bird pests and their damage
17.	Vermiculture – visit to vermiculture unit
18.	Biopesticides used in IPM with mass multiplication of NPV and Entomopathogenic fungi.

Marks distribution for practical examination

1. Collection-6
2. Spotting -15
3. Problem / written – 15
4. Vivavoce -04
5. Practical manual -5
6. General performance-5

Suggested Readings:

1) Metcalf, R.L. and Luckman W.H. 1982. Introduction to Insect Pest Management. Wiley Inter Science publishing, New York.
2) G.S. Dhaliwal and Ramesh Arora 2001. Integrated Pest Manageemnt. Concepts and Approaches. Kalyani publishers, New Delhi.
3) Larry P. Pedigo. 1991. Entomology and Pest Management. Larry P. Pedigo. 1991. Mac Millan publishing company, New York.
4) Yazdani G. S. and Agarwal M.L. 1979. Elements of Insect Ecology. Naroji publishing house, New Delhi.
5) Hufakar C.V. Ecological Entomology
6) Clark L.R., Gier P.W., Rughas R.D. and Marris R.F. The Ecology and Insect Population.
7) Odum E.P. Fundamentals of Insect Ecology
8) Gupta S. K. Plant Mites of India, 1995

Course :	ENTO 243	**Credit:**	2(1+1)	**Semester-IV**
Course title:	Pest of Horticultural Crops and their Management			

Syllabus

Theory

General – economic classification of insects. Ecology and insect-pest management with reference to fruit, plantation crops. Distribution, host range, bio-ecology, injury, integrated management of important insect pests affecting tropical, sub-tropical and temperate fruits, plantation, vegetable, ornamental, spices and condiments crops like citrus, mango, grapevine, pomegranate, guava, fig, banana, papaya, custard apple, ber, sapota, aonla, coconut, arecanut, cashew, apple, tea, coffee, brinjal, okra, tomato, chilli, potato, sweet potato, cruciferous, cucurbitaceous, colocassia and moringa, turmeric, ginger, onion, garlic, coriander, curry leaf, black pepper, rose, gerbera and carnation.

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: Fruit Crops, Vegetable Crops, Plantation, Spices and Condiments.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage %
	Distribution, host range, bio-ecology, injury, integrated management of important insect pests affecting-	
1.	**Citrus:-** Lemon butterfly,White fly, Black fly, Leafminer,Fruit sucking moth, (*Eudocimafullonica*C, *E. materna* L.*Achoeajanata*L.), Citrus psylla,Citrus aphids, Mealybug, Citrus thrips,Scale insects	50
2.	**Mango:-**Mango stem borer,Mango stone weevil,Mango fruit fly, Mealy bugs, Mango hoppers, Shoot borer, Thrips,Slug caterpillar, Midge fly, Leaf gall	
3.	**Grapevine:-**Flea beetle /Udadya beetle, Thrips, StemGirdler, Mealy bug, Mite	
4	**Guava:-**Fruit fly, Spiraling white fly, Bark eating caterpillar, Fruit Borers- **(** *Congethes (Dichocrocis) punctiferalis,Deudorix (Viracholа) isocrates, Rapalavaruna,)*Green Scale, Mealy bug.	
5	**Banana:-**Root stock weevil/Rhizome weevil, Pseudostem borer, Fruit rust thrips, Aphids, Tingid or Lace wing bug, Leaf eating caterpillar **Papaya:-**Papaya mealy bugs, White fly, Green peach aphid, Ash weevils,	
6	**Sapota :-**Chiku moth / Sapota Leaf Webber, Sapota seed borer, Fruit fly, Stem borer, Hairy caterpillar, Leaf folder, Bud borer.	
7	**Coconut:-**Rhinocerosbeetle, Black headed caterpillar, Red palm weevil, Eriophyid mite, Rat.	
8	**Aracanut:-** Spindle Bug, Inflorescence Caterpillar, **Cashew nut:-**Tea mosquito bug,Cashew stem and root borer, Thrips	
9	**Apple** :-Mites, Codlingmoth,	

Lecture	Topic	Weightage %
	Fig :-Jassids, Mites **Ber:-** Ber fruit borer, Ber fruit fly **Aonla**:- Bark Borer,	
10	**Pomogranate:-**Anar caterpillar, Fruit sucking moth *(Eudocimafullonica, Eudocima materna, Achoeajanata L.*) Thrips, Shot hole borer, Barkeatingcaterpiller, Mealy bug, Whitefly, Aphids,	
11.	**Brinjal:-** Brinjal shoot & fruit borer, Jassids /leaf hopper, Aphids, Whiite fly, Red Spider Mites, Hadda Beetle,Brinjal leaf roller, Lace wing bug, Stem borer **Okra:-**Shoot & fruit borer,Leafhoppers, Aphids, White fly,Leaf Roller, Red Spider Mite**,***Helicoverpa,* Flea beetle,Leaf miner (*Liriomyza)*	40
12	**Tomato** :-Fruit borer,Leaf miner- *Liriomyza* and *Tutaabsoluta* Aphids, Thrips, White Fly,Mites **Chilli: -** Thrips, Fruit borer (*Helicoverpa*), Mites.	
13	**Potato:-** Potato tuber moth, Cutworm, Thrips, Mites, Jassids **Sweet potato**:-Sweet potato weevil, Sweet potato leaf eating caterpillar / Sphinx caterpillar.	
14	**Cruciferous crops (Cauliflower, Cabbage, Broccoli and Knolkol):-** Diamond back moth, Aphids, Painted bug, Cabbage butterfly, Leaf eating caterpillar, Flea beetle,Head borer andMustard saw fly	
15	**Cucurbitaceous vegetables:-** Fruit Fly, Aphids, Leaf miner, whitefly,Thrips, Pumpkinn beetle, Blister beetle **Colocassia and Moringa**:- Leaf eating catterpiller, Webworm, Stem borer, Spodoptera and Aphid,	
16	**Turmeric and Ginger:-**Rhizome fly, Shoot borer, Rhizome scale, Leaf roller, Thrips **Onion and Garlic:-**Onion and garlic thrips**,** **Coriander :-** Mites, Aphids **Curry leaf:-**Scale insect, Psylla, Leamon butterfly **Black pepper:-**Pollu beetle/Floes beetle, Mealy bug,	10
17	**Rose, Gerbera, carnation:-**Thrips, Mites, White Fly, Bud borer, Leaf miner **Ornamental:-** Snail and slugs,Mealy bug, Scale insects,	
18.	**Tea:-** Tea Green leaf Hopper, Tea mosquito bug, Mites **Coffee:-**Coffee seed borer, Coffee berry borer	
	Total	**100**

b) Practical

Experiment	Topic
1	Identification, Damage symptoms and management of - Pests of Citrus
2	Pests of Mango
3	Pests of Grapevine
4	Pests of Guava
5	Pests of Banana and Papaya
6	Pests of Sapota
7	Pests of Coconut
8	Pests of Aracnut and Cashew nut
9	Pests of Pomegranate
10	Pests of Apple, Fig, Ber, Aonla
11	Pests of Brinjal, Okra
12	Pests of Tomato, Chilli
13	Pests of Potato, Sweet potato
14	Pests of cruciferous vegetables
15	Pests of cucurbitaceous vegetables and Colocassia and Moringa
16	Pests of Turmeric, Ginger, Onion, Garlic, Curry leaf, Black Pepper and Coriander
17	Pests of Rose, Gerbera, Carnation, and Ornamentals
18	Pests of Tea and Coffee

Marks for Practical Examination:-Practical Manual : 05
Insect collection : 05
Spotting : 36
Viva : 04

Total : 50

Suggested Readings:

1) A.S. Atwal and G.S. Dhaliwal: Agricultural Pests of South Asia and their Management
2) B.V. David and V.V. Rammurthy: Elements of Economic Entomology
3) Pedigo L.P.: Entomology and Pest Management.
4) VenuGopalRao: Insect Pest Management
5) S. Pradhan: Insect pests of crops
6) V.B. Awasthi: Introduction of General and Applied Entomology.

Course :	ENTO 354	Credit:	2(1+1)	Semester-V
Course title:	Pests of Crops and Stored Grain and their Management			

Syllabus

Theory

General account on nature and type of damage by different arthropods pests: Scientific name, order, family, host range, distribution, biology, nature of damage and management of insect pests of **Cereals-Rice -** Paddy stem borer, Green leaf hopper, Brown plant hopper, White backed plant hopper, Gall midge, Paddy grasshopper, Blue beetle, Caseworm, Armyworm, Gundhi bug, Hispa, Leaf folder. **Sorghum –** Shoot fly, Stem borer, Aphids, Delphacids, Grasshopper, Earhead midge, Earhead caterpillars. **Maize –** Shoot fly, Stem borer, Armyworm, Cob earworm. **Bajra –** Shoot fly, Blister beetle. **Wheat –** Stem borer, Aphids, Termites. **Minor millets. Pulses – Pigeon pea**, **chickpea, mungbean, urdbean, cowpea, pea. Pigeon pea** – Pod borer, Plume moth, Pod fly, Spotted pod borer, Leaf webber, Mites. **Chickpea –** Gram pod borer, Aphids, Cutworm. **Mung and Urdbean** – Aphids, Leaf eating caterpillar, Semilooper, Pod borer. **Cowpea and Pea** – Aphids, Blue butterfly, Pod borer. **Oilseeds -Groundnut** – Leaf miner, Hairy caterpillar, Tobacco leaf eating caterpillar, Aphids, Thrips, White grub, Pod sucking bug. **Castor** – Semilooper, Capsule borer, Jassids, Tobacco leaf eating caterpillar. **Sunflower** – Capitulum borer, Hairy caterpillar, Jassids, Thrips, Whitefly, Stem borer. **Safflower-** aphids, Capitulum borer, Guzia weevil. **Mustard –** Aphids, Sawfly, Leaf webber. **Linseed –** Gall fly. **Soybean –** Stem fly, Girdle beetle, Leaf miner, Tobacco leaf eating caterpillar, Whitefly, Semilooper, Gram pod borer. **Sesamum –**Til hawk moth, Gall fly, leaf eating caterpillar. **Niger –**Semilooper, Gram pod borer. **Fiber crops –Cotton –** Aphids, Jassids, Thrips, Whitefly, Mealy bugs, Spotted bollworm, American bollworm, Pink bollworm, Tobacco leaf eating caterpillar, Leaf folder, Semilooper, Red cotton bug, Dusky cotton bug, Grey weevil. **Sunhemp and Mesta** – Sunhemp hairy caterpillar. **Sugarcane crops** - Early shoot borer, Internode borer, Top shoot borer, Whitefly, Pyrilla, Woolly aphids, Mealy bug, Scale insect, Termites, White grub. **Non-insect pests of above crops –** Crabs, Snails and Slugs, millepedes, Mites, Rats and squirrels. **Stored grain pests** - Biology and damage of Primary and Secondary pests. Primary store grain pests- Internal feeders - Rice weevil, lesser grain borer, pulse beetle and Angoumois grain moth. External feeders - khapra beetle, Indian meal moth. Secondary store grain pests – Rust red flour beetle, Saw toothed grain beetle, Long headed beetle. Primary and Secondary store grain pests - Rice moth. Non insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management. Preventive and curative methods of stored grain pests. Storage structure and methods of grain storage and fundamental principles of grain store management.

Practical

Identification of different type of damage. Identification and study of life cycle and seasonal history of various insect pests attacking crops and their produce. **Field crops: Cereals**-Rice, Sorghum, Maize, Bajra, Wheat and Miner millets. **Pulses-** Pigeon pea, Chickpea, Mung bean, Urd bean, Cowpea and Pea. **Oilseeds:** Groundnut, Castor, Sunflower, Safflower, Mustard, Linseed, Soybean, Sesamum and Niger. **Fibre:** Cotton, Sunhemp and Mesta. **Sugar crop:** sugarcane. Non insect pests of field crops. Store grain pests. Non insect pests, mites, rodents, birds and microorganisms associated with stored grain and their

management. Preventive and curative methods of stored grain pests. Storage structure and methods of grain storage and fundamental principles of grain store management.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
	Distribution, biology, nature of damage and management of insect pests of ….	20
	Cereals	
1	Rice - Paddy stem borer, Green leaf hopper, Brown plant hopper, White backed plant hopper, Gall midge, Paddy grasshopper, Blue beetle, Caseworm, Armyworm, Gundhi bug, Hispa, Leaf folder	
2	Sorghum – Shoot fly, Stem borer, Aphids, Delphacids, Grasshopper, Earhead midge, Earhead caterpillars	
3	Maize – Shoot fly, Stem borer, Armyworm, Cob earworm	
	Bajra – Shoot fly, Blister beetle	
	Wheat – Stem borer, Aphids, Termites,	
	Minor millets -	
	Pulses – Pigeon pea, **chickpea, mungbean, urdbean, cowpea, pea**	10
4	Pigeon pea – Pod borer, Plume moth, Pod fly, Spotted pod borer, Leaf webber, Mites	
5	Chickpea – Gram pod borer, Aphids, Cutworm	
	Mung and Urdbean – Aphids, Leaf eating caterpillar, Semilooper, Pod borer	
	Cowpea and Pea – Aphids, Blue butterfly, Pod borer	
	Oilseeds -	20
6	Groundnut – Leaf miner, Hairy caterpillar, Tobacco leaf eating caterpillar, Aphids, Thrips, White grub, Pod sucking bug	
7	Castor – Semilooper, Capsule borer, Jassids, Tobacco leaf eating caterpillar	
	Sunflower – Capitulum borer, Hairy caterpillar, Jassids, Thrips, Whitefly, Stem borer	
8	Safflower – Aphids, Capitulum borer, Guzia weevil	
	Mustard – Aphids, Sawfly, Leaf webber	
	Linseed – Gall fly	
9	Soybean – Stem fly, Girdle beetle, Leaf miner, Tobacco leaf eating caterpillar, Whitefly, Semilooper, Gram pod borer	
	Sesamum – Til hawk moth, Gall fly, leaf eating caterpillar	
	Niger – Semilooper, Gram pod borer	
	Fiber crops –	10
10-11	Cotton – Aphids, Jassids, Thrips, Whitefly, Mealy bugs, Spotted bollworm, American bollworm, Pink bollworm, Tobacco leaf eating caterpillar, Leaf folder, Semilooper, Red cotton bug, Dusky cotton bug, Grey weevil	
	Sunhemp and Mesta – Sunhemp hairy caterpillar	
	Sugarcane crops	10
12	Sugarcane – Early shoot borer, Internode borer, Top shoot borer, Whitefly, Pyrilla, Woolly aphids, Mealy bug, Scale insect, Termites, White grub	

Lecture	Topic	Weightage (%)
13	**Non-insect pests of above crops –** Crabs, Snails and Slugs, millepedes, Mites, Rats and squirrels	10
14-15	**Stored grain pests -** Biology and damage of Primary and Secondary pests Primary store grain pests- Internal feeders - Rice weevil, lesser grain borer, pulse beetle and Angoumois grain moth External feeders - khapra beetle, Indian meal moth Secondary store grain pests – Rust red flour beetle, Saw toothed grain beetle, Long headed beetle Primary and Secondary store grain pests - Rice moth	20
16	Non insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management	
17	Preventive and curative methods of stored grain pests	
18	Storage structure and methods of grain storage and fundamental principles of grain store management.	
	Total	**100**

b) Practical

Experiment	Topic
1.	Pests of Rice
2.	Pests of Sorghum
3.	Pests of Maize, Bajra, Wheat and Miner millets
4.	Pests of Pigeon pea
5.	Pests of Chickpea, Mung bean, Urd bean, Cowpea and Pea
6.	Pests of Groundnut
7.	Pests of Castor and Sunflower
8.	Pests of Safflower, Mustard, Linseed
9.	Pests of Soybean, Sesamum and Niger
10 & 11.	Pests of Cotton, Sunhemp and Mesta
12.	Pests of Sugarcane
13.	Non insect pests of field crops
14 & 15.	Store grain pests
16.	Non insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management
17.	Preventive and curative methods of stored grain pests
18.	Storage structure and methods of grain storage and fundamental principles of grain store management.

Marks distribution for practical examination

1. Spotting -36
2. Viva-voce -04
3. Practical manual-5
4. Collection-5

Suggested Readings:

1) A.S. Atwal and G.S. Dhaliwal :Agricultural Pests of South Asia and their Management
2) B.V. David and V.V. Rammurthy: Elements of Economic Entomology
3) Manishekharan and Sudarrajan : Pest Management in Field Crops.
4) Pedigo L.P. : Entomology and Pest Management.
5) VenuGopalRao: Insect Pest Management.
6) B.P. Khare : Storage Entomology

Course :	ENTO 365	**Credit:**	2(1+1)	**Semester-VI**
Course title:	Management of Beneficial Insects			

Syllabus

Theory

Importance of beneficial insects. Bee keeping, pollinating plants and their cycle, 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.

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. Pests and diseases of silkworm, their 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 pollinators, weed killer 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.

Teaching schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Importance of beneficial insects in Agriculture, Honeybee, Silkworm, Lac insects, Bioagents as natural enemies, Various Institutes related to beneficial insects	20
2	**Apiculture**: Introduction and history of Beekeeping Bee keeping, morphology and anatomy, bee biology, Pollinating plants and their cycle, bee conservation	
3	Commercial methods of bee rearing, equipments used, seasonal management of bees	
4	Bee hives and their description, Bee pasturage, bee foraging, behaviour and communication	
5	Enemies- Insect pests and diseases of honey bee and their management	
6	**Sericulture**: Related terminologies, History and development of	

Lecture	Topic	Weightage (%)
	silkworms in India, types of silkworm, voltinism and biology of silkworm	30
7	Mulberry cultivation, crop varieties, method of harvesting and preservation of mulberry leaves	
8	Rearing house and rearing appliances of mulberry silkworm, methods of disinfection and hygiene	
9	Silkworm rearing, mounting, harvesting and marketing of cocoons	
10	Pest and diseases of silkworm and their management	
11	**Lac culture**: Species of lac insect, morphology, biology, behaviour, host plants	10
12	Lac production and its uses, Types of lac- seed lac, button lac, shellac, and lac-products	
13	**Biocontrol agents** (Natural Enemies): Introduction of bioagents, Ideal characteristics of bioagents, Successful examples of biological control	35
14	General classification: Important insect orders bearing predators and parasitoids used in pest control Identification of major parasitoids and predators commonly used in biological control of crop pests.	
15	Major parasitoids: *Trichogramma sp., Chelonusblackburni, Cotesia (Apanteles) sp., Bracon sp., Epiricaniamelanoleuca, Goniozusnephantidis, Campoletischloridae,* Major predators: *Chrysoperla* sp., Australian lady bird beetle- *Cryptolaemus*montrouzieri Weed killers: *Zygogrammabicolorata, Neochetina*spp.	20
16	Mass multiplication and field release techniques of some important parasitoids: *T. chilonis, Chelonusblackburni, Cotesia / Bracon, Goniozusnephantidis, Epiricaniamelanoleuca*	
17	Mass multiplication and field release techniques of important predators: *Chrysoperla* sp., Australian lady bird beetle, Weed predators/killers: *Zygogramma bicolorata*, *Neochetina* sp.	
18	Important species of pollinator and scavengers with their importance	5

b) Practical

Experiment	Topic
1	Studies on honey bee colony: Bee species and castes of bees
2 & 3	Bee keeping appliances and seasonal management
4	Bee enemies and diseases
5 & 6	Bee pasturage, bee foraging and communication
7 & 8	Types of silkworm, voltinism and biology of mulberry silkworm
9	Mulberry cultivation, mulberry varieties and methods of harvesting of leaves
10	Rearing of mulberry silkworm on artificial diet / natural mulberry leaves
11	Studies on strains / species of lac insect, host plant and their identification
12	Identification of other important pollinators and scavengers.

13 14	Mass production of host insect- *Corcyra cephalonica*St. Mass multiplication of parasitoids: *Trichogrammachilonis, Chelonusblackburnii, Goniozusnephantidis*
15	Mass multiplication of predators: *Chrysoperla* sp. and Australian lady beetle- *Cryptolaemusmontrouzieri*Mulsant
16, 17 and 18	Visit to research and training Institution/Unit of Beekeeping, Sericulture, Lac culture and Bioagent production units.

Topic	Marks
Collection	06
Writing of procedures	30
Viva	04
Laboratory work / General performance	10
Total	**50**

Suggested Readings:

1) Singh, S., 1975.Bee keeping in India – ICAR, New Delhi., 214p.
2) Sunita, N.D, Guled, M.B, Mulla, S.R and Jagginavar, 2003, Beekeeping, UAS Dharwad
3) Mishra, R.C. and Rajesh Gar. 2002. Prospective in Indian Apiculture. Agrobios, Jodhpur.
4) Singh, D. and Singh, D.P. 2006. A Hand Book of Beekeeping, Agrobios (India).
5) Paul DeBach and Devid Rosen 1991. Biological control by natural enemies. Cambridge University Press; 2 edition (27 June 1991)
6) Y.A. Shinde and BR Patel. Sericulture in India
7) Tribhuwan Singh. Principles and Techniques of Silkworm Seed Production, Discovery publishing House Pvt. Ltd
8) M.L. Narasaiah. Problems and Prospects of Sericulture.discovery publishing House Pvt. Ltd.
9) Ganga, G. and SulochanaChetty, J. 1997. An Introduction to Sericulture (2nd Edn.). Oxford & IBH publishing Co. Pvt. Ltd., New Delhi.
10) Krishnaswamy, S. (Ed). 1978. Sericulture Manual - Silkworm Rearing. FAO Agril. Services bulletin, Rome.
11) Glover, P.M. 1937. Lac Cultivation in India. Indian Lac Research Institute, Ranchi.
12) Jolly, M.S. 1987. Appropriate Sericulture Techniques. International Centre for Training and Research inTropical Sericulture, Mysore, 209.
13) K.P. Srivastava. A Text Book on Applied Entomology. Vol. I & II, Kalyani Publishers, Ludhiana
14) B.R. David and V.V. Ramamurthy. Elements of Economic Entomology, 7thEdn. Namrutha Publications, Chennai

B. Sc. (Hons) Agriculture

Horticulture

- **Syllabus**
- **Teaching Schedule**
- **Suggested Readings**

B. Sc. (Hons) Agriculture

Departmentwise list of courses

Horticulture

Sr. No.	Semester	Course No.	Credits	Course Title
1	I	HORT 111	2(1+1)	Fundamentals of Horticulture
2	III	HORT 232	2(1+1)	Production Technology for Vegetables and Spices
3	IV	HORT 243	2(1+1)	Production Technology for Fruit and Plantation Crops
4	V	HORT 354	2(1+1)	Production Technology for Ornamental Crops, MAP and Landscaping
5	V	ELE HORT 355	3(2+1)	Protected cultivation of horticultural crops
6	VI	HORT 366	2(1+1)	Post-harvest Management and Value Addition of Fruits and Vegetables
7	VI	ELE HORT 367	3(2+1)	Landscaping
8	VI	ELE HORT 368	3(2+1)	Hi-tech Horticulture
9	VIII	ELM HORT 489	10(0+10)	Commercial Horticulture
10	VIII	ELM HORT 4810	10(0+10)	Floriculture and Landscape Gardening
11	VIII	ELM HORT 4811	10(0+10)	Nursery Management of Horticultural Crops (Proposed)
12	VIII	ELM HORT 4812	10(0+10)	Commercial Vegetable Production (Proposed)
13	VIII	ELM HORT 4813	10(0+10)	Protected Cultivation of Flowers and Vegetables (Proposed)
14	VIII	ELM HORT 4814	10(0+10)	Post-harvest Management and Value Additions of Horticultural Crops (Proposed)
10		**Total**		

Course :	HORT 111	**Credit:**	2(1+1)	**Semester-I**
Course title:	Fundamentals of Horticulture			

Syllabus

Theory

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

Practical

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

Teaching Schedule

a) Theory

Lecture	**Topics**	**Weightage (%)**
1	Horticulture-Its definition and branches, importance and scope	10
2	Horticultural and botanical classification	05
3	Climate and soil for horticultural crops	10
4	Plant propagation-methods and propagating structures	10
5	Principles of orchard establishment	05
6	Principles and methods of training and pruning, juvenility and flower bud differentiation	10
7	Unfruitfulness	10
8	Pollination, pollinizers and pollinators	
9	Fertilization and parthenocarpy	
10	Kitchen gardening	10
11	Garden types and parts;	
12	Lawn making;	05
13	Medicinal and aromatic plants;	05
14	Spices and condiments;	05
15	Use of plant bio-regulators in horticulture	05
16	Irrigation & fertilizers application-method and quantity	10
	Total	**100**

b) Practical

Experiment	Topics
1	Identification of garden tools
2	Identification of horticultural crops
3	Identification of horticultural crops
4	Preparation of seed bed/nursery bed
5	Practice of sexual method of propagation
6	Practice of asexual methods of propagation – Cutting & Layering
7	Practice of asexual methods of propagation – Budding
8	Practice of asexual methods of propagation – Grafting
9	Layout and planting of orchard plants
10	Training and pruning of fruit trees
11	Transplanting and care of vegetable seedlings
12	Making of herbaceous and shrubbery borders
13	Preparation of potting mixture, potting and repotting
14	Fertilizer application in different crops
15	Visits to commercial nurseries
16	Visits to commercial orchard

Suggested Readings:

Sr. No	Title of Book	Authors
1	Fruit Culture in India	Sham Singh and others
2	Handbook of Horticulture	ICAR Publication
3	Principles of Horticulture and fruit growing	Kunte and Yawalkar
4	Production Technology of Fruit Crops	Shanmugvelu, K.G.

Course :	HORT 232	Credit:	2(1+1)	Semester-III
Course title:	Production Technology for Vegetables and Spices			

Syllabus

Theory

Importance of vegetables & spices in human nutrition and national economy, brief about origin, area, production, improved varieties and cultivation practices such as time of sowing, sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting, storage, physiological disorders, disease and pest control and seed production of important vegetable and spices.

Practical

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

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Importance of vegetables & spices in human nutrition and national economy	10
	Brief about origin, area, production, improved varieties and cultivation practices such as time of sowing, sowing,transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting, storage, physiological disorders, disease and pest control of following crops	
2	Solanaceous vegetables	10
3	Cucurbits	10
4	Legume vegetables	05
5	Okra	10
6	Onion and Garlic	10
7	Leafy vegetables	05
8	Perennial vegetables, under exploited and wild vegetables	20
9	Black pepper	
10	Nutmeg	
11	Cinnamon	
12	Clove & Cardamom	
13	Turmeric & Ginger	10
14	Minor spices – Kokum, Curry leaf, Tirphal	
15	Multistoried cropping	05
16	Seed production of important vegetables and spices	05
	Total	**100**

b) Practical

Experiment	Topic
1	Identification of vegetables crops and their seeds (Solanaceous, Cucurbits, Okra)
2	Identification of vegetables crops and their seeds (Leguminous, leafy, Other)
3	Identification of spices crops and their seeds (Tree Spices)
4	Identification of spices crops and their seeds (Seed Spices and condiments)
5	Nursery raising
6	Direct seed sowing and transplanting
7	Study of morphological characters of different vegetables
8	Study of morphological characters of different spices
9	Fertilizers applications
10	Propagation and raising of nursery of vegetables
11	Propagation and raising of nursery of spices
12	Vegetables & spices seed extraction
13	Harvesting & preparation for market of vegetables
14	Harvesting & preparation for market of spices
15	Economics of vegetables cultivation
16	Economics of spices cultivation

Suggested Readings:

Book	Title of Book	Authors
1	Vegetables	B. Choudhary
2	Vegetable Crops	T. K. Bose, M. G. Som and T. Kabir
3	Vegetable, Tuber and Spices	S.Thamburaj
4	Production technology of vegetable crops	S. P. Singh
5	Vegetables – Production Technology Astral International	Haldavnekar, P.C.; Parulekar, Y.R.; Mali, P.C. and Haldankar, P.M.
6	Major Spices of India	J.S.Pruthi
7	Minor Spices and Condiments	J.S.Pruthi
8	Introduction to spices and plantation crops	N.Kumar and others
9	Spice Crops Vol.I and Vol. II	Parthasarathi and Others

Course :	HORT 243	**Credit:**	2(1+1)	**Semester-IV**
Course title:	Production Technology for Fruit and Plantation Crops			

Syllabus

Theory

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

Practical

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

Teaching Schedule

a) Theory

Lecture	**Topic**	**Weightage (%)**
1	Importance and scope of fruit and plantation crop industry in India	05
2	High density planting; Use of rootstocks	05
3	Special Horticulture practices	05
	Production technologies for the cultivation of major fruits	
4	Mango	10
5	Banana	10
6	Citrus	20
7	Grape	
8	Guava	
9	Litchi	
10	Papaya	05
11	Apple, Pear and Peach	05
12	Minor fruits- pineapple & Pomegranate	05
13	Minor fruits- Jackfruit &Strawberry	05
14	Nut crops; plantation crops-Coconut &Arecanut	10
15	Cashew	10
16	Tea, coffee & rubber	05
	Total	**100**

b) Practical

Experiment	Topics
1	Seed propagation
2	Scarification and stratification of seeds
3	Propagation methods for fruit crops including Micro-propagation
4	Propagation methods for plantation crops including Micro-propagation
5	Description and identification of fruit
6	Description and identification of Plantation crops
7	Preparation of plant bio regulators and their uses
8	Establishment of commercial nursery, Nursery Act
9	Establishment of model orchard and its economics
10	Intercropping and multistoried cropping
11	Rejuvenation of old senile orchards
12	Pests of above fruit and plantation crops
13	Diseases of above fruit and plantation crops
14	Physiological disorders of above fruit and plantation crops
15	Visit to commercial orchard of fruits
16	Visit to commercial orchard of plantation crop

Suggested Readings:

Book No.	Title of Book	Authors
1	Handbook of Horticulture	ICAR publication
2	Tropical and Subtropical Fruit crops	T.K.Bose and others
3	Fruit Culture in India	Sham Singh and others
4	Fruits	Ranjit Singh
5	Physiology of Fruit Production	Amar Singh
6	Coconut	Thumpan
7	Advance s in Horticulture	Ed by K.L.Chadha
8	Temperate fruits	Mitra, Thakur and Bose
9	Introduction to spices and Plantation crops	N.Kumar
10	Plantation Crops	J.S.Pruthi

Course :	HORT 354	**Credit:**	2(1+1)	**Semester-V**
Course title:	Production Technology for Ornamental Crops, MAP and Landscaping			

Syllabus

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, lilium and orchids under protected conditions and gladiolus, tuberose, chrysanthemum under open conditions.Package of practices for loose flowers like marigold and jasmine under open conditions. Production technology of important medicinal plants like asparagus, aloe, costus, Cinnamomum, periwinkle, isabgol 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.

Teaching Schedules:

a) Theory

Lecture	Topic	Weightage (%)
1	Importance and scope of ornamental crops and landscaping	10
2	Importance and scope of medicinal and aromatic plants	
3	Principles of landscaping	10
4	Landscape uses of trees, shrubs and climbers	
5	Production technology of important cut flowers like rose under protected conditions	10
6	Production technology of important cut flowers like gerbera, carnation under protected conditions	10
7	Production technology of important cut flowers like lilium and orchids under protected conditions	05
8	Production technology of important cut flowers like gladiolus, tuberose under open conditions.	10
9	Production technology of important cut flowers like chrysanthemum under open conditions.	10
10	Package of practices for loose flowers like marigold and jasmine under open conditions.	10
11	Production technology of important medicinal plants like asparagus, aloe, costus.	05
12	Production technology of important medicinal plants like	

Lecture	Topic	Weightage (%)
	Cinnamon, periwinkle, isabgol	
13	Production technology of important aromatic plants like mint, lemongrass, citronella,palmarosa.	10
14	Production technology of important aromatic plants like ocimum, rose, geranium, vetiver.	
15	Processing and value addition in ornamental crops	05
16	Processing and value addition in MAPs produce	05

b) Practical

Practical No.	Topic
1	Identification of Ornamental plants and flower crops
2	Identification of Medicinal and Aromatic Plants
3	Propagation of Ornamental plant
4	Propagation of medicinal and aromatic plants
5	Nursery bed preparation and seed sowing
6	Training and pruning of Ornamental plants
7	Planning and layout of garden
8	Bed preparation and planting of MAP
9	Protected structures – care and maintenance
10	Intercultural operations in flowers
11	Intercultural operations in MAP
12	Harvesting and post harvest handling of cut flowers
13	Harvesting and post harvest handling of loose flowers
14	Processing of MAP
15	Visit to commercial flower
16	Visit to MAP unit

Suggested Readings:

Book	Title of Book	Authors
1	Floriculture and Landscaping	T.K.Bose
2	Floriculture in India	Randhawa and Mukhopadhay
3	Fundamentals of Floriculture	Laury
4	Complete Home Gardening	Dey, S.C.
5	Landscape Gardening & Design with Plants –	Supriya Kumar Bhattacharjee
6	Landscaping principles and practices –	Jack E. Ingels

Course :	ELE HORT 355	**Credit:**	3(2+1)	**Semester-V**
Course title:	Protected cultivation of horticultural crops			

Syllabus

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 fertigationmanagement.Propagation and production of quality planting material of horticultural crops. Greenhouse cultivation of important horticultural crops – rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lilium, tulip, tomato, bell pepper, cucumber, strawberry, pot plants, etc. Cultivation of economically important medicinal and aromatic plants.Off-season production of flowers and vegetables.Insect pest and disease management.

Practical

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

Teaching Schedule:

a) Theory

Lecture	Topic	Weightage (%)
1-4	Protected cultivation- importance and scope in India Current status of protected cultivation in India and World	10
5-6	Types of protected structure based on site and climate, cladding material involved in greenhouse/ poly house	10
7-8	Greenhouse design, environment control, artificial lights, automation	5
9-11	Soil preparation and management, substrate management, types of benches and containers	10
12-13	Irrigation and fertigation management	10
14-15	Propagation and production of quality planting material of horticultural crops	5
16-24	Greenhouse cultivation of important horticultural crops – rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lilium, tulip, etc	15
25-29	Greenhouse cultivation of important horticultural crops like tomato, bell pepper, cucumber, strawberry, pot plants. Cultivation of economically important medicinal and aromatic plants	20
30	Off-season production of flowers and vegetables	5
31-32	Insect pest and disease management	10

b) Practical

Experiment	Topic
1	Raising of seedlings and saplings under protected conditions Use of protrays in quality planting material production
2	Bed preparation and planting of crop for production
	Inter cultural operations of flower and vegetable crops
3	Green bending, disbudding, deshooting in roses
4	Supporting, pinching and disbudding in carnation
5	Deleafing, disbudding, in gerbera
6-7	Training, pruning of tomato, bell pepper, cucumber, etc.
8	Soil and water EC and pH measurement as per crop need
9	Regulation of irrigation and fertilizers through drip, fogging and misting
10-11	Harvesting, Precooling, grading, packing, storage of – rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lilium, tulip, etc.
12-13	Harvesting, Precooling, grading, packing, storage of tomato, bell pepper, cucumber, strawberry, pot plants, etc.
14-15	Pest and disease management of flower and vegetable crops
16	Visit to commercial units and market

Suggested Readings:

1) S.D. Warade. 2003. Protected cultivation of Horticulture crops, CAFT(fruits), MPKV, Rahuri
2) Balraj Singh. 2005. Protected cultivation of vegetable crops, Kalyani publishers, New Delhi
3) Commercial Floriculture – Prasad & Kumar.
4) Proceedings of International seminar on protected cultivation in India, held at Bangalore (1997)
5) Greenhouse operation and management- Paul. V. Nelson
6) Patil, M.T and Patil, P.V. 2004. Commercial Protected Floriculture, MPKV, Rahuri

Course :	HORT 366	Credit:	2(1+1)	Semester-VI
Course title:	Post-harvest Management and Value Addition of Fruits and Vegetables			

Syllabus

Theory

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

Practical

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

Teaching Schedule:

a) Theory

Lecture	Topic	Weightage (%)
1	Importance of fruits and vegetables, extent and possible causes of post harvest losses	10
2	Pre-harvest factors affecting postharvest qualityandMaturity	
3	Ripening and changes occurring during ripening	10
4	Respiration and factors affecting respiration rate, Role of ethylene	
5	Post harvest diseases& disorders	
6	Heat, chilling & freezing injury	
7	Harvesting and field handling	10
8	Storage (ZECC, Cold storage, CA, MA, and Hypobaric)	10
9	Value addition concept	05
10	Principles and methods of preservation	10
11	Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards	10
12	Fermented and non-fermented beverages	05
13	Tomato products- Concepts and Standards	10
14	Drying/ Dehydration of fruits and vegetables – Concept and methods, osmotic drying	05
15	Canning -– Concepts and Standards	10
16	Packaging of products	05

b) Practical Schedule

Experiment	Topic
1	Applications of different types of packaging containers for shelf life extension.
2	Effect of temperature on shelf life and quality of produce.
3	Demonstration of chilling and freezing injury in vegetables and fruits.
4	Extraction and preservation of pulps and juices.
5	Preparation of Jam
6	Preparation of Jelly
7	Preparation of RTS and nectar
8	Preparation of squash and syrup
9	Preparation of osmotically dried products
10	Preparation of fruit bar and candy
11	Preparation of tomato products
12	Preparation of canned products.
13	Layout and planning of pack house
14	Layout and planning of processing unit
15	Quality evaluation of products -- physico-chemical and sensory.
16	Visit to processing unit/ industry.

Suggested Readings:

Book	Title of Book	Authors
1	Fruits and vegetables Preservation	Girdharilal, Sidappa and Tondan
2	Post Harvest Physiology, Handling, Utilization of tropical and subtropical fruits and vegetables	E.R.B. Pantastico
3	Preservation of fruits and vegetables – Principals and Practices	Shrivastava and Sangeev Kumar
4	Commercial fruits and Vegetable Products	W.V.Cruess
5	Post Harvest handling of fruits and Vegetables	Bal and Sandhu

Course :	ELE HORT 367	**Credit:**	3(2+1)	**Semester-VI**
Course title:	Landscaping			

Syllabus

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

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Importance and scope of landscaping	5
2 - 4	Principles of landscaping	5
4 - 6	Garden styles and types, terrace gardening, vertical gardening,	10
7 - 9	Garden components, adornments, lawn making, rockery, water garden, walk-paths, bridges, other constructed features etc.	10
10–12	Gardens for special purposes.	05
13–16	Trees: selection, propagation, planting schemes, canopy management, shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture.	10
17–19	Climber and creepers: importance, selection, propagation, planting,	05
20–21	Annuals: selection, propagation, planting scheme,	05
22–23	Other garden plants: palms, ferns, grasses and cacti succulents.	05
24–25	Pot plants: selection, arrangement, management.	05
26	Bio-aesthetic planning: definition, need, planning;	05
27–29	Landscaping of urban and rural areas, Peri-urban landscaping, Landscaping of schools, public places like bus station, railway	15

Lecture	Topic	Weightage (%)
	station, townships, river banks, hospitals, play grounds, airports, industries, institutions.	
30	Bonsai: principles and management,	05
31	Lawn: establishment and maintenance.	05
32	CAD application.	05
	Total	**100**

b) Practical

Experiment	Topic
1.	Identifications and propagation of annual, herbs and shrubs
2.	Identifications and propagation of climbers, creepers and perennials
3.	Identifications and propagation palms, ferns, grasses, cacti and succulents
4.	Planning, designing and layout of formals and informal gardens
5.	Planning, designing and layout special gardens.
6.	Study of different potting mixtures, soilless cultures and preparation of potted plants
7.	Maintenance and repairs of potted plants
8.	Planting and Maintenance of Lawn
9.	Irrigation and nutrient management in Landscape garden
10.	Practicing terrarium gardens and vertical garden
11.	Development and Maintenance of topiary
12.	Practicing flower Arrangement
13.	Bonsai Practicing and training
14.	Canopy Management in ornamentals shrubs and perennials
15 & 16	Visit to Landscape gardens.

Suggested Readings:

1) Complete Gardening in India – Gopalswamiengar
2) Complete Home Gardening – Dey, S.C.
3) Floriculture and Landscaping – Bose, T.K.
4) Floriculture and Landscaping – Deshraj
5) Floriculture in India – Randhawa and Mukhopadhyay
6) Introduction to Landscaping, Designing, Construction and Maintenance – Ronald J.Biondo and Charles B. Schroder
7) Landscape Gardening & Design with Plants – Supriya Kumar Bhattacharjee
8) Landscaping principles and practices – Jack E. Ingels

Course :	ELE HORT 368	**Credit:**	3(2+1)	**Semester-VI**
Course title:	Hi-tech Horticulture			

Syllabus

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 equipments identification and application, Micro propagation, Nursery-protrays, micro-irrigation, EC, pH based fertilizer scheduling, canopy management, visit to hi-tech orchard/nursery

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Introduction, importance and scope of Hi- tech horticulture in India	10
2	Hi- tech nursery management and mechanization of horticultural crop	10
3	Micro- propagation of horticultural crops	
4	Hi- tech field preparation and planting methods	5
5	Protected cultivation: advantages and constraints	5
6-7	Environmental control in green house -– temperature, light, CO_2, relative humidity and ventilation methods and techniques.	10
8	Micro irrigation systems and its components	5
9	EC and pH based irrigation / fertigation scheduling	5
10-11	Hi-tech canopy management of horticultural crop	5
12-16	High density orcharding in mango, guava, papaya, citrus, pineapple etc.	10
17	Remote sensing and Geographical Information System (GIS)	5
18	Differential Geo-positioning System (DGPS)	
19-30	Components of precision farming and application of precision farming in horticultural crops (fruits, vegetables and ornamental crops 2 crops each)	20
31	Mechanized harvesting of produce	5
32	Post harvest management for export	5
	Total	**100**

b) Practical

Experiment	Topic
1	Tools and equipments, identification and application
2	Study of different types of polyhouses and shade net houses
3-4	Intercultural operations in high density orchards
5-6	Intercultural operations in vegetables and flowers
7-8	Plant architecture
9-10	Micropropogation of horticultureal crops
11-12	Hi-tech nursery production technique in protrays
13	Hi-tech Irrigation systems
14	Soil and water EC, pH measurement and fertigation
15	Precision farming techniques used in horticultural crops
16	Visit to hi-tech orchard/nursery

Suggested Readings:

1. T. A. More, Karale A. R. and Patil M.T. 2001. Hi-tech Horticulture, CAFT (Fruits), MPKV, Rahuri.
2. Balraj Singh.2005. Protected cultivation of vegetable crops, Kalyani Publishers, New Delhi.
3. Patil, M.T and Patil, P.V. 2004. Commercial Protected Floriculture, MPKV, Rahuri
4. Commercial Floriculture – Prasad & Kumar.
5. Proceedings of International seminar on protected cultivation in India, held at Bangalore (1997)
6. Greenhouse operation and management- Paul. V. Nelson

B. Sc. (Hons) Agriculture

Agricultural Economics

- **Syllabus**
- **Teaching Schedule**
- **Suggested Readings**

B. Sc. (Hons) Agriculture
Departmentwise list of courses

Agricultural Economics

Sr. No.	Semester	Course No.	Credits	Course Title
1	II	ECON 121	2(2+0)	Fundamentals of Agricultural Economics
2	IV	ECON 242	3(2+1)	Agricultural Finance and Cooperation
3	V	ECON 353	3(2+1)	Agricultural Marketing Trade and Prices
4	V	ELE ECON 354	3(2+1)	Agribusiness Management
5	VI	ECON 365	2(1+1)	Farm Management, Production and Resource Economics
		Total		

Course :	ECON 121	Credit:	2(2+0)	Semester-II
Course title:	Fundamentals of Agricultural Economics			

Syllabus

Theory

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, 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's surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity.

Production: process, creation of utility, factors of production, input output relationship. *Laws of returns*: Law of variable proportions and law of returns to scale.

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

Market structure: meaning and types of markets, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points.

Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit.

National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control.

Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation. Banking: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy.

Agricultural and public finance: meaning, micro v/s macro finance, need for agricultural finance, public revenue and public expenditure. *Tax:* meaning, direct and indirect taxes, agricultural taxation, VAT. *Economic systems:* Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.

Teaching Schedule

Lecture No.	Topic/Lesson	Weightage
1	*Economics:* Meaning, subject matter scope and definitions of economics, divisions of economics-Traditional and Modern Approach	2
2	Approaches to economic analysis; micro and macroeconomics, positive and normative analysis- Deductive and Inductive methods of investigation	2
3	Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior.	2
4	Basic concepts: Goods and services, classification of goods, characteristics of goods and services, desire, want, demand, utility, Cardinal and Ordinal approaches, Characteristics of utility - Forms of utility. Cost and price, wealth, capital, income and welfare, Classification of Wealth	4
5	Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development.	4
6	Cardinal approach/utility theory, Law of Diminishing Marginal Utility – statement, assumptions of law, explanation, limitations of the law, Importance	5
7	Law of Equi-marginal Utility – Meaning, Assumptions, Explanation of the Law, Practical Importance, Limitations	5
8	Consumer's Surplus – Meaning, Assumptions, Explanation, Difficulties in measuring Consumer's Surplus, Importance. Ordinal Approach-Consumer's equilibrium, indifference curve analysis	5
9	Demand – Meaning, Definition, Types of demand - income demand, price demand, cross demand. Demand schedule , demand curve, Law of demand – contraction and extension, increase and decrease in demand, Determinants of demand	6
10	Elasticity of demand – Definition, elastic and inelastic demand, kinds of elasticity of demand, perfectly elastic, perfectly inelastic, relatively elastic, relatively inelastic, unitary elastic demand. Types of elasticity of demand , Price elasticity, income elasticity and cross elasticity of demand, factors affecting demand , practical importance of elasticity of demand	5
11	Production: meaning, process, creation of utility, factors of production, input output relationship.	2
12	*Laws of returns*: Law of variable proportions and law of returns to scale	4
13	*Cost:* Cost concepts, short run and long run cost curves	3

Lecture No.	Topic/Lesson	Weightage
14	Supply – meaning, definition, law of supply, supply schedule, supply curve. Increase and decrease in supply, contraction and extension in supply, factors affecting supply.	5
15	Elasticity of supply, kinds of elasticity of supply – perfectly elastic, perfectly inelastic, relatively elastic, relatively inelastic and unitary elastic - factors affecting elasticity of supply.	2
16	Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets.	2
17	Price determination under perfect competition;	2
18	Short run and long run equilibrium of firm and industry, shut down point, normal & super normal profits	2
19	Distribution theory: meaning, factor market and pricing of factors of production.	2
20	Concepts of rent, wage, interest and profit.	2
21	*National income:* Meaning and importance, circular flow, concepts of national income accounting- Gross domestic product, gross national product, net national product, net domestic product-national income at factor cost, personal income, disposable income	5
22	Methods/Approaches of measurement of NI – product method, income method and expenditure method, Difficulties in measurement.	4
23	Population: Importance, Malthusian and Optimum population theories,	3
24	Natural and socio-economic determinants, current policies and programmes on population control.	2
25	Money: Barter system of exchange and its problems, evolution, meaning and functions of money,	2
26	Classification of money, money supply,	3
27	General price index, inflation and deflation.	3
28	Central bank functions and important policies	2
29	Public revenue and public expenditure	3
30	*Tax:* meaning, direct and indirect taxes, agricultural taxation, VAT.	3
31	*Economic systems:* Concepts of economy and its functions	2
32	Important features of capitalistic, socialistic and mixed economies, elements of economic planning.	2

Suggested Readings:

1) Dewett, K.K. and Chand, A.2009 Modern Economic Theory S.Chand and Co., New Delhi
2) Dewett, K.K. and Varma, J.D. 1986 Elementary Economics S.Chand and Co., New Delhi.
3) Jhingan, M.L.1990 Advanced Economic Theory Vikas Publishing House, New Delhi
4) Subba Reddy, S, Raghu Ram, P., Sastry, T.V.N. and Bhavani Devi, I. 2010
5) Agricultural Economics Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi
6) Nagpure S.C., and Patil E.R.2011,2014, Principles of Agricultural Economics by, Agroment Publishers, 52 B, Indraprasta, Opp. Asha Mangal, Dharampeth, Nagpur-440010(MS)India.

Course :	ECON 242	Credit:	3(2+1)	Semester-IV
Course title:	Agricultural Finance and Cooperation			

Syllabus

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, Deposit 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.

Teaching Schedule

a) Theory

Lecture No.	Topic/Lesson	Weightages
1	Definition of agricultural finance – nature – scope - meaning - significance - micro & macro finance	4
2	Credit needs in agriculture – meaning and definition of credit - classification of credit based on time, purpose, security, lender and borrower	8
3	Credit analysis - Economic feasibility tests- Returns to investment, Repayment capacity and Risk bearing ability (3Rs)	8
4	Five Cs of credit - Character, Capacity, Capital, Condition and Common sense and Seven Ps of credit - Principle of productive purpose, Principle of personality, Principle of productivity, Principle of phased disbursement, Principle of proper utilization, Principle of payment and Principle of protection	6
5	Methods and mechanics of processing loan application.	5
6	Repayment plans: Lump sum repayment /straight-end repayment, Amortized decreasing repayment, Amortized even repayment, Variable or quasi variable repayment plan, Future repayment plan and Optional repayment plan	6
7	Recent trends in agricultural finance - Social control and Nationalization of Banks	5
8	Lead Bank Scheme – origin – objectives - functions and progress; Regional Rural Banks (RRBs) – origin – objectives – functions – progress - RRBs in Andhra Pradesh	8
9	Crop Loan System: objectives – importance - scale of finance – estimation – Term Loans – objectives and interest rates, kisan credit card	8
10	Schemes for financing weaker sections - Differential Interest Rate (DIR), Integrated Rural Development Programme (IRDP), Ganga Kalyan Yozana (GKY), Swarnajayanti Gram Swarozgar Yojana (SGSY), Self Help Groups etc.	8
11	Crop Insurance - meaning and its advantages - progress of crop insurance scheme in India - limitations in application - Agricultural Insurance Company of India – National Agricultural Insurance scheme (NAIS) - salient features - Weather insurance	5
12	Higher Financing Agencies - Reserve Bank of India (RBI) - origin – objectives and functions - role of RBI in agricultural development and finance; National Bank for Agricultural and Rural Development (NABARD) - origin, functions, activities and its role in agricultural development; International Bank for Reconstruction and Development (IBRD); International Monetary Fund (IMF); International Development Agency (IDA); Asian Development	8

Lecture No.	Topic/Lesson	Weightages
	Bank (ADB); Deposit Insurance and Credit Guarantee Corporation of India	
13	Co-operation – meaning - scope, importance and definition - principles - objectives of co-operation	6
14	Origin and history of Indian cooperative movement – cooperative movement during pre-independence period - progress of cooperative movement during post-independence period	4
15	Short comings of Indian co-operative movement and remedies - recommendations of various committees – development of cooperative credit and non-credit organizations- co-operative credit structure	4
16	Classification of co-operative credit institutions - Short Term (ST), Medium Term (MT) and Long Term (LT) Credit – Primary Agricultural Cooperative Credit Societies (PACS) - Farmers Service Societies (FSS) - Multi-Purpose Cooperative Credit Societies (MPCS) and Large-Sized Adivasi Multipurpose Cooperative Societies (LAMPS) - Objectives and functions - Reorganization of Rural Credit Delivery System and concept of single window system – Andhra Pradesh mutually aided Co-operative Societies Act,1995	7

b) Practical

Exercise No	Topics
1	Working out the various repayment plans
2	Study of commercial banks/ RRB
3	Study of NABARD
4	Study of PACS/ DCCB
5	Study of SHGs
6	Estimation of scale of finance
7	Estimation of indemnity
8	Estimation of credit limits under Kisan Credit Card
9	Study of FSS
11	Study of Dairy co-operatives/ any other co-operative institution
12	Appraisal of loan proposal-A case study
13	Techno-Economic parameters for preparation of projects
14	Preparation of bankable projects for various agricultural products and its value added products
15	Seminar on selected topics
16	Final Practical Examination

Suggested Readings:

1) Ghosal, S.N., Agricultural Financing in India, Asia Publishing House, Bombay, 1966
2) Johl, S.S. and C.V. Moore., Essentials of Farm Financial Management, Today and Tomorrow's Printers and Publishers, New Delhi, 1970
3) John, J. Hamptron., Financial Decision Making: Concepts, Problems and Cases, Prentice-Hall of India , New Delhi, 1983
4) Kenneth, Duft D., Principles of Management in Agribusiness, Reston Publishing Company, Reston, 1979
5) Mamoria, C.B. and R.D. Saksena., Co-operation in India, Kitab Mahal, Allahabad, 1973
6) Mamoria, C.B. and Saksena., Agricultural Problems in India, Kitab Mahal, Allahabad
7) Mukhi, H R. Cooperation in India and Abroad. New Heights Publishers, New Delhi, 1983
8) Muniraj, R., Farm Finance for Development, Oxford & IBH Publishing Company Private Ltd., New Delhi, 1987
9) Subba Reddy, S. and P.Raghuram., Agricultural Finance and Management, Oxford & IBH Publishing Company Private Ltd., New Delhi, 2005
10) Subba Reddy, S., P.Raghuram., P. Sastry, T.V.N. and Bhavani Devi I. Agricultural Economics., Oxford & IBH Publishing Company Private Ltd., New Delhi, 2010
11) William, G. Murray and Nelson Aarson, G., Agricultural Finance, The Iowa State University Press, Ames, Iowa, 1960

Course :	ECON 353	Credit:	3(2+1)	Semester-V
Course title:	Agricultural Marketing Trade and Prices			

Syllabus

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.

Teaching Schedule

a) Theory

Lecture	Topic/Lesson	Weightage
1	Market and Marketing – Meaning – Definitions – Components of market – Market structure – Meaning – Components – Market conduct – Market performance	2
2	Agricultural Marketing – Meaning – Definition – Scope – Subject matter – Importance of Agricultural Marketing in economic development.	2
3	Classification of markets – On the basis of location, Area of coverage, time span, volume of transaction, nature of transaction, number of commodities, degree of competition, nature of commodities, stage of marketing, extent of public intervention, type of population served, accrual of marketing margins	4
4	Marketing mix and market segmentation,	2
5	Demand, supply and producer's surplus of agri-commodities: nature and determinants of demand and supply of farm products,	2
6	Producers surplus- Meaning- Marketable surplus- Marketed surplus-importance- factors influencing marketable surplus- Marketing channels - Definition	3
7	Product life cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC;	4
8	Strategies in different stages of PLC; pricing and promotion strategies:	3
9	Pricing considerations and approaches –cost based and competition based pricing;	3
10	Market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits & demerits;	4
11	Marketing process and functions: Marketing process-concentration, dispersion and equalization;	3
12	Marketing functions – Meaning -exchange functions – buying and selling;	2
13	Physical functions – storage, transport and processing	3
14	Facilitating functions – packaging, branding, grading, quality control and labeling (Agmark);	4
15	Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing;	5
16	Meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products;	4
17	Market integration-definition-types of market integration-	4

Lecture	Topic/Lesson	Weightage
	horizontal, vertical and conglomeration-	
18	Marketing efficiency-meaning-definitions-technical or physical or operational efficiency-pricing or allocative efficiency	5
19	Marketing cost-margins-price spread-factors affecting the costs of marketing-reasons for higher marketing costs of agricultural commodities- ways of reducing marketing costs for farm products.	3
20	Role of Govt. in agricultural marketing- Remedial measures-Regulated markets-definition-important features of regulated markets, functions, progress and defects	4
21	Public sector institutions- Warehousing-meaning- warehousing in India - Central Warehousing Corporation(CWC)- working of warehouses -advantages- State Warehousing Corporations (SWC)-Food Corporation of India(FCI)-objectives- functions	3
22	Characteristics of agricultural product prices-agricultural price stabilization-need for agricultural price policy- commission for Agricultural cost and Prices (CACP)- administered prices-minimum support price, procurement price and issue price.	3
23	Cooperative marketing- meaning-structure- Functions of cooperative marketing societies-.	2
24	National Agricultural Cooperative Marketing Federation (NAFED) and State Agricultural Cooperative Marketing Federations (MARKFED)- State Trading-objectives-Types of state trading.	4
25	Risk in marketing: Types of risk in marketing;	3
26	Speculation & hedging; an overview of futures trading;	2
27	Characteristics of agricultural product prices-agricultural price stabilization-need for agricultural price policy- commission for Agricultural cost and Prices (CACP)- administered prices-minimum support price, procurement price and issue price	4
28	Trade: Concept of International Trade and its need, International trade-definition-difference between international and inter-regional trade- free trade vs protection.	3
29	Theories of absolute and comparative advantage.	3
30	Present status and prospects of international trade in agri-commodities; GATT and WTO;	2
31	Agreement on Agriculture (AoA) and its implications on Indian agriculture;Trade Related Intellectual Property Rights(TRIPS)	2
32	Market and Marketing – Meaning – Definitions – Components of market – Market structure – Meaning – Components – Market conduct – Market performance	3
	Total	**100**

b) Practical

Exercise	Topic
1	Plotting and study of demand and supply curves
2	Calculation of elasticities
3	Study of relationship between market arrivals and prices of some selected commodities
4	Computation of marketable and marketed surplus of important commodities
5	Study of price behaviour over time for some selected commodities;
6	Visit to a local market to study various marketing functions performed by different agencies,
7	Visit to regulated market
8	Identification of marketing channels for selected commodity
9	Collection of data regarding marketing costs, margins and price spread.
10	Presentation of report in the class.
11	Visit to market institution – NAFED to study their organization and functioning.
12	Visit to SWC to study their organization and functioning.
13	Visit to CWC to study their organization and functioning.
14	Visit to cooperative marketing society to study their organization and functioning.
15	Application of principles of comparative advantage of international trade.
16	Final practical exam.

Suggested Readings:

1) Acharya S.S and Agarwal NL, 2006, Agricultural Marketing in India. Oxford & IBH Publishing Co.Pvt.Ltd. New Delhi
2) Kahlon, A.S and Tyagi.D S, 1983 Agricultural Price Policy in India. Allied Publishers Pvt. Ltd., New Delhi.
3) Kulkarni, K R.1964, Agricultural Marketing in India. The Co-operators Books Depot, Mumbai.
4) Mamoria, C.B. and Joshi. R L.1995, Principles and Practices of Marketing in India, Kitab Mahal, Allahabad
5) Mamoria, C.B., 1973., Agricultural Problems in India, Kitab Mahal, Allahabad
6) Subba Reddy, S., P.Raghu Ram., P. Sastry, T.V.N. and Bhavani Devi I. 2010. Agricultural Economics., Oxford & IBH Publishing Company Private Ltd., New Delhi, 2010

Course :	ELE ECON 354	**Credit:**	3(2+1)	**Semester-V**
Course title:	Agribusiness Management			

Syllabus

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, polices procedures, rules, programs and budget. Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation. Ordering, leading, supervision, communications, control. Capital Management and Financial management of Agribusiness. Financial statements and their importance. Marketing Management: Segmentation, targeting & positioning. Marketing mix and marketing strategies. Consumer behavior analysis, Product Life Cycle (PLC). Sales & Distribution Management. Pricing policy, various pricing methods. Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.

Practical

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

Teaching Schedule

a) Theory

Lecture	Details of Topic	Weightage
1	Agribusiness: Meaning of Agribusiness, Definition of Agribusiness, Transformation of agriculture into agribusiness, Various stakeholders and components of Agribusiness systems.Agricultural Input Sector, Production Sector, Processing Manufacturing Sector, Distribution-Marketing Sector.	5
2, 3 & 4	Importance of Agribusiness in Indian Economy New Agricultural Policies National Agril. Policy, National Seed Policy, National Price Policy, National Food Processing Policy, National Foreign Trade Policy, National Fishery Policy, National Food Security Policy, National Food & Biotech, National Transportation of Food, National Nutrient Based Subsidy	4
5 & 6	Agro-based Industries: Importance of Agro based Industries , Need of Agro based Industries, Classification of Agro based Industries, Types of Agro based Industries- Sugar Mills, Cotton Ginning Mills, Dal Mills, Rice Mills, Poha Mills, Fruit Processing Industries etc. Institutional Arrangement- Ministry of Agriculture (GOI), Financial Institutions, NABARD, NCDC, NDDB, NCUI, APEDA, ICAR, NAFED, FCI, CWC, NHM, CFTRI, EPO	7
7	Procedure to set up agro-based Industries Constraints in establishing Agro based Industries	4
8 & 9	Agricultural Value Chain : Value Chain Concept Primary activities and support activities and their linkages, Supply Chain v/s. Value Chain, Vertical Corporation, Horizontal relation, Nature of Association. Business Process and Agribusiness Supply Chain- Production, Processing/Manufacturing, Wholesaling, Retailing, Logistics, Supply Network	5
10	Business Environment PEST Analysis(Political, Economic, Social & Technological) SWOT Analysis (Strengths, Weaknesses Opportunities and Threats)	3
11	Management Functions: Role and Activities, Organization Culture, Functions of Management- Planning, Organizing, Directing, Controlling, Coordinating, Financing	2
12	Planning Meaning, Definition of Planning, Function of Planning, Types of Plan/Planning Process- Purpose, Objective, Policies, Procedure, Practices, Characteristics of Sound Plan	4
13	Rules, Programmes and Budget for Planning Components of Business Plan	3
14	Steps in Planning and Implementation Gathering Facts, Analyzing Facts, Forecasting Change, Setting Goals & Results, Developing Alternatives, Evaluating Progress	4
15	Organization- Meaning, Legal Structure, Sole Proprietorship, Creating a sole Proprietorship, Advantages & Disadvantages Partnership- Creating Partnership, Characteristics of Partnership Corporation- Creating Corporation, Characteristics of Corporation, Limited, Liability, Continuity of Operation, Tax Aspects, Estate	4

Lecture	Details of Topic	Weightage
	Planning	
16	Organization Structure – Responsibility, Authority, Accountability Directing : Meaning, Objective of Directing, Personnel Management, Finding OR Recruiting People, Selecting the Right Person, Job Orientation, Compensation & Fringe Benefits, Evaluating performance, Training & Development, Promotion & Advancement, Terminations & dismissal	5
17	Motivation : Meaning, Different ideas for Managing & Motivating People, Mallow's Need Hierarchy, Motivators & Hygienic Factors	3
18	Controlling : Meaning and Concept, Ordering : Meaning and Concept Leading : Meaning and Concept, Supervision : Meaning and Concept Communication : Meaning and Concept	2
19 & 20	Capital Management and Financial Management Definition of capital, Types of capital, Assess capital, Shares, Debentures, Ploughing back of earnings, Managing agent, Public deposit, Hire purchase, Leasing, Trade credit Importance of Capital and Financial Management Balance Sheet- Meaning, Concept, Importance, Precautions in preparing the balance sheet of business farm Study of different test Ratios- Current Ratio, Intermediate Ratio, Net Capital Ratio, Current Liability Ratio, Debt Equity Ratio, Equity Value Ratio	6
21	Profit & Loss Statement- Meaning, Concepts, Hypothetical Form of Profit & Loss Statement, Study of different Financial Test Ratio- Capital turnover Ratio, Rate of return on investment, Net Farm Income, Net return to total capital	4
22 & 23	Marketing Management:Meaning of Marketing, Definition of Marketing, Concepts of Marketing- Exchange concept, Product Concept, Marketing Myopia, Sales Concept, Difference between Marketing and Selling, Features of Marketing Concept- Consumer Orientation, Integrated Management Action, Consumer Satisfaction. Realizing the organizations goals including profit	7
24	Marketing Mix : Meaning, 4 Ps of Marketing, Product Variable, Place Variable, Price Variable, Promotion Variables. Marketing Strategies. Consumer behaviour analysis	4
25 & 26	Market Segmentation - Meaning and concept of Market Segmentation, Importance Role of Market Segmentation, Methods of Market. Product Life Cycle : Meaning, Stages of Product Life Cycle, Market Pioneering stage, Market growth stage, Market Maturity stage, Market decline stage. Sales and Distribution Management : Meaning, Management of Sales and Distributions, Price Policy - Meaning of Price Policy, Objectives of Price Policy, Pricing Methods, Prices at various stages of Marketing	7
27 & 28	Project : Meaning of Project, Definition of Project, Concept of Project, Types of Agricultural Projects- Water Resource Development Projects, Agricultural Credit Projects, Agricultural Development Projects, Agro-Industries & commercial Development Project. Phases in Project Cycle :Conception OR Identification, Formulation OR Preparation of the Project, Appraisal OR Analysis, Implementation, Monitoring, Evaluation, Criteria for section of Agricultural Projects	7

Lecture	Details of Topic	Weightage
29 & 30	Methods of Project Appraisal: Undiscounted Measures-Payback Period, Proceeds per Rupee of Outlay, Average, Annual Proceeds of Rupee Outlay. Discounted Measures- Net Present worth (NPW), Benefit Cost Ratio (B:C Ratio), Internal rate of Return (IRR), Profitability India, Appropriate Selection of Choice Indicator. Sensitivity Analysis	6
31 & 32	Guide lines for project preparation report- Summary & Conclusion, Introduction, Back ground, Project Rationale, Project Area, The Project, Organization & management, Production, Markets & Financial results, Benefits & Justification. Outstanding Issues Preparation of Project reports for various Activities in agriculture & allied sectors : Dairying, Poultry, Fisheries, Agro-Industries, etc.	4
	Total	**100**

b) Practical

Exercise	Title of Exercise
1.	Study of Input Market : Seed Fertilizer, Pesticides
2.	Study of Output market : Grain, Fruits, Vegetable, Flower
3.	Study of Product Market : Retail trade commodity trading, value added products
4.	Study of Financing Institutions, Co-operatives, Commercial Banks
5.	Study of Regional Rural Bank
6.	Study of Agribusiness Finance Limited
7.	Study of NABARD
8.	Study of Financial Criteria for appraisal of the Project
9.	Appraisal of Irrigation Project
10.	Study of Financial Test Ratios for Evaluation Agro based Industries
11.	Study of Methods of Project Evaluation
12.	Case study of Agro based Industries
13.	Visit to Financial Institution
14.	Study on E-Commerce of Agricultural Commodities
15.	Visit to Export Market of Fruits/Vegetables/Flowers/Grains
16.	Visit to Processed Industries/Malls/Producer's Companies

Suggested Readings:

1) Agribusiness Management by Dr. Shivaji Nagpure & Dr. R.G. Deshmukh, M/s. AGROMET Publishers, Nagpur.
2) Indian Agriculture & Agri-Business Management by Dr. Smita Diwase, M/s. Scientific Publishers, Jodhpur, Rajasthan.
3) Agricultural Finance & Management by S. Subha Reddy, & P. Raghu Ram, M/s. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
4) Agri Business Management by Dr. J.S. Amarnath & Dr. A.P.V. Samvel, M/s. Satish Serial Publishing House, Delhi-110033.
5) The Agribusiness Book by Mukesh Pandey, Deepali Tewari, M/s. ibdc Publishers, Lukhnow (U.P.), Pin-226 001.
6) Economics analysis of Agricultural Projects by J. Price Gittinger, M/s. The Economics Development Institute/World Bank, Washington D.C.-20433, U.S.A.

Course :	ECON 365	Credit:	2(1+1)	Semester-VI
Course title:	Farm Management, Production and Resource Economics			

Syllabus

Theory

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

Meaning and concept of cost, types of costs and their interrelationship, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income and farm business income.

Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting-linear programming, appraisal of farm resources, selection of crops and livestock's enterprises.

Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies**,** Crop/livestock/machinery insurance – weather based crop insurance, features, determinants of compensation.

Concepts of resource economics, differences between NRE and agricultural economics, unique properties of natural resources. Positive and negative externalities in agriculture, Inefficiency and welfare loss, solutions, Important issues in economics and management of common property resources of land, water, pasture and forest resources etc.

Practical

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

Teaching Schedule

a) Theory

Lecture	Topic	Weightages
1	Farm Management – Meaning – Definitions – Scope – Objectives - Relationship with other sciences	2
2	Farm – Meaning – Definition – its types and characteristics – factors determining size of farms	2
3	Economic principles applied to farm management – Principle of variable proportions – Determination of optimum input and optimum output	4
4	Minimum loss principle (Cost Principle) - Principle of factor substitution	3
5	Principle of product substitution - Law of Equi-marginal returns – Opportunity cost principle	3
6	Principle of comparative advantage – Time comparison principle	4
7	Types of farming – Specialization, Diversification, Mixed farming, Dry farming and Ranching – factors influencing types of farming	4
8	Types of farm business organizations – Peasant farming, Co-operative farming, Capitalistic farming, Collective farming and State farming	3
9	Meaning and concept of cost –types of costs – cost concepts – farm income measures – Gross income, farm business income, family labour income, net farm income & farm investment income	4
10	Farm business analysis – meaning and concept of farm income and profitability – technical and economic efficiency measures	4
11	Farm records and accounts – importance – types of farm records needed to maintain on farm	3
12	Farm inventory – methods of valuation– net selling price, cost less depreciation, market price, cost method, replacement cost less depreciation and income capitalization methods	5
13	Balance sheet or Networth statement – Assets, liabilities and networth – ratio measures	3
14	Income statement or profit and loss statement – Receipts, expenses and net income – ratio measures	4
15	Income statement or profit and loss statement – Receipts, expenses and net income – ratio measures	3
16	Farm planning – Meaning – Need for farm planning – types of farm plans – simple farm plan and whole farm plan – Characteristics of a good farm plan – basic steps in farm planning	4
17	Farm budgeting – Meaning – types of farm budgets – Enterprise budgeting – Partial budgeting and whole farm budgeting.	3
18	Linear programming – Meaning – Assumptions – Advantages and limitations	4

Lecture	Topic	Weightages
19	Risk and uncertainty in agriculture – nature and sources of risks – Production and technical risks – Price or marketing risk – Financial risk – methods of reducing risk	3
20	Agricultural Production Economics – Definition – Nature – Scope and subject matter of Agricultural Production Economics – Objectives of Production Economics – Basic Production Problems	4
21	Law of returns - Law of increasing returns – Law of constant returns – Law of decreasing returns	3
22	Factor-product relationship – production function and its types – Elasticity of production - Three stages of production function	3
23	Factor-factor relationship – Isoquant and their characteristics – MRTS – Types of factor substitution	2
24	Iso-cost lines – Characteristics – Methods of determining Least-cost Combination of resources – Expansion path – Isoclines – Ridge lines	4
25	Product-product relationship – Production possibility curve – Marginal rate of product substitution – Types of enterprise relationships – Joint products – Complementary – Supplementary – Competitive and Antagonistic products	3
26	Iso-revenue line and characteristics – Methods of determining optimum combination of products – Expansion path – Ridge lines	2
27	Resource productivity – Returns to scale	2
28	Resource economics – Definition, subject matter and scope - Differences between NRE and agricultural economics	3
29	Natural resources classification and characteristics – Resource depletion and causes for the same	2
30	Positive and negative externalities in agriculture	2
31	Inefficiency and welfare loss, solutions	2
32	Important issues in economics and management of common property resources of land, water, pasture and forest resources, etc.	3
	Total	**100**

b) Practical

Exercise	Topic
1	Basic concepts and terms
2	Determination of optimum input and output, and least cost combination of inputs
3	Determination of profitable combination of products and application of principle of equi-marginal returns
4	Seven types of costs and their computation
5	Farm cost concepts and their imputation procedure
6	Depreciation methods
7	Farm holding survey
8	Livestock – Farm survey

9	Estimation of cost of cultivation and farm income measures of major crops
10	Farm inventory analysis
11	Farm financial analysis – Preparation and analysis of balance sheet
12	Preparation and analysis of profit and loss statement
13	Preparation of farm plans
14	Preparation of enterprise budget and partial budge
15	Study of farm management aspects related to Agriculture college farm
16	Final Practical Examination

Suggested Readings:

1) Economics of Agricultural Production and Resource Use: Heady, Earl O, Prentice Hall of India, Private Limited, New Delhi, 1964
2) Introduction to Agricultural Economic Analysis: BISHOP, C.E., & TOUSSAINT, W.D., NEWYORK, John Wiley and Sons, Inc., London, 1958
3) Fundamentals of Farm Business Management: S.S. Johl, J.R. Kapur, Kalyani Publishers, New Delhi
4) Agricultural Economics: Subba Reddy S., Raghuram P., NeelakantaSastry T.V., Bhavani Devi I., Oxford and IBH Publishing Company, Private Limited, New Delhi, 2006
5) Farm Management Economics: Heady Earl O and Herald R. Jenson, Prentice Hall, New Delhi, 1954
6) Elements of Farm Management Economics: I.J. Singh, Affiliated East-West press, Private Limited, New Delhi
7) Introduction to Farm Management: Sankhayan, P.L., Tata – Mc Graw – Hill Publishing Company Limited, New Delhi, 1983
8) Resource Economics: A. Randall Wiley, Oxford India Publication
9) Environmental Economics: R. N. Bhattacharya, Oxford India Publication
10) Hand Book of Environmental Economics: K. Chopra and Vikram Dayal, Oxfor India Publication
11) Resource Economics: Conrad, Jon M, Cambridge University Press
12) Environmental economics: Prakash Vohra, Commonwealth Publishers
13) Natural Resource Economics: Theory and Applications in India: Kerr, John M, Marothia D.K., Katar Singh, Ramasamy C & Bentley W.R., Oxford & IBH Publishing Company, Private Limited, New Delhi, 1997
14) Environmental Economics: Sankar U, Oxford University Press, 2001
15) Environmental and Natural Resource Economics: Tietenberg T. 6th Ed. Addison Wesley 2003

B. Sc. (Hons) Agriculture

Agricultural Extension Education

- **Syllabus**
- **Teaching Schedule**
- **Suggested Reading**

Agricultural Extension Education

Sr. No.	Semester	Course No.	Credits	Course Title
1	I	EXTN 111	2(2+0)	Rural Sociology & Educational Psychology
2	II	EXTN 122	3(2+1)	Fundamentals of Agricultural Extension Education
3	II	EXTN 123	2(1+1)	Communication Skills and personality Developments (Common Course)
4	IV	ELE EXTN 244	3(2+1)	Agricultural Journalism
5	V	EXTN 355	2(1+1)	Entrepreneurship Development and Business Communication (Common Course)
		Total	**12(8+4)**	

Course :	EXTN 111	Credit:	2(2+0)	Semester-I
Course title:	Rural Sociology & Educational Psychology			

Syllabus

Theory

- **Sociology: Meaning**, definition
- **Rural Sociology**: Meaning, definition, scope, importance of Rural Sociology in agricultural extension and interrelationship between Rural Sociology and Agricultural Extension.
- **Indian Rural Society:** Important characteristics, differences between rural and urban societies.
- **Social Groups:** Meaning, definition, classification, factors considered in formation and organization of groups, and role of social groups in agricultural extension
- **Social Stratification**: Meaning, definition, functions, Basis for stratification, forms of social stratification, Characteristics and differences between class and caste system
- **Cultural Concepts**: Culture, customs, folkways, mores, taboos, rituals and traditions – Meaning, definition and their role in agricultural extension.
- **Social Values and Attitudes:** Meaning, definition, types and role of social values and attitudes in agricultural extension.
- **Social Institutions: Meaning**, definition, major institutions in rural society : Marriage, family, and religion, functions and their role in agricultural extension.
- **Social Control:** Meaning, definition, need of social control and means of social control.
- **Social Change:** Meaning, definition, nature of social change, dimensions of social change and factors of social change.
- **Leader:** Meaning, definition, types and their role in agricultural extension.
- **Psychology and Educational Psychology :** Meaning, definition, scope and importance of educational psychology in agricultural extension.
- **Behavior:** Cognitive, affective, psychomotor domain
- **Intelligence:** Meaning, definition, types, factors affecting intelligence.
- **Personality:** Meaning, definition, types, factors influencing personality.
- **Teaching-Learning Process :** Meaning and definition of teaching, learning, Learning experience and learning situation, elements of learning situation and its characteristics, Principles of learning and their implication for teaching.
- **Perception:** Meaning, definition, role of perception in agricultural extension
- **Motivation: Meaning**, definition, role of motivation in agricultural extension

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Sociology: Meaning, definition	5
2, 3	Rural Sociology: Meaning, definition, scope, importance of Rural Sociology in agricultural extension and interrelationship between Rural Sociology and Agricultural Extension.	5
6, 7	Indian Rural Society: Important characteristics, differences between rural and urban societies.	10
8, 9	Social Groups: Meaning, definition, classification, factors considered in formation and organization of groups, and role of social groups in agricultural extension	5
10, 11	Social Stratification: Meaning, definition, functions, Basis for stratification, forms of social stratification, Characteristics and differences between class and caste system	5
12, 13	Cultural Concepts: Culture, customs, folkways, mores, taboos, rituals and traditions – Meaning, definition and their role in agricultural extension.	5
14, 15	Social Values and Attitudes: Meaning, definition, types and role of social values and attitudes in agricultural extension.	5
16, 17	Social Institutions: Meaning, definition, major institutions in rural society: Marriage, family, and religion, functions and their role in agricultural extension.	5
18, 19	Social Control: Meaning, definition, need of social control and means of social control.	5
20, 21	Social Change: Meaning, definition, nature of social change, dimensions of social change and factors of social change.	5
22	Leader: Meaning, definition, types and their role in agricultural extension	5
23	Psychology and Educational Psychology: Meaning, definition, scope and importance of educational psychology in agricultural extension.	5
24	Behavior: Cognitive, affective, psychomotor domain	5
25, 26	Intelligence: Meaning, definition, types, factors affecting intelligence.	5
27, 28	Personality: Meaning, definition, types, factors influencing personality.	5
29, 30	Teaching-Learning Process : Meaning and definition of teaching, learning, Learning experience and learning situation, elements of learning situation and its characteristics, Principles of learning and their implication for teaching.	10
31	Perception: Meaning, definition, role of perception in agricultural extension	5
32	Motivation: Meaning, definition, role of motivation in agricultural extension	5
	Total	**100**

Suggested Reading

1) Ray, G.L. (2003), Extension Communication and Management. Kalyani Publishers. Fifth revised and enlarged edition.
2) Dahama, O.P. and Bhatnagar, O.P. (2003). Education and Communication for Development. Oxford and IBH Publishing Co. Pvt. Ltd.
3) Sandhu, A.S. (1993) Textbook on Agricultural Communication: Process and Methods. Oxford and IBH Publishing Co. Pvt. Ltd.
4) Chitambar, J.B. (2008). Introductory Rural Sociology. New Age International (P) Limited.
5) Sachdeva, D. R. and Bhushan, V (2007). An Introduction to Sociology. KitabMahal Agency.
6) Chitambar, J.B. (1973). Introductory rural sociology. New York, John Wilex and Sons.
7) Desai, A.R. (1978). Rural sociology in India. Bombay, Popular Prakashan, 5th Rev. ed.
8) Doshi, S.L. (2007). Rural sociology. Delhi Rawat Publishers.
9) Jayapalan, N. (2002). Rural sociology. New Delhi, Altanic Publishers.
10) Sharma, K.L. (1997). Rural society in India. Delhi, Rawat Publishers.

Course :	EXTN 122	Credit:	3(2+1)	Semester-II
Course title:	Fundamentals of Agricultural Extension Education			

Syllabus

Theory

- **Education**:Meaning, definition andtypes – Formal, informal and non formal education
- **Extension Education**-Meaning, definition, need, scope and process; history, objectives, philosophy, principles and approaches.
- **ExtensionProgrammePlanning**- Meaning, process, principles and steps in programmedevelopment.
- **Extension systems in India**:
  - Extension efforts in pre-independence era : Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment
  - Post-independence era : Etawah Pilot Project, Nilokheri Experiment
  - Present extension System : Department of Agriculture : Structure, Function
- **Various extension/ agriculture development programmes launched by ICAR/ Government of India :** Introduction, Objectives and Salient Achievements
  - Intensive Agricultural DistrictProgramme (IADP)
  - Intensive Agricultural Area Programme (IAAP)
  - High Yielding Varieties Programme (HYVP)
  - Institution-Village Linkage Programme (IVLP)
  - Operational Research Project (ORP)
  - National Agricultural Technology Project (NATP)
  - National Agricultural Innovation Project (NAIP)
  - RashtriyaKrishiVikasYojana (RKVY).
- **New trends in agricultural extension:**Meaning , Objectives, Salient features
  - Privatization in extension,
  - ICT in Extension education - Cyber extension/ e-extension,
  - Market-led extension,
  - Farmer-led extension,
- **Rural Development:**Concept, meaning, definition, objectivesand genesis
- **Various rural development programmes launched by Government of India** : Introduction, Objectives and salient features
  - Swarnajayanti Gram SwarojgarYojana (SGSY)
  - Indira AwasYojana (IAY)
  - Mahatma Gandhi National Rural Employment Guarantee Act
  - Prime Ministers' RozgarYojana (PMRY)
  - District Rural Development Agency (DRDA)
  - Integrated Watershed Development Programme (IWDP)
  - Providing Urban Amenities in Rural Area (PURA)
  - Rashtriya MahilaKosh – (National Credit Fund for Women)
  - MahilaArthikVikasMahamandal (MAVIM)
- **Community Development**. : Meaning, definition, concept, principles and philosophy.
- **Democratic Decentralization (Panchayati Raj)** : Meaning, Constitution and functions

- **Extension administration and management**:Meaning and concept, principles, functions and differences
- **Evaluation in Extension** : Meaning, definition, types of evaluation, monitoring and evaluation
- **Transfer of technology programmes**: Lab to Land programme (LLP),National Demonstration (ND), Front Line Demonstration (FLD),KrishiVigyanKendras (KVK), Technology Assessment and Refinement Programme (TARP) of ICAR.
- **Capacity building of extension personnel and farmers** : Meaning, Training and Education, Types of training, Training institutes in India, Concept of Human Resource Development
- **Extension Teaching Methods and Audio-Visual Aids** : Meaning, definition, importance, classification, media mix strategies; Factors affecting selection and use of methods and aids
- **Communication:** Meaning and definition; elements, selected models and barriers to communication.
- **Agriculture journalism** : Meaning, definitions, news writing
- **Diffusion and adoption of innovation**: Concept and meaning, Attributes of innovation, Innovation decision process, adopter categories.

Practical

1. Study of university extension system.
2. Organizing group discussion- exercise;
3. Handling and use of digital camera
4. Handling and use of LCD projector
5. Handling and use of Public Address System,
6. Preparation of extension literature – leaflet, folder,
7. Preparation of effective power point presentations
8. Writing of news story
9. Writing success story
10. Study of structure and functioning of DRDA
11. Study of structure and functioning of Department of Agriculture
12. Visit to NGO and learning from their experience in rural development;
13. Visit to village to understand PRA techniques and their application in village development planning;
14. Visit to community radio / television studio for understanding the process of programme production;
15. Writing for print / electronic media,
16. Developing script for radio / television.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	**Education:**Meaning, definition and types – Formal, informal and non formal education	2
2, 3, 4	**Extension Education-** Meaning, definition, need, scope and process; history, objectives, philosophy, principles and approaches.	10
5, 6	**Extension Programme Planning-** Meaning, process, principles and steps in programmedevelopment	5
7, 8	**Extension systems in India:** ▪ Extension efforts in pre-independence era : Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment ▪ Post-independence era : Etawah Pilot Project, Nilokheri Experiment ▪ Present extension System : Department of Agriculture : Structure, Function	5
9, 10	**Various extension/ agriculture development programmes launched by ICAR/ Government of India :** Introduction, Objectives and Salient Achievements ▪ Intensive Agricultural District Programme (IADP) ▪ Intensive Agricultural Area Programme (IAAP) ▪ High Yielding Varieties Programme (HYVP) ▪ Institution-Village Linkage Programme (IVLP) ▪ Operational Research Project (ORP) ▪ National Agricultural Technology Project (NATP) ▪ National Agricultural Innovation Project (NAIP) ▪ RashtriyaKrishiVikasYojana (RKVY).	10
11, 12	**New trends in agricultural extension:** Meaning , Objectives, Salient features ▪ Privatization in extension, ▪ ICT in Extension education - Cyber extension/ e-extension, ▪ Market-led extension, ▪ Farmer-led extension,	5
13	**Rural Development:**Concept, meaning, definition, objectives and genesis	5
14, 15, 16	**Various rural development programmes launched by Government of India** : Introduction, Objectives and salient	10

Lecture	Topic	Weightage (%)
	features ▪ Swarnajayanti Gram SwarojgarYojana (SGSY) ▪ Indira AwasYojana (IAY) ▪ Mahatma Gandhi National Rural Employment Guarantee Act ▪ Prime Ministers' RozgarYojana (PMRY) ▪ District Rural Development Agency (DRDA) ▪ Integrated Watershed Development Programme (IWDP) ▪ Providing Urban Amenities in Rural Area (PURA) ▪ Rashtriya MahilaKosh – (National Credit Fund for Women) ▪ MahilaArthikVikasMahamandal (MAVIM)	
17	**Community Development. :** Meaning, definition, concept, principles and philosophy	3
18	**Democratic Decentralization (Panchayati Raj) :** Meaning, Constitution and functions	2
19	**Extension administration and management:** Meaning and concept, principles, functions and differences	3
20	**Evaluation in Extension** : Meaning, definition, types of evaluation, monitoring and evaluation	2
21, 22	**Transfer of technology programmes :** Lab to Land programme (LLP), National Demonstration (ND), Front Line Demonstration (FLD), KrishiVigyanKendras (KVK), Technology Assessment and Refinement Programme (TARP) of ICAR	5
23, 24	**Capacity building of extension personnel and farmers** : Meaning, Training and Education, Types of training, Training institutes in India, Concept of Human Resource Development	5
25, 26, 27	**Extension Teaching Methods and Audio-Visual Aids** : Meaning, definition, importance, classification, media mix strategies; Factors affecting selection and use of methods and aids	10
28, 29	**Communication: Meaning and definition;** elements, selected models and barriers to communication	10
30	**Agriculture journalism** : Meaning, definitions, news writing	3
31, 32	**Diffusion and adoption of innovation:** Concept and meaning, Attributes of innovation, Innovation decision process, adopter categories.	5
	Total	**100**

b) Practical

Experiment	Topic
1	Study of university extension system
2	Organizing group discussion- exercise
3	Handling and use of digital camera
4	Handling and use of LCD projector
5	Handling and use of Public Address System
6	Preparation of extension literature – leaflet, folder
7	Preparation of effective power point presentations
8	Writing of news story
9	Writing success story
10	Study of structure and functioning of DRDA
11	Study of structure and functioning of Department of Agriculture
12	Visit to NGO and learning from their experience in rural development
13	Visit to village to understand PRA techniques and their application in village development planning
14	Visit to community radio / television studio for understanding the process of programme production
15	Writing for print / electronic media
16	Developing script for radio / television

Suggested Readings

1) Dahama, O.P. and Bhatnagar, O.P. 1980. Education and Communication for Development. Oxford &lBH Publishing Co. Pvt. Ltd., New Delhi.
2) Dudhani, C.M.; Hirevenkatgoudar, L.V., Manjunath, L.; Hanchinal, S.N. and Patil, S.L. (2004). Extension Teaching Methods and Communication Technology, UAS, Dharwad.
3) Kamat, M.G. (1985). Writing for Farm Families. Allied Publishers, New Delhi.
4) Kelsey, L.D. and Hearne, G.C. (1963). Cooperative Extension Work, Comstar Publishing Associate, New York.
5) Mehta, D.S.(1981). Mass Communication and Journalism in India. Vikas Publication, New Delhi.
6) Ray, G.L. (1991). Extension Communication and Management. NoyaPrakash, Calcutta.
7) Reddy, A.A 2005 Extension Education. Sri Lakshmi Press, Bapatla.
8) Rogers, E.M. 2003. Diffusion of Innovations. Free Press, New Delhi.
9) Samanta, R.K. (1990). Development Communication for Agriculture. BR Publishing Corporation, Delhi.
10) Sandhu, A.S. (1993).Textbbok on Agricultural Communication : Process and Methods. Oxford and IBH Publishing Pvt.Ltd., New Delhi.
11) Singh, A.K., Lakhan Singh, R. and Roy Burman (2006). Dimensions of Agricultural Extension. Aman Publishing House, Meerut

Course :	EXTN 123	**Credit:**	2(1+1)	**Semester-II**
Course title:	Communication Skills and personality Developments (Common Course)			

Syllabus

Theory

Unit I- Communication Skill

1. Meaning and Process of Communication Skill
2. Verbal And Non-Vrerbal Communication Skill
3. Public Speaking, Impromptu Presentation
4. Individual Presentation, roup Presentation, Seminars nd conference

Unit II- Writing Skill

1. Precise Writing, Summarizing, abstracting
2. Listening and Note taking, Field Diary and Lab Record
3. Indexing, Footnote and Bibligraphic procedures

Unit III- Personality Development

1. Meaning and Definition of Personality
2. Factors afeecting on Personality
3. Personality traits

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
	Unit I- Communication Skill	
1	Meaning and Process of Communication Skill	2
2,3	Verbal And Non-Vrerbal Communication Skill	5
4,5	Public Speaking, Impromptu Presentation	5
6,7	Individual Presentation, roup Presentation, Seminars nd conference	5
	Unit II- Writing Skill	
8,9,10	Precise Writing, Summarizing, abstracting	5
11,12,13	Listening and Note taking, Field Diary and Lab Record	5
14	Indexing, Footnote and Bibligraphic procedures	4
	Unit III- Personality Development	
15	Meaning and Definition of Personality	2
16,17	Factors afeecting on Personality	4
18	Personality traits	3
	Total	**50**

b) Practical

Sr.	Exercise	Remark
1	Listening and Note Taking	
2	Oral Presentation Skill	
3	Individual and Group Presentation	
4	Writing Skill	
5	Field Diary and Lab Record	
6	Indexing, Footnote and Bibliographic Procedures	
7	Precise writing, Summarizing, Abstracting	
8	Organizing Group Discussion	
9	Impromptu Presentation	

Suggested Reading

1) Balasubramanian T. 1989. A Textbook of Phonetics for Indian Students. Orient Longman, New Delhi.
2) Balasubrmanyam M. 1985. Business Communication. Vani Educational Books, New Delhi.
3) Naterop, Jean, B. and Rod Revell. 1997. Telephoning in English. Cambridge University Press, Cambridge.
4) Mohan Krishna and Meera Banerjee. 1990. Developing Communication Skills. Macmillan India Ltd. New Delhi.
5) Krishnaswamy,. N and Sriraman, T. 1995. Current English for Colleges. Macmillan India Ltd. Madras.
6) Narayanaswamy V R. 1979. Strengthen your writing. Orient Longman, New Delhi.
7) Sharma R C and Krishna Mohan. 1978. Business Correspondence. Tata McGraw Hill publishing Company, New Delhi.
8) Carnegie, Dale. 2012. *How to Win Friends and Influence People in the Digital Age*. Simon & Schuster.
9) Covey Stephen R. 1989. *The Seven Habits of Highly Successful People*. Free Press.
10) Spitzberg B, Barge K &Morreale, Sherwyn P. 2006. *Human Communication: Motivation,Knowledge& Skills*. Wadsworth.
11) Verma, KC. 2013. *The Art of Communication*. Kalpaz.
12) MamathaBhatnagar and NitinBhatnagar. 2011. Effective Communication and Soft Skills. Person Education.
13) Meenakshi Raman, Sangeeta Sharma. Technical Communication Principles and Practice
14) Harold Wallace and Ann Masters. Personality Development. Cengage Publishers.
15) Andrea J. Rutherford. Basic Communication Skills for Technology. Pearson Education.

Course :	ELE EXTN 244	Credit:	3(2+1)	Semester-IV
Course title:	Agricultural Journalism			

Syllabus

Theory

- **Journalism :** Meaning, definition, importance
- **Agricultural Journalism :** Meaning, definition, agricultural journalism in rural areas, problem and prospectus of agricultural journalism
- **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 outing.

Practical

1) Practice in interviewing.
2) Covering agricultural events.
3) Abstracting stories from research and scientific materials and from wire services.
4) Writing news story
5) Writing magazine story
6) Writing success story.
7) Preparation of leaflet
8) Preparation of folder
9) Script writing for radio and television
10) Selecting pictures and artwork for the agricultural story.
11) Practice in editing, copy reading, headline and title writing,
12) Use of proofreading symbols
13) Preparing layout of farm publication
14) Preparing cover design of farm publication
15) Testing copy with a readability formula.
16) Visit to press to understand the process of publication of newspaper

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	**Journalism :** Meaning, definition, importance	5
2, 3	**Agricultural Journalism :** Meaning, definition, agricultural journalism in rural areas, problem and prospectus of agricultural journalism	10
4, 5, 6, 7	**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	10
8, 9, 10, 11	**Newspapers and magazines as communication media:** Characteristics; kinds and functions of newspapers and magazines, characteristics of newspaper and magazine readers	10
12, 13, 14, 15	**Form and content of newspapers and magazines:** Style and language of newspapers and magazines, parts of newspapers and magazines	10
16, 17, 18, 19	**The agricultural story:** Types of agricultural stories, subject matter of the agricultural story, structure of the agricultural story	10
20, 21, 22, 23	**Gathering agricultural information:** Sources of agricultural information, interviews, coverage of events, abstracting from research and scientific materials, wire services, other agricultural news sources	10
24, 25, 26, 27	**Writing the story:** Organizing the material, treatment of the story, writing the news lead and the body, readability measures	15
28, 29	**Illustrating agricultural stories:** Use of photographs, use of artwork (graphs, charts, maps, etc.), writing the captions	10
30, 31, 32	**Editorial mechanics:** Copy reading, headline and title writing, proofreading, lay outing	10
	Total	**100**

b) Practical

Exercise	Topic
1	Practice in interviewing
2	Covering agricultural events
3	Abstracting stories from research and scientific materials and from wire services
4	Writing news story
5	Writing magazine story
6	Writing success story
7	Preparation of leaflet
8	Preparation of folder
9	Script writing for radio and television
10	Selecting pictures and artwork for the agricultural story
11	Practice in editing, copy reading, headline and title writing
12	Use of proofreading symbols
13	Preparing layout of farm publication
14	Preparing cover design of farm publication
15	Testing copy with a readability formula
16	Visit to press to understand the process of publication of newspaper

Suggested Reading

1. Arvind Kumar (1999). The Electronic Media. Anmol Publications, New Delhi.
2. Bhatt, S.C. (1993) Broadcast Journalism. Basic Principles HarAnand Publications, Delhi
3. Bhatnagar, R. (2001). Print Media and Broadcast Journalism. Indian Publisher Distributors, Delhi
4. Katyal, V.P (2007). Fundamentals of Media Ethics. Cyber Tech Publishers, New Delhi.
5. Yadava, J.S and Mathur, P. (1998). Issues in Mass Communication: the basic concepts. Volumes 1 and 2. Indian Institute of Mass Communication, New Delhi.

Course :	EXTN 355	**Credit:**	2(1+1)	**Semester-V**
Course title:	Entrepreneurship Development and Business Communication (Common Course)			

Syllabus

Theory

Entrepreneurship development

- Entrepreneur : Meaning, definitions, characteristics of entrepreneurship
- Assessment of entrepreneurship skills, identifying potential entrepreneurs
- Entrepreneurship development –Concept of entrepreneurship, Process of entrepreneurship development,
- Achievement motivation and entrepreneurship development
- Generation, incubation and commercialization of business ideas and innovations
- SWOT analysis : Concept and technique
- Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs/SSIs)
- Supply chain management, Time management and Total quality management
- Market Survey : Meaning, objectives, methods of conducting survey
- Formulation of project, financial analysis of project

Business Communication

- Communication – Meaning and process of communication
- Communication skills for entrepreneurship – Written communication, Verbal communication, Investigating and analyzing, Planning and Organizing, Negotiating and persuading, Cooperative (Team work), Leadership and Numeracy
- Developing different skills for entrepreneurship - Leadership Skills, Speaking Skills, Listening Skills, Organizational skill , Managerial skills, Problem solving skill,
- Writing Skill – Business letter, letters of enquiry, quotation, orders, and tenders, complaint letter
- Oral presentation skills – Preparation, presentation and evaluation
- Advertisements – Meaning, types, forms, functions

Practical

1. Assessing entrepreneur potential
2. Assessment of problem solving ability
3. Exercises in creativity
4. Conducting market survey to know the demands for different products
5. Preparing advertisements for popularization of products and news writing
6. Preparing project proposals
7. Individual and group presentations and evaluation of presentation
8. Telephonic conversation : Rate of speech, clarity of voice, speaking and listening politeness, telephonic etiquettes
9. Conducting meeting – Purpose, procedure, participation, physical arrangements, recording and writing of minutes of meeting

10. Seminar and conferences : Use of body language
11. Conducting mock interviews – testing initiative, team spirit and leadership
12. Group discussion and debates on current topics
13. Visit to entrepreneurship institute/ case study of successful entrepreneurs
14. Presentations by the students

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	**Entrepreneur :** Meaning, definitions, characteristics of entrepreneurship	10
2	Assessment of entrepreneurship skills, identifying potential entrepreneurs	5
3	**Entrepreneurship development** – Concept of entrepreneurship, Process of entrepreneurship development	5
4	Achievement motivation and entrepreneurship development	5
5	Generation, incubation and commercialization of business ideas and innovations	5
6	**SWOT analysis :** Concept and technique	10
7	Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs/SSIs)	5
8	Supply chain management, Time management and Total quality management	5
9	**Market Survey :** Meaning, objectives, methods of conducting survey	10
10	Formulation of project, financial analysis of project	10
11	Communication – Meaning and process of communication	5
12	Communication skills for entrepreneurship – Written communication, Verbal communication, Investigating and analyzing, Planning and Organizing, Negotiating and persuading, Cooperative (Team work), Leadership and Numeracy	5
13	Developing different skills for entrepreneurship - Leadership Skills, Speaking Skills, Listening Skills, Organizational skill , Managerial skills, Problem solving skill	5
14	Writing Skill – Business letter, letters of enquiry, quotation, orders, and tenders, complaint letter	5
15	Oral presentation skills – Preparation, presentation and evaluation	5
16	Advertisements – Meaning, types, forms, functions	5
	Total	**100**

b) Practical

Exercise	Topic
1	Assessing entrepreneur potential
2	Assessment of problem solving ability
3	Exercises in creativity
4	Conducting market survey to know the demands for different products
5	Preparing advertisements for popularization of products and news writing
6	Preparing project proposals
7	Individual and group presentations and evaluation of presentation
8	Individual and group presentations and evaluation of presentation
9	Telephonic conversation : Rate of speech, clarity of voice, speaking and listening politeness, telephonic etiquettes
10	Conducting meeting – Purpose, procedure, participation, physical arrangements, recording and writing of minutes of meeting
11	Seminar and conferences : Use of body language
12	Conducting mock interviews – testing initiative, team spirit and leadership
13	Group discussion and debates on current topics
14	Visit to entrepreneurship institute/ case study of successful entrepreneurs
15	Presentations by the students
16	Presentations by the students

Suggested Readings

1. Akhouri, M.M.P., Mishra, S.P. and Sengupta, Rita (1989). Trainers Manual on Developing Entrepreneurial Motivation, NIESBUD, New Delhi
2. Betty, Gorddan B. (1979). Entrepreneurship, Playing to Win, Taraporewala, Mumbai
3. Entrepreneurship Development Institute in India (1987). Developing New Entrepreneurs, EDII, Ahmedabad, NISIET, Library : 338.93/EDI/87/25104.
4. Mancuso, Joseph (1974). The Entrepreneurs Handbook, Vol.I& II, Artech House Inc. USA.
5. Patel, V.G. (1987). Entrepreneurship Development in India and its relevant Developing Countries, Entrepreneurship Development Institute of India, Ahmedabad, NISIET, Library : 338.93 (540)/PAT/87/25103.
6. Singh, A.K., Lakhan Singh, R. and Roy Berman (2006). Dimensions of Agricultural Extension, Aman Publishing House, Meerut.
7. MondalSagar and G.L.Ray (2009). Text Book of Entrepreneurship and Rural Development. Kalyani Publishers, Ludhiana. ISBN 978-81-272-5599-2

B. Sc. (Hons) Agriculture

Agricultural Engineering

- **Syllabus**
- **Teaching Schedule**
- **Suggested Readings**

Agril. Engineering

Sr. No.	Semester	Course No.	Credits	Course Title
1	II	ENGG 121	2(1+1)	Soil and Water Conservation Engineering
2	III	ENGG 232	2(1+1)	Farm Machinery and Power
3	IV	ENGG 243	2(1+1)	Renewable Energy and Green Technology
4	VI	ENGG 364	2(1+1)	Protected Cultivation and secondary Agriculture
5	VIII	ELM ENGG 485	10(0+10)	Natural Resources Management
		Total	18 (4+14)	

Course :	ENGG 121	**Credit:**	2(1+1)	**Semester-II**
Course title:	Soil and Water Conservation Engineering			

Syllabus

Theory

Introduction of soil and water conservation - definition and scope, causes of soil erosion, types, geological and accelerated soil erosion, Accelerated soil erosion - water and wind erosion definitions, Forms of water erosion, Wind erosion : Principle, mechanics, types of soil movement, Land use capability classification and planning, erosion control measures – Agronomical and Engineering measures (examples on grassed waterways) Contouring, strip cropping, contour bunds, graded bunds, terracing, waterways , Gully development classification and control measures : Temporary and permanent structures , Soil loss estimation by USLE (examples), Hydrological cycle, Runoff: Definition, types, factors affecting, estimation. Examples on rational formula, Water harvesting and its techniques, types (examples on capacity), Introduction of surveying: definitions, object of surveying, use of surveying, classification of surveying and principles of surveying, Watershed: definition, characteristics, deterioration, classification, Watershed management: definition and objects, steps of watershed management, Watershed monitoring and evaluation.

Practical

General status of soil conservation in India, Study of surveying instruments, Study of leveling instruments, Chain triangulation survey, Plane table survey, Estimation of runoff by rational method, Estimation of soil loss (USLE), Measurement of soil loss (multi slot divisor), Study of grassed waterway, Study of graded bunds, Study of contour bund and compartmental bunding, Study of terrace, Study of CCT and staggered trenches, Study of gully control structures (KT weir, Drop spillway, earthen nala bund), Determination of pond capacity, Visit to a developed watershed

Teaching Schedule

a) Theory

Lecture	**Topic**	**Weightage (%)**
1	Introduction of soil and water conservation - definition and scope, causes of soil erosion, types, geological and accelerated soil erosion	7
2	Accelerated soil erosion - water and wind erosion definitions, types of water erosion	7
3	Wind erosion : Principle, mechanics, types of soil movement	6
4 & 5	Land use capability classification and planning, erosion control measures (list and adoptability of agronomical and engineering measures) Contouring, strip cropping, contour bunds, graded bunds, terracing, waterways	8
6	Gully development, classification and control measures : Temporary and permanent gully control structures	7

Lecture	Topic	Weightage (%)
7	Soil loss estimation by USLE (examples)	7
8 & 9	Hydrological cycle, Runoff: Definition, types, factors affecting	9
10	Estimation of runoff. Examples on rational formula with Tc	7
11	Water harvesting and its types (examples on capacity of dug out types FP)	7
12	Introduction of surveying: definitions, object of surveying, use of surveying, classification of surveying and principle of surveying	8
13	Contour : definition, uses and characteristics	6
14	Watershed: definition, characteristics, deterioration, classification	7
15	Watershed management: definition and objects, steps of watershed management	8
16	Watershed monitoring and evaluation	6
	Total	**100**

b) Practical

Experiment	Topic
1	General status of soil conservation in India
2	Study of surveying instruments
3	Study of leveling instruments
4	Chain triangulation survey
5	Plane table survey
6	Estimation of runoff by rational method
7	Estimation of soil loss (USLE)
8	Measurement of soil loss (multi slot divisor)
9	Study of grassed waterway
10	Study of graded bunds
11	Study of contour bund and compartmental bunding
12	Study of terrace
13	Study of CCT and staggered trenches
14	Study of gully control structures (KT weir, Drop spillway, Earthen Nala bund)
15	Determination of pond capacity
16	Visit to a developed watershed

Suggested Readings

1) Principles of Agril. Engg.- Vol – II by A. M. Maichael& T. P. Ojha (2011), Jain Brothers, New Delhi
2) Soil and Water Conservation Engineering by R. Suresh (2000), Standard Publishers Distributrs,Delhi
3) Surveying &LevellingPart – 1 by T.P.Kanetkar and S.V.Kulkarni (2002), Pune VidyarthiGrihaPrakashan, Pune
4) Irrigation Theory and Practice By A. M. Michael (2005), Vikas Publishing House Pvt Ltd, New Delhi
5) Soil Conservation in India by Rama Rao M.S.V. (1974) ICAR, New Delhi.
6) Manual of Soil & Water Conservation Practices by Gurmel Singh and others (1996), Oxford & IBH publishing Co. Pvt. Ltd., New Delhi
7) Watershed Hydrology by R. Suresh (1997),Standard Publishers Distributrs, Delhi
8) Surveying &Levelling Part – 1 by N. N. Basak (2005) Tata McGraw-Hill Publishing Company Ltd, New Delhi
9) Manual of SWCE by Scwab G. O. et al (1996) WMC Brown Co. Publishers, Lowa, USA
10) Agricultural Engineer's Handbook by Richey et al (1961) Tata McGraw-Hill Publishing Company Ltd, Nw York

Course :	ENGG 232	**Credit:**	2(1+1)	**Semester-III**
Course title:	Farm Machinery and Power			

Syllabus

Theory

Status of Farm Power in India, Sources of Farm Power , Scope of Mechanization, 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 operation of power tiller, 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.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Sources of farm power in ..Human, Animal, Mechanical, electrical, solar, Wind Power, Scope of Mechanization.	6
2-3	Principle of operation of I.C. engine- I.C. engine working principles Two and Four stroke engine, Engine terminology and examples	13
4-5	I.C. Engine systems -Fuel supply system, cooling system, Air cleaner, lubrication of tractor.	12
6-7	Tractor -Tractor types and their selection, fixed and operating cost of tractor power and attached implements with examples	13
8	Tillage - Tillage, objectives of tillage, classification & types of tillage, Tillage implements	7
9	Primary tillage implements - M. B. plough and Disc plough, Rotavator, with examples	6
10	Secondary tillage implements - Harrows, cultivators & examples	6

Lecture	Topic	Weightage (%)
11-12	Implements for inter-culturing operations - Hand tools, Improved hoes, Wheel hoe, Multipurpose hoe, Tractor drawn intercultural equipments	12
13	Seed drills - Sowing methods, seed drill, components of seed drill, seed metering mechanism (Fluted roller and plate type only) , types of furrow openers, calibration of seed drill, examples	7
14	Study of planter -Planter, Functions, seed metering devices, type of planters, solved examples	6
15	Plant protection equipments- Classification, types of spraying and types of dusting machines.	6
16	Harvesting and threshing equipments-Definition of harvesting and threshing, harvesting /threshing methods implements , mower and combine harvester-thresher, solved examples	6
	Total	**100**

b) Practical

Experiment	Topic
1.	Study of components of internal combustion (I. C.) engine
2.	Study of two stroke cycle engine
3.	Study of four stroke cycle engine
4.	Study of Fuel supply systems for S. I. engines
5.	Study of Fuel supply systems for C. I. engines
6.	Study of Air Cleaning and Cooling systems of an engine
7.	Study of Lubrication system
8.	Study of clutch, Gear box and differential unit of the tractor
9.	Study of primary tillage implements: mould board plough and disc plough
10.	Study of secondary tillage implements- harrows and cultivators.
11.	Study of inter-culturing tools and implements- manual and animal drawn.
12 &13	Study of seed-cum-fertilizer drill and calibration of seed drill.
14.	Study of sprayers and dusters
15.	Study of harvesting and threshing machinery
16.	Study of power tiller- important parts and attachments

Suggested Readings

1) Principles of Agricultural Engineering Vol. 1. Reprint Edition: 2012. by T. P. Ojha, A. M. Michael, Jain Brothers, New Delhi
2) Elements of Agricultural Engineering by JagadishwarSahay. Forth Edition, 2010 Standard Distributor and Publishers, New Delhi
3) Agricultural Engineering by O P Singhal (2011) Aman Publishing House, Meerut
4) Elements of Farm Mechaneries by A C Srivastava, Oxford and IBH Publishing Co Pvt Ltd, New Delhi
5) Farm Tractor -Repair and Maintenance by S.C. Jain and C.R. Rai.
6) Principles of Farm Machineies by R A Kepner, R Bainer, E C Barger (2000) CBS Publishers and Distributors, Delhi
7) Farm Engines and Tractors by H E Gulvin (2001) McGraw Hill, New York
8) Servicing and Maintenance of Farm Tractors (2005) E J Johnson and A HHollenburg, McGraw Hill, New York
9) Tractor Implement System by Alcock and Ralph (1986) Athe AVI Publishing Co. Inc Springer, New York

Course :	ENGG 243	**Credit:**	2(1+1)	**Semester-IV**
Course title:	Renewable Energy and Green Technology			

Syllabus

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 biooil 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.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Classification of energy sources	4
2	Energy utilization pattern in crop production	5
3	Biofuels: Introduction, Ethanol production process, Biodiesel production process, Environmental Benefits	8
4	Biogas: Introduction, process description, Constituents of biogas, main features of biogas plant, Classification & Popular designs, Applications	8
5	Gasifier :Types of gasifier, Gasification process, Producer gas and its constituents	8
6	Bio-oil: Pyrolysis or Destructive distillation	5
7	Solar Energy: Introduction Collection and applications	6
8	Solar Energy Devices: Solar Cooker	6
9	Solar Water Heater	6
10	Solar Distillation (solar still)	6
11	Solar Dryer	6
12	Solar Pond	6
13	Solar Photo-voltaic System (SPV)	6
14	Wind energy (Introduction, characteristics, measurement equipment, conversion systems, uses of wind energy systems)	7
15	Some other Renewable Energy Sources: Ocean thermal energy conversion, Tidal energy, Geothermal Energy, Hydrogen Energy,	7

Lecture	Topic	Weightage (%)
	Fuel cells, Hydroelectric.	
16	Use of New and Renewable energy sources in energy conservation	6
	Total	**100**

b) Practical

Experiment	Topic
1.	Study of floating drum biogas plants.
2.	Study of fixed drum biogas plants
3.	Study of different types of gasifiers.
4.	Study of the production process of biodiesel
5.	Study of production process of ethanol.
6.	Study of Solar Photovoltaic fencing.
7.	Study of box type solar cooker.
8.	Study of parabolic cooker.
9.	Study of solar water heater.
10.	Study of solar dryer.
11.	Study of solar water pumping system.
12.	Study of solar lightning system.
13.	Study of solar photovoltaic system.
14.	Study of solar distillation system.
15.	Study of the solar pond.
16.	Visit to Renewable energy integrated plant.

Suggested Readings

1. Non-conventional Energy Sources by G. D Rai 5th Edition. KhannaPubhishers, Delhi
2. Renewable Energy Theory and Practice by N.S. Rathore, N.L. Panwar, A.K. Kurchania. Himanshu Publications, Udaipur.
3. Handbook of Agricultural Engineering, ICAR Publication.
4. Solar Energy Utilization by G.D. Rai 5th Edition. KhannaPubhishers, Delhi.
5. Solar Energy: Principles of Thermal Collection and Storage by S.P. Sukhatme& J.K. Nayak 3rd Edition. McGraw Hill Education, Delhi.
6. Principle of Renewable Energy – Twidell and Weir.
7. Principle of Energy Conversion. Culp A.W. 1991. McGraw Hill Pub. Co. Inc.
8. Dufee J.A. and Beckman W.A. 1986. Renewable Energy Sources. E and FA Spon. Ltd. London
9. Biotechnology and Other Alternative Technologies for Utilization of Biomass and Agricultural Wastes by AmlenduChakravarti.
10. Biogas Technology; A practical Handbook by K. C. Khandalwal and S.S Mahdi, 1986.

Course :	ENGG 364	Credit:	2(1+1)	Semester-VI
Course title:	Protected Cultivation and secondary Agriculture			

Syllabus

Theory

Green house technology: Introduction, Types of Green Houses; Plant response to Green house environment, Planning and design of greenhouses, Design criteria of green house for cooling and heating purposes.Materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, 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,, re-circulatory 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.Study of Greenhouse Covering and Construction Materials. Study of Cooling System used in Green House. Study of Irrigation System used in Green House. Cost Estimation of Poly houses for 560 Sq.m Study of greenhouse equipment's. Visit to Commercial Green House. Visit to various Post Harvest Laboratories. Determination of Moisture content of various grains by oven drying & infrared moisture methods.Study of Grain Dryers.Study of Material Handling Equipments.Determination of engineering properties (shape and size, bulk density and porosity of biomaterials).Determination of Moisture content of various grains by Universal moisture meter.Field visit to seed processing plant.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1.	Green house technology - Green house technology: Introduction, History of green house, Advantages of green house, Green house effect.	6
2.	Types of Green houses-Types of Green houses: Green house type based on Shape, Utility, Construction and Covering materials	7
3.	Plant response to green house environment -Plant response to green house environment : Light, Temperature, Relative Humidity, Ventilation and Carbon di-oxide.	6
4.	Planning and Design of green house- Planning and Design of green house: Site selection and orientation, structural design and covering materials.	6
5.	Materials of construction - Materials of construction for traditional and low cost green house: Wood, G.I., aluminum, steel, R.C.C. and Glass	6
6.	Irrigation Systems used in green house - Irrigation Systems used in green house: Rules of watering, Overhead Sprinklers , Drip irrigation system and Foggers (Mist spraying)	6

Lecture	Topic	Weightage (%)
7.	Design criteria of green house for Cooling and Heating purposes - Design criteria of green house for Cooling and Heating purposes: Cooling - Natural ventilation, forced ventilation Heating- Heating system, solar heating system, Water & Rock storage.	6
8.	Engineering Properties - Engineering Properties of cereals, pulses and oil seed. Their applications in PHT equipment design and operation: Physical properties: Size and Shape (Roundness and Sphericity) Porosity, Coefficient of friction, and angle of repose, Thermal properties: Definition of Specific heat and Thermal conductivity. Aero & hydrodynamic properties: Definition of Terminal velocity	6
9.	Drying and Dehydration - Drying and Dehydration: Definition of drying and dehydration, Utilities/Importance of drying Grain drying Theory- EMC definition, Thin layer drying and deep bed drying	6
10 & 11	Moisture Measurements- Moisture measurements: Moisture content and its measurement, Moisture content representation: Dry basis and wet basisMoisture Content determination Methods:- Direct methods- Air oven method, Vacuum oven method and Infra-red methodIndirect Methods- Electrical resistance method and Di-electric method.	12
12.	Various Drying Methods - Various Drying Methods: Sun drying, Mechanical Drying Mechanical Drying Methods:- Contact drying, Convection drying, Radiation drying	6
13.	Numerical on Moisture content and its representation- Numerical on Moisture content and its representation: Conversion of wet basis moisture contents to dry basis moisture contents Conversion of dry basis moisture contents to wet basis moisture contents, Problems on drying Problems on moisture contents Problem No.1 & No.2.	6
14 & 15	Commercial Grain Dryers - Commercial Grain Dryers: Construction and working principle - Deep bed dryer, Flat bed dryer, Recirculating dryer – (LSU and Baffle dryers) , Tray dryer and Solar dryers	13
16.	Material Handling Equipments- Material Handling Equipment's: Construction and working principle- Conveyor- Belt conveyor and Screw conveyor Elevator- Bucket elevator	8
	Total	**100**

b) Practical

Experiment	Topic
1	Study of Different Types of Green Houses
2	Study of Green House Covering and Constructional Materials
3	Study of Cooling System Used in Green House
4	Study of Instruments and Equipments used in Green House
5	Study of Irrigation Systems Used in Green House
6	Cost Estimation of Poly-house for 560 sqm.
7	Visit to Commercial Green House
8	Determination of Moisture Content of Various Grains by Oven Method
9	Determination of Moisture Content of Various Grains by Universal Moisture Meter
10	Determination of Moisture Content of Various Grains by Infrared Moisture Meter
11	Determination of Physical Properties of Grains
12	Study of LSU and Baffle Dryers
13	Study of Tray and Solar Dryers
14	Study of Material Handling Equipments-Belt Conveyor, Screw Conveyor and Bucket Elevator
15	Visit to Seed Processing Plant
16	Visit to Post Harvest Laboratories

Suggested Readings

1) Green House Technology & Management by K.RadhaManohar (2000) C.Igathinathane B.S. Publications 4-4-309, Sultan Bazar, Hyderabad-500095.
2) Unit Operations of Agricultural Processing by K.M. Sahay and K.K.Singh (2009)Vikas Publishing House Pvt. Ltd. New Delhi-110007
3) Post harvest Technology of Cereals, Pulses and Oilseeds by A. Chakraverty (1997)Oxford & IBH Publishing Co. Pvt. Ltd., 66 Janpath, New Delhi-110001.
4) Green House management by L R Taft (1997) Biotech Books, Delhi
5) Post Harvest Technology and Quality management of Fruits and Vegetables by P. Suresh Kumar, V R Sagar and M Kanwat (2009) Agrotech Publishing Academy, Udaipur
6) A Text Book of Greenhouse and Post Harvest Technology by B.P. Sawant, J.M. Potekar, H.W. Awari(2008) Nikita Publication, Latur.
7) Green House Technology by G. N. Tiwari and R.K. Goyal(1998) Narosa publishing House, 6 community Centre, Panchsheel Park New Delhi- 110017
8) Green House Technology and Application by V M Salokhe and A KSharma(2006) Agrotech Publishing Academy, Udaipur
9) Emerging Trends in PHT and Utilization of Plant Food by N Khetarpaul et al(2003) Agrotech Publishing Academy, Udaipur
10) Green House Operation and Management by Nelson and Paul V (1994) Prentice Hall, USA

B. Sc. (Hons) Agriculture

Plant Pathology

- **Syllabus**
- **Teaching Schedule**
- **Suggested Reading**

Plant Pathology

Sr. No.	Semester	Course No.	Credits	Course Title
1	I	MIBO 111	2(1+1)	Introductory Microbiology
2	II	PATH 121	3(2+1)	Fundamentals of Plant Pathology
3	II	PATH 232	2(1+1)	Principles of Integrated Disease Management
4	IV	ELE PATH 243	3(2+1)	Biofertilizers, biocontrol agents and biopesticides
5	V	PATH 354	3(2+1)	Diseases of Field and Horticultural Crops and their Management – I
6	VI	PATH 365	3(2+1)	Diseases of Field and Horticultural Crops and their Management-II
7	VIII	ELM PATH 486	10(0+10)	Mushroom Cultivation Technologies
		Total		

Course :	MIBO 111	**Credit:**	2(1+1)	**Semester-I**
Course title:	Introductory Microbiology			

Syllabus

Theory

Introduction.Microbial world: History of Agril. Microbiology, Prokaryotic and eukaryotic microbes. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial nutrition: classification of nutrients Macroelements, Microelements, growth factors, culture media, nutritional classification of microorganisms 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.**Mushrooms- edible and poisonous types, nutritive values, Culturing and production techniques.**

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.Simple Staining, Negative staining and Gram Staining. Isolation of P and silicon Solubilizing Microbes, Mycorrhiza, Isolation of cellulose and Pectin degrading microbes for agro waste management

Teaching Schedule

a) Theory

Lecture	Topic	Weightages (%)
1	Microbiology: Introduction, Scope in Agriculture and allied fields.	5
2	History of Agricultural Microbiology, development of Microbiology. Development of Microscope	5
3	Microbial World: Prokaryotic and eukaryotic microorganisms.	6
4	Bacteria: cell structure, morphology, cytology and other characters, functions of external and internal parts.	6
5	Bacteria: Nutrients required for growth of bacteria, chemoautotrophy, photo autotrophy, Microbial growth	6
6	Bacterial genetics: Genetic recombination- Gene transfer by transformation, conjugation and transduction, Plasmids,	8
7	Role of microbes in soil fertility and crop production. Microbial transformation of Nitrogen, Biological nitrogen fixation-symbiotic, asymbiotic and associative , Azolla, blue green algae.	8
8	Microbial transformation of phosphorus, sulphur and carbon, decomposition of organic matter	11
9	Mycorrhiza: structure, types, merits, demerits	5
10	Rhizosphere and Phylloshere: Rhizosphere concept, microbes of Rhizosphere,Phylloshere: Phylospheric microflora	6
11	Silage production, single cell protein, Bio-fuel production-concept	8
12	Biofertilizers: definition, types of biofertilizers,	6
13	Bio-pesticides-Microbial insecticides	4
14	Biodegradation of agro-waste	5
15	Mushrooms- edible and poisonous, culturing and production	6
16	Microbes in human welfare:	5
	Total	**100**

b) Practical

Experiment	Topic
1	Acquaintance with microscope and other lab equipments
2	Methods of sterilization
3	Nutritional media and their preparations.
4	Enumeration of microbial population in soil- bacteria, fungi, actinomycetes.
5	Methods of isolation and purification of microbial cultures.
6	Isolation of *Rhizobium* from legume root nodule.
7	Isolation of *Azotobacter* from soil.
8	Isolation of *Azospirillum* from roots.
9	Isolation of BGA
10	Simple staining of bacteria
11	Gram staining of bacteria
12	Isolation of P and silicon Solubilizing Microbes

Experiment	Topic
13	Isolation of Potash solubilisingMicrobes
14	Isolation of Mycorrhiza
15	Isolation of cellulolytic microbes for agro waste management
16	Isolation of Pectin degrading microbes for agro waste management

Suggested Readings

1. M T Madigan, and J M Martinko, 2014. *Biology of Microorganisms* 14th Edn.
2. Pearson.M J Pelczer, 1998. *Microbiology* 5th Edn. Tata McGrow Hill Education Pvt. Ltd.
3. Strainer, R, 1987. *General Microbiology*. Palgrave Macmillan.Edward Alchano, 2002.

   Introduction to Microbiology.Jones and Bartlett hearing.
4. R P Singh, 2007. *General Microbiology*. Kalyani Publishers.
5. J Heritage, E G V Evans, R A Killington, 2008. *Introductory Microbiology*. Cambridge

   University press P. date.
6. Pelczar, jr. M.J.E.C.S.Chan and Krieg, N.R. 1996. *Microbiology*. Mc Graw Hill Publishers,

   Newyork.
7. Prescott, L.M. Harley, J.P. and Klein, D.A (5ed) 2002. *Microbiology*. Mc Graw Hill Publishers, Newyork.
8. Jamaluddin, M. Malvidya, N. and Sharma, A. 2006. *General Microbiology*. Scientific Publishers, Washington.
9. Sullia, S.B, and Shantaram 1998. *General Microbiology*. Oxford and IBH.
10. Borkar,S,G, and Patil N.M. 2016.Mushroom,A nutritive food and its cultivation. Astral

    International Pvt.Ltd,New Delhi
11. Borkar,S.G. 2015.Beneficial Microbes as Biofertilizers and its Production Technology Woodhead Publisher,I ndia,New Delhi
12. Madigan, M. Martinkoj, M. and Parker (10 ed.) 2003. *Biology of Microorganisms*. Prentice Hall of India Pvt. Ltd., New Delhi.

Course :	PATH 121	**Credit:**	3(2+1)	**Semester-II**
Course title:	Fundamentals of Plant Pathology			

Syllabus

Theory

Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work.Terms and concepts in Plant Pathology.Pathogenesis.Cause and classification of plant diseases. Important plant pathogenic organisms, 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, architecture, multiplication 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* etc.) Principles and methods of plant disease management. Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.

Practical

Acquaintance with various laboratory equipments and microscopy. 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 ant parasites.Study of morphological features and identification of plant parasitic nematodes.Extraction of nematodes from soil.Study of fungicides and their formulations.Methods of pesticide application and their safe use. Calculation of fungicide sprays concentrations.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Importance of plant diseases, scope and objectives of Plant Pathology.....	3
2	History of Plant Pathology with special reference to Indian work	3
3,4	Terms and concepts in Plant Pathology, Pathogenesis	6
5	classification of plant diseases	5
6,7, 8	Causes of Plant Disease Biotic (fungi, bacteria, fastidious vesicular bacteria, Phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, and nematodes) and abiotic causes with examples of diseases caused by them	10
9	Study of phanerogamic plant parasites.	3
10, 11	Symptoms of plant diseases	6
12,13, 14	Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus,	7
15	Reproduction in fungi (asexual and sexual).	4
16, 17	Nomenclature, Binomial system of nomenclature, rules of nomenclature,	6
18, 19	Classification of fungi.Key to divisions, sub-divisions, orders and classes.	6
20, 21, 22	Bacteria and mollicutes: general morphological characters. Basic methods of classification and reproduction in bacteria	8
23,24, 25	Viruses: nature, architecture, multiplication and transmission	7
26, 27	Nematodes: General morphology and reproduction, classification of nematode Symptoms and nature of damage caused by plant nematodes (Heterodera, Meloidogyne, *Anguina* etc.)	6
28, 29, 30	Principles and methods of plant disease management.	6
31, 32, 33	Nature, chemical combination, classification of fungicides and antibiotics.	7
34, 35, 36	Mode of action and formulations of fungicides and antibiotics.	7
	Total	**100**

b) Practical

Experiment	Topic
1.	Acquaintance with various laboratory equipments and microscopy
2.	General study of different structures of fungi.
3.	Study of symptoms of various plant diseases.
4.	Study of representative fungal genera
5.	Staining and identification of plant pathogenic bacteria
6	Study of phanerogamic plant parasites
7	Transmission of plant viruses
8	Study of morphological features and identification of plant parasitic nematodes.
9	Preparation of media
10	Isolation and purification of fungi and bacteria
11	Extraction of nematodes from soil
12	Koch's postulates
13	Study of fungicides and their formulations
14	Methods of pesticide application and their safe use
15	Calculation of fungicide sprays concentrations.
16	Collection and preservation of disease specimen

Suggested Readings

1) Pathak, V. N. Essentials of Plant Pathology. Prakash Pub., Jaipur
2) Agrios, GN. 2010. *Plant Pathology*. Acad. Press.
3) Kamat, M. N. Introductory Plant Pathology. Prakash Pub, Jaipur
4) Singh R S. 2008. *Plant Diseases.*8th Ed. Oxford & IBH.Pub.Co.
5) Singh R S. 2013. *Introduction to Principles of Plant Pathology.*Oxford and IBH Pub.Co.
6) Alexopoulos, Mims and Blackwel. Introductory Mycology
7) Mehrotra R S & Aggarwal A. 2007.Plant Pathology.7th Ed. Tata Mc Graw Hill Publ. Co. Ltd.
8) Gibbs A & Harrison B. 1976. *Plant Virology - The Principles*. Edward Arnold, London.
9) Hull R. 2002. *Mathew.s Plant Virology*. 4th Ed. Academic Press, New York.
10) Verma JP. 1998. *The Bacteria*. Malhotra Publ. House, New Delhi.
11) Goto M. 1990. *Fundamentals of Plant Bacteriology*. Academic Press, New York.
12) Dhingra OD & Sinclair JB. 1986. *Basic Plant Pathology Methods*. CRC Press, London, Tokyo.
13) Nene YL & Thapliyal PN. 1993. *Fungicides in Plant Disease Control.* 3rd Ed. Oxford & IBH, New Delhi.
14) Vyas SC. 1993. *Handbook of Systemic Fungicides*. Vols. I-III. Tata McGraw Hill, New Delhi.
15) Rajeev K & Mukherjee RC. 1996. Role of Plant Quarantine in IPM. Aditya Books.
16) Rhower GG. 1991. Regulatory Plant Pest Management. In: Handbook of Pest Management in Agriculture. 2nd Ed. Vol. II. (Ed. David Pimental). CRC Press.
17) Walia RK & Bajaj HK. 2003. *Text Book on Introductory Plant Nematology*. ICAR, New Delhi.

Course :	PATH 232	Credit:	2(1+1)	Semester-II
Course title:	Principles of Integrated Disease Management			

Syllabus

Theory

IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of diseases and pest risk analysis.Methods of detection and diagnosis of diseases.Measurment of lossess causes due to diseases. 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 disease management.Survey surveillance and forecasting of plant diseases. Development and validation of IPM module.Implementation and impact of IPM (IPM module for diseases. Safety issues in pesticide uses. Political, social and legal implication of IPM.Case histories of important IPM programmes.

Practical

Methods of diagnosis and detection of various plant diseases, Methods of plant disease measurement, Assessment of crop yield losses, calculations based on economics of IPM, Identification of biocontrol agents,Mass multiplication of *Trichoderma, Pseudomona*s, NPV etc. identification of diseases and their management. Crop (agro-ecosystem) dynamics of selected diseases.Plan & assess preventive strategies (IPM module) and decision making. crop monitoring attacked by diseases . Awareness campaign at farmers' fields.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	IPM: Introduction, history, importance, concepts.	8
2	Principles and tools of IPM	8
3	Economic importance of diseases	6
4	Pest risk analysis	6
5	Methods of detection and diagnosis of diseases	6
6	Measurement of losses causes due to diseases	6
7	Methods of control: Host plant resistance, cultural, mechanical, physical,	6
8	Legislative, biological and chemical control	6
9	Ecological management of crop environment	6
10	Introduction to conventional pesticides for the disease management	6
11	Survey surveillance and forecasting of plant diseases	6
12	Development and validation of IPM module	6
13	Implementation and impact of IPM (IPM module for diseases)	6
14	Safety issues in pesticide uses	6
15	Political, social and legal implication of IPM	6
16	Case histories of important IPM programmes	6
	Total	**100**

Practical

Experiment	Topic
1	Methods of diagnosis various plant diseases,
2,3	Methods of detection of various plant diseases
4,5	Methods of plant disease measurement
6	Assessment of crop yield losses
7	calculations based on economics of IPM
8	Identification of biocontrol agents
9	Mass multiplication of *Trichoderma,*
10	Mass multiplication of *Pseudomona*s,
11	Mass multiplication ofNPV
12	Identification of diseases and their management
13	Crop (agro-ecosystem) dynamics of selected diseases
14	Plan & assess preventive strategies (IPM module) and decision making
15	Crop monitoring attacked by diseases
16	Awareness campaign at farmers fields.

Suggested Readings

1) Singh RS. 2013. *Introduction to Principles of Plant Pathology*. Oxford and IBH Co., New Delhi.

2) Pathak, V. N. Essentials of plant pathology. Prakash Pub., Jaipur

3) Agrios, G. N. Plant Pathology. 5th edition, Published by a division of Reed Elsvier India Pvt., Ltd., New Delhi (2005)

4) Kamat, M. N. Introductory Plant Pathology. Prakash Pub, Jaipur

5) Stakman E C & Harrar JG. 1957. *Principles of Plant Pathology*. Ronald Press, USA.

6) *Tarr SAJ*. 1964. *The Principles of Plant Pathology*. McMillan, London.

7) *Vander Plank, JE*. 1975. *Principles of Plant Infection.* Acad. Press

8) Verma JP, Varma A & Kumar D. (Eds). 1995. *Detection of Plant Pathogens and theirManagement*. Angkor Publ., New Delhi

9) Mehrotra RS & Aggarwal A. 2003. *Plant Pathology*. 2nd Ed. Oxford & IBH,

10) Dhingra OD & Sinclair JB. 1986. *Basic Plant Pathology Methods*. CRC Press

11) Fox RTV. 1993. *Principles of Diagnostic Techniques in Plant Pathology*. CABINene YL & Thapliyal PN. 1993. *Fungicides in Plant Disease Control*. Oxford & IBH, NewDelhi.

12) Palti J. 1981. *Cultural Practices and Infectious Crop Diseases*. Springer- Verlag, New York.

13) Vyas SC. 1993 *Handbook of Systemic Fungicides*. Vols. I-III. Tata McGraw

14) Rajeev K & Mukherjee RC. 1996. Role of Plant Quarantine in IPM. Aditya Books.

15) Rhower GG. 1991. Regulatory Plant Pest Management. In: Handbook of Pest Management in

16) Agriculture. 2nd Ed. Vol. II. (Ed. David Pimental). CRC Press.

Course :	ELE PATH 243	Credit:	3(2+1)	Semester-IV
Course title:	Biofertilizers, biocontrol agents and biopesticides			

Syllabus

Theory

Biofertilizers: Introduction and types and importance of biofertilizers, Biopesticides and bioagents in agriculture and organic farming system, History of biofertilizers production Classification of biofertilizers microorganisms used in biofertilizers production. A study of growth characteristics of various microbes used in biofertilizers production. Nitrogen cycle in Nature. Process of nodule formation ,Role of Nif and Nod gene in Biological Nitrogen fixation, Enzyme nitrogenase and its component, Biochemistry of nitrogen fixation, Cross inoculation groups amongst *Rhizobium*, Methods used for the studying selection of efficient strain of *Rhizobium* .Quality standard for biofertilizers different methods of application of biofertilizers, role of microorganisms in decomposition of organic farm wastes, methods of quality control assessment in respect of biofertilizers, Strategies of Mass multiplication and packing Registration of biofertilizers. Strategies of marking and Registration with CIB of bioagents and biopesticides

Importance of *Trichoderma* spp., *Pseudomona*s spp. and *Bacillus* spp. as a biocontrol agents,Mechanism of disease control by thses organisms bioagents .Types of diseases controlled bioagents formulations, Effectiveness of bioagents against seed borne and soil borne plant pathogens, Mass multiplication and packing , Strategies of marking, and Registration with CIB and organic farming institute

Importance of *Trichogramma*, *Cryptolaemus*, *Chrysoperla,* NPV and entomofungal pathogens. Establishing insectary for host insects and natural enemies, Mass production of *Verticillium/Beauveria/Metarhzium/Nomuraea/Paecilomyces*/*Hirsutella thompsoni/Trichoderma,/Pseudomonas/Bacillus/Potash Mobilizers/Sulphur oxidizers /organic matter decomposers*

Practical

Equipment, machinery and tools used for biofertilizers,Biopesticides and bioagents production. Preparation of media used for isolation and culturing of biofertilizers : Jensen's agar, NFb medium, Yeast extract manitol agar, BGA-medium, Pikovaskaya's medium ; Isolation of *Rhizobium* from root nodulesIsolation *Azotobacter* from rhizosphere of cereal crops, *Beijernickia, Acetobacter*from soil, *Azospirillium* from roots of graminicious plants, BGA from soil, Mycorrhizae from the roots,PSM sulphur oxidizing microorganisms, ion chealator, potash mobilizers ,organic matter decomposers and their isolation in pure culture form. Estimating the efficiency of *Rhizobium* through pot culture experiments and through nodulation tests in test tubes and Leonard jar.. Preservation of cultures of these organisms. Production of commercial biofertilizers *viz*. *Rhizobium*, *Azotobacter*, *Azospirillum* and *Acetobacter* : selection of efficient strains, carriers and their sterilization, mother culture preparation, mass multiplication using shake culture method, mixing of culture and carriers and preparation of packets. Production of carrier based and grain based phosphate solubilizing biofertilizers.

Methods of mass multiplication of BGA and *Azolla*.A large scale production of decomposting cultures. Va-mycorrhiza : growth on Guinea grass roots and observations for root colonization. Preparation of VA-mycorrhizal inoculum.

Methods of application of*Rhizobium*, *Azotobacter*, *Azospirillum* and phosphate solubilizing biofertilizers. Methods of application of *Azolla* and blue green algal biofertilizers in paddy farming.Production of compost cultures.

Quality control of biofertilizers: ISI standards specified and estimating the viable bacterial count in carrier based biofertilizers. Storage of biofertilizer packets. Visit to biofertilizer plants. Preparation of plan of biofertilizer production unit and proposal of loan.

Biopesticide and bioagents: Mass production of *Trichogramma*, *Cryptolaemus*, *Crysoperla*, Mass HaNPV, and EPN. Importance of*Verticillium/Beauveria/ Metarhzium/Nomuraea/ Paecilomyces*/*Hirsutella thompsoni/Trichoderma,/Pseudomonas/Bacillus/ organic matter decomposers*. Testing of quality parameters and standardization of biopesticides.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Introduction and types and importance of biofertilizers, Biopesticides and bioagents in agriculture and organic farming system	3
2	History of biofertilizers production	5
3,4	Classification of biofertilizers microorganisms used in biofertilizers production	4
5	A study of growth characteristics of various microbes used in biofertilizers production	4
6	Nitrogen cycle in Nature and its importance	5
7	Process of nodule formation ,Role of Nif and Nod gene in Biological Nitrogen fixation	3
8	Enzyme nitrogenase and its component	3
9	Biochemistry of nitrogen fixation,	4
10	Cross inoculation groups amongst *Rhizobium*,	3
11	Methods used for the studying selection of efficient strain of *Rhizobium*	5
12	Quality standard for biofertilizers, ,.	3
13	Different methods of application of biofertilizers, biopesticides and bioagents	5
14	Methods of quality control assessment in respect of biofertilizers	3
15	Strategies of Mass multiplication and packing Registration of biofertilizers	4
16,17	Strategies of marking and Registration with CIB of bioagents and biopesticides	4
18	Role of microorganisms in decomposition of organic farm wastes	4

Lecture	Topic	Weightage (%)
19,20	Importance of *Trichoderma* spp., *Pseudomona*s spp. and *Bacillus* spp. as a biocontrol agent.	4
21	Mechanism of disease control by these organisms bioagents	3
	Types of diseases by controlled bioagents formulations	3
22	Factors responsible for effectiveness of bioagents against seed borne and soil borne plant pathogens	4
23	Mass multiplication and packing	2
24,25	Strategies of marking, and Registration with CIB and organic farming institute	4
26,27	Importance of *Trichogramma*, *Cryptolaemus, Chrysoperla*, NPV and entomofungal pathogens.	4
28	Establishing insectary for host insects and natural enemies	3
29	Mass production of bioagents *Trichoderma,Bacillus*,Pseudomonas	4
30	Quality parameters as per CIB specifications, Registration of biopesticides and case	3
31,32	Importance of *Verticillium/Beauveria/ Metarhzium/Nomuraea/ Paecilomyces*/*Hirsutella thompsoni* as biopesticides and their mass production	4
	Total	**100**

b) Practical

Experiment	Topic
1	Equipment, machinery and tools used for biofertilizers, Biopesticides and bioagents production.
2	Media used for biofertilizers, Biopesticides and bioagents production.
3	Isolation of *Rhizobium* from root nodules. Isolation of *Azotobacter ,Acetobactor,Beijernickia,Azospirillium*. I. By dilution pour plate technique and II. By enrichment culture technique
4	Isolation of *BGA,PSB*, sulphur oxidizing microorganisms, ion chealator, potash mobilizers ,organic matter decomposers I. By dilution pour plate technique and II. By enrichment culture technique
5	Estimating the efficiency of *Rhizobium* through pot culture experiments and through nodulation tests in test tubes and Leonard jar.
6	Production of *Rhizobium* commercial biofertilizers of *Azotobacter , AzospirillumAcetobacter,* organic matter decomposers
7	Production of carrier biofertilizers of sulphur oxidizing microorganisms, ion chealator, potash mobilizers
6	Study of VA-mycorrhiza: growth on Guinea grass roots and observations for root colonization. Methods of preparation and application of VA-mycorrhizal inoculum
7	Mass production of Trichogramma,Cryptolaemus,Crysoperla
8	Mass production of HaNPV, SlNPV and EPN
9	Mass production of *Verticillium/Beauveria/ Metarhzium/Nomuraea/ Paecilomyces/Hirsutella thompsoni/Trichoderma*

Experiment	Topic
10	Mass multiplication of BGA and *Azolla* and its application in paddy field
11	Methods of application of biofertilizers, Biopesticides and bioagents
12	Quality control of biofertilizers: ISI standards specified and estimating the viable bacterial count in carrier based biofertilizers, Biopesticides and bioagents
13	Quality control tests for the biofertilizers, Biopesticides and bioagents
14	Preparation of plan of biofertilizers, Biopesticides and bioagents production unit and proposal of loan.
15	CIB Registration for Biopesticides and bioagents
16	Visits to Commercial biocontrol units and Krishi Seva Kendra.

Suggested Readings

1. Alexander M. 1977. Soil Microbiology. John Wiley.
2. Bergerson FJ. 1980. Methods for Evaluating Biological Nitrogen Fixation. John Wiley and Sons.
3. Motsara, I.M.R., Bhattacharyya, P. and Srivastava, B. 1995. Biofertilizer Technology, Marketing and Usage- A Source Book-cum-glossary. FDCO, New Delhi.
4. Subba Rao, N.S. Biofertilizers in Agriculture and Forestry. 1993. Oxford and IBH. Publ. Co., New Delhi.
5. Burges, H.D. and Hussey, N.W. (1971). Microbial Control of Insects and mites. Academic Press, New York.
6. Burges, H.D. Formulation of microbial pesticides – Kluversep, ACB, Dordrecht-ISBN. 0412 625 202.
7. Coppel H.C. and J.W. Martin. (1977). Biological control of insect pest suppression. Springail.
8. De Bach P. 1964. Biological control of Insect Pest and Weeds Chapman and Hall, New York.
9. Gautam, R.D. (2006). Biological suppression of insect pests. Kalyani Publisher, New Delhi.
10. Huffaker, C.B. and Messenger, P.S. (1976). Theory and Practice of Biological control. Academic Press, New York.
11. Ignacimuthu, S.S. and Jayaraj, S. (2003). Biological Control of Insect Pests. Phoenix Publ. New Delhi.
12. Saxena, A.B. (2003). Biological Control of Insect Pests. Anmol Publ. New Delhi.
13. Huffaker, C.B. and Messenger, P.S. (1976). Theory and Practice of Biological control. Academic Press, New York.
14. Pepper HJ and Perlman D. 1979. Microbial Technology. 2nd Ed. Academic Press.
15. A century of Nitrogen Fixation Research Present status and Future propects. 1987. F.J. Bergersen and J.R. Postgate The Royal Soc., London.

16. Biology and Biochemistry of Nitrogen fixation. 1991. M.J. Dilworth,and A.R. Glenn, Elsevier, Amsterdam. .

17. Nitrogen Fixation in plants. 1986. R.O.D. Dixon,and C.T. Wheeler, Blackie USA, Chapman and Hall, New York.

18. A treatise on dinitrogen Fixation Section IV. Agronomy and Ecology 1977. R.W.F Hardy, and A.H. Gibson John Wiley & Sons, New York..

19. Bioresearches technology for sustainable agriculture. 1999. S. Kannaiyan, Assoc. Pub. Co., New Delhi.

20. Biofertilizer Technology, Marketing and usage- A source Book -cum-glossary 1995. Motsara, I. M.R., P. Bhattacharyya and Beena Srivastava, FDCO, New Delhi.

21. Symbiotic nitrogen fixation in plants, 1976. P.S. Nutman, Cambridge Univ. Press, London.

22. Hand book for Rhizobia; Methods in legume Rhizobium Technology, 1994. P. Somasegaran and H.J. Hoben Springer-Verlag, New York.

23. Biofertilizers in Agriculture and Forestry 1993. N.S. Subba Rao Oxford and IBH Publ. Co., New Delhi.

Course :	PATH 354	Credit:	3(2+1)	Semester-V
Course title:	Diseases of Field and Horticultural Crops and their Management – I			

Syllabus

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; Finger millet: Blast and leaf spot

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; Black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic; Castor: Phytophthora blight; Tobacco: black shank, black root rot and mosaic.

Horticultural Crops: Guava: wilt and anthracnose; Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top; Papaya: foot rot, leaf curl and mosaic, Pomegranate: bacterial blight;

Cruciferous vegetables: Alternaria leaf spot and black rot; Brinjal: Phomopsis blight and fruit rot and Sclerotinia blight; Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic; Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot; Colocasia: Phytophthora blight;

Coconut: wilt and bud rot; Tea: blister blight; Coffee: rust

Practical

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

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

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
	Symptoms, etiology, disease cycle and management of major diseases of following crops	
	Field crops	
1,2,3	Rice	6
4,5	Maize	5
6,7	Sorghum	5
8	Bajara	3
9	Finger millet	3
	Oilseed	
10	Groundnut	5
	Pulses	
11,12,13	Soybean , Black & green gram	8
14	Pigeonpea	5
	Cash Crop	

Lecture	Topic	Weightage (%)
15	Caster	5
16	Tobacco	5
	Horticultural Crops	
17	Guava	5
18,19	Banana	5
20,21	Papaya	5
22,23	Pomegranate	5
	Cruciferous vegetables:	
24,25	Cruciferous vegetables	6
26,27	Brinjal, Tomato , Okra	9
28,29	Beans Ginger, Colocasia	6
	Plantation Crops	
30,31,32	Coconut, Tea, Coffee	9
	Total	**100**

b) **Practical**

Experiment	Topic
	Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Collection and preservation of disease specimen (Note: Students should submit 50 pressed and well-mounted specimens)
1.	Rice: blast, brown spot, bacterial blight, sheath blight, false smut, Khaira and tungro
2.	Maize: stalk rots, downy mildew, leaf spots, Sorghum: smuts, grain mold and anthracnose, Bajra: downy mildew and ergot;
3.	Finger millet: Blast and leaf spot, Groundnut: early and late leaf spots ,wilt.
4.	Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic, Pigeonpea: Phytophthora blight, wilt and sterility mosaic
5.	Black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic,.
6	Castor: Phytophthora blight; Tobacco: black shank, black root rot and mosaic
7	Guava: wilt and anthracnose; Papaya: foot rot, leaf curl and mosaic, Papaya ring spot,
8	Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top
9	Pomegranate: bacterial blight ,wilt
10	Cruciferous vegetables: Alternaria leaf spot and black rot,
11	Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic
12	Brinjal: Phomopsis blight and fruit rot and Sclerotinia blight,
13	Okra: Yellow Vein Mosaic, Beans: anthracnose and bacterial blight
14	Ginger: soft rot; Colocasia: Phytophthora blight;
15	Coconut: wilt and bud rot; Tea: blister blight; Coffee: rust
16	Field visit for the diagnosis of field problems

Suggested Readings

1) Agrios, GN. 2010. *Plant Pathology*. Acad. Press
2) Diseases of Horticultural Crops fruits (1999) By Verma L.R and Sharma R.c,Indus Publishing company, New Delhi
3) Diseases of fruit crops (1986) By V.N.Pathak ,Oxford & IBH publication, New Delhi
4) Diseases of fruit crops (1986) By R.S.Singh ,Oxford & IBH publication, New Delhi
5) Diseases of Fruits and vegetables (2007) S.A.M.H. Naqvi,Springer Science & Business Media
6) Diseases of Plantation Crops (2014) By P.Chowdappa, Pratibha Sharma IPS 263pp
7) Diseases of Horticulture Crops and their management ,ICAR e-book for B.Sc.(Agri) & B.Tech (Agri) By TNAU pp172
8) Advances in the diseases of Plantation crops & spices (2004) P.Santha Kumari,International Book Distributing Company , 247 pp
9) Mehrotra RS & Aggarwal A. 2007. *Plant Pathology*. 7th Ed. Tata Mc Graw Hill Publ. Co. Ltd
10) Vegetable Diseases : A Colour full Hand book (2006) by Steven T.Koike ,Peter Gladers and Albert Paulus ,Academic Press, pp448
11) Diseases of Vegetables crops by R.S.Singh (1987) Oxford & IBH publication, New Delhi
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14) Diseases of Vegetable crops (2005) by Alferd Steferud ,Biotech Books ,New Delhi
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17) Singh H. 1984. *House-hold and Kitchen Garden Pests - Principles and Practices*. Kalyani Publishers.

Course :	PATH 365	Credit:	3(2+1)	Semester-VI
Course title:	Diseases of Field and Horticultural Crops and their Management – II			

Syllabus

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; Rust, Downy mildewMustard: 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.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
	Symptoms, etiology, disease cycle and management of major diseases of following crops	
	Field crops	
1,2,3	Wheat: Rusts, loose smut, Karnal bunt, powdery mildew, Alternaria blight, and ear cockle	5
4,5	Sugarcane: Red rot, Smut, Wilt, Grassy shoot, Ratoon stunting and Pokka Boeng	5
	Oilseed	
6,7	Sunflower: Sclerotinia stem rot and Alternaria blight, Rust, Downy mildew	3
8,9	Mustard: Alternaria blight, White rust, Downy mildew and Sclerotinia stem rot	3
	Pulses	

Lecture	Topic	Weightage (%)
10	Gram: wilt, grey mould and Ascochyta blight	5
	Lentil: rust and wilt	4
11	Linseed :Alternaria bud blight, Rust ,Powdery mildew	2
12	Pea: Downy mildew, Powdery mildew and Rust, wilt	5
	Cash Crop	
13,14	Cotton: Root rot, Wilt, Anthracnose, and black arm, Dahiya diseases, leaf curl of cotton, 2-4-D injury	7
	Horticultural Crops	
15,16,17,	Mango: Die back, Anthracnose, Mango-malformation, bacterial blight and powdery mildew, Spongy tissue, Red rust, Pink diseases, Loranthus, Stone graft Mortality, Lime induced chlorosis	6
18,19	Citrus : Citrus canker, Gummosis, Fruit rot, Citrus greening, Anthracnose, Tristeza, Citrus Exocortis, Scab of citrus, Mottle leaf of citrus	6
20,21	Grape vine: Downy mildew, Powdery mildew, Anthracnose, Bacterial Canker, Grape fan-leaf virus	6
22	Apple: Scab, Powdery mildew, Fire blight and Crown gall, Mosaic	3
23	Peach: leaf curl	2
23	Strawberry: Leaf spot	3
	Vegetables	
24	Potato: Early and late blight, black scurf, leaf roll, and Mosaic	5
25,26	Cucurbits: Downy mildew, powdery mildew, wilt, Angular leaf spot, Mosaic, TOSPO virus	5
27	Onion: Purple blotch, and Stemphylium blight, Downy mildew, Smut, Smudge, Erwinia rot	6
28	Garlic : Neck and bulb rot, and Stemphylium blight, Blemish, Black mould	3
29	Chilli : Anthracnose and fruit rot, Wilt and leaf curl	5
30	Coriander : Stem gall, Powdery mildew, Wilt	2
30	Turmeric: leaf spot	3
	Ornamental Crops	
31	Marigold :Botrytis blight, Alternaria blight	3
32	Rose: Dieback, Powdery mildew and Black leaf spot	3
	Total	**100**

b) Practical

Experiment	Topic
	Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Collection and preservation of disease specimen (Note: Students should submit 50 pressed and well-mounted specimens)
	Field crops
1	Wheat: Rusts, loose smut, Karnal bunt, powdery mildew, Alternaria blight, and ear cockle
2	Sugarcane: Red rot, Smut, Wilt, Grassy shoot, Ratoon stunting and Pokka Boeng
	Oilseed
3	Sunflower: Sclerotinia stem rot and Alternaria blight, Rust, Downy mildew
4	Mustard: Alternaria blight, White rust, Downy mildew and Sclerotinia stem rot
	Pulses
5	Gram: wilt, grey mould and Ascochyta blight
6	Lentil: rust and wilt
7	Linseed :Alternaria bud blight, Rust ,Powdery mildew
8	Pea: Downy mildew, Powdery mildew and Rust, wilt
	Cash Crop
9	Cotton: Root rot, Wilt, Anthracnose, and black arm, Dahiya diseases, leaf curl of cotton, 2-4-D injury
	Horticultural Crops
10	Mango: Die back, Anthracnose, Mango-malformation, bacterial blight and powdery mildew, Spongy tissue, Red rust, Pink diseases, Loranthus, Stone graft Mortality, Lime induced chlorosis
11	Citrus : Citrus canker, Gummosis, Fruit rot, Citrus greening, Anthracnose, Tristeza, Citrus Exocortis, Scab of citrus, Mottle leaf of citrus
12	Grape vine: Downy mildew, Powdery mildew, Anthracnose, Bacterial Canker, Grape fan-leaf virus
13	Peach: leaf curl
14	Apple: Scab, Powdery mildew, Fire blight and Crown gall, Mosaic
15	Strawberry: Leaf spot
	Vegetables
16	Potato: Early and late blight, black scurf, leaf roll, and Mosaic
17	Cucurbits: Downy mildew, powdery mildew, wilt, Angular leaf spot, Mosaic, TOSPO virus
18	Onion: Purple blotch, and Stemphylium blight, Downy mildew, Smut, Smudge, Erwinia rot
19	Garlic : Neck and bulb rot, and Stemphylium blight, Blemish, Black mould
20	Chilli : Anthracnose and fruit rot, Wilt and leaf curl
21	Coriander : Stem gall, Powdery mildew, Wilt
22	Turmeric: leaf spot
	Ornamental Crops
23	Marigold :Botrytis blight, Alternaria blight
24	Rose: Dieback, Powdery mildew and Black leaf spot
25	Field visit for the diagnosis of field problems

Suggested Readings

1) Agrios, GN. 2010. *Plant Pathology*. Acad. Press
2) Diseases of Horticultural Crops fruits (1999) By Verma L.R and Sharma R.c,Indus Publishing company, New Delhi
3) Diseases of fruit crops (1986) By V.N.Pathak ,Oxford & IBH publication, New Delhi
4) Diseases of fruit crops (1986) By R.S.Singh ,Oxford & IBH publication, New Delhi
5) Diseases of Fruits and vegetables (2007) S.A.M.H. Naqvi,Springer Science & Business Media
6) Diseases of Plantation Crops (2014) By P.Chowdappa, Pratibha Sharma IPS 263pp
7) Diseases of Horticulture Crops and their management ,ICAR e-book for B.Sc.(Agri) & B.Tech (Agri) By TNAU pp172
8) Advances in the diseases of Plantation crops & spices (2004) P.Santha Kumari,International Book Distributing Company , 247 pp
9) Mehrotra RS & Aggarwal A. 2007. *Plant Pathology*. 7th Ed. Tata Mc Graw Hill Publ. Co. Ltd
10) Vegetable Diseases : A Colour full Hand book (2006) by Steven T.Koike ,Peter Gladers and Albert Paulus ,Academic Press, pp448
11) Diseases of Vegetables crops by R.S.Singh (1987) Oxford & IBH publication, New Delhi
12) Plant Diseases.(2008) Singh RS. 20088th Ed. Oxford & IBH. Pub. Co.
13) Diseases of Crops Plants in India (2009) By PHI learning Pvt. Ltd, pp 548
14) Diseases of Vegetable crops (2005) by Alferd Steferud ,Biotech Books ,New Delhi
15) Mehrotra RS & Aggarwal A. 2007. *Plant Pathology*. 7th Ed. Tata Mc Graw Hill Publ. Co. Ltd
16) Diseases of Vegetable Crops ,Diagonosis and Management (2014) Dinesh Singh and P.Chodappa, Today and Tomorrow Printers ,pp734
17) Singh H. 1984. *House-hold and Kitchen Garden Pests - Principles and Practices*. Kalyani Publishers.

B. Sc. (Hons) Agriculture

Soil Science and Agricultural Chemistry

- **Syllabus**
- **Teaching Schedule**
- **Suggested Readings**

Soil Science and Agril. Chemistry

Sr. No.	Semester	Course No.	Credits	Course Title
1	I	SSAC 111	3(2+1)	Fundamentals of Soil Science
2	IV	SSAC 242	2(1+1)	Problematic Soils and their Management
3	V	SSAC 353	3(2+1)	Manures, Fertilizers and Soil Fertility Management
4	VI	ELE SSAC 364	3(2+1)	Agrochemicals
5	VIII	ELM SSAC 485	10(0+10)	Soil, Water, Plant and Fertilizer Analysis
6	VIII	ELM SSAC 486	10(0+10)	Agricultural Waste Management
		Total	**31(7+24)**	

Course :	SSAC 111	**Credit:**	3(2+1)	**Semester-I**
Course title:	Fundamentals of Soil Science			

Syllabus

Theory

Soil as a natural body,pedological and edaphological concepts of soil. Soil genesis: soil forming rocks and minerals. Weathering, processes and factors of soil formation; Soil Profile, components of soil; Soil physical properties: soil-texture, structure, density and porosity, soil colour, consistence and plasticity; Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; Soil air, composition, gaseous exchange, problem and plant growth, 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 micro organisms, their beneficial and harmful effects; Soil pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

Practical

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

Teaching schedule

a) Theory

Lecture	Topic	Weightage (%)
1 & 2	History and development of soil science, its scope and importance. Soil as natural body, pedological and edapholgical concept of soil.	5
3 & 4	Soil genesis: Soil forming rocks and minerals.	6
5 & 6	Weathering of Rocks and Minerals.	6
7 & 8	Processes and factors of soils formation.	5
9	Soil profile, components of soil.	5
10 & 11	Soil physical properties: Soil texture, structure, density and porosity.	5
12	Soil colour, consistency and plasticity.	3
13 ,14	Elementary knowledge of soil survey, soil taxonomy, classification, Land capability classification.	5
15	Soils of India and Maharashtra.	3
16 , 17& 18	Soil water : Soil water classification, soil water retention , soil water potential, soil moisture constants', Hydraulic conductivity, permeability, percolation, movement and availability in soil.	6
19	Soil air: composition, gaseous exchangeand effect on plant growth.	6
20	Soil temperature: source, amount and flow of heat in soil and effect on plant growth.	6
21 &22	Soil reaction: pH, soil acidity and alkalinity, buffering capacity, effect of soil pH on nutrient availability.	6
23 & 24	Soil colloids: soil colloidal properties, inorganic and organic colloids.	4
25 , 26 & 27	Silicate clay: constituents and properties, sources of charge, ion exchange, cation and anion exchange capacity, base saturation.	6
28,29 & 30	Soil organic matter: sources, composition, properties, factors affecting SOM, its importance and influence on soil properties.	6
31	Humic substances-nature and properties	5
32 ,33 &34	Soil organisms: macro and micro organism, their beneficial and harmful effects on soil and plant. soil biological properties (SMBC, soil respiration, DHA etc.)	6
35 & 36	Soil pollution – sources of soil pollution*, behavior of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.	6
	Total	**100**

b) Practical

Experiment	Topic
1	Study of soil forming minerals.
2	Study of soil forming rocks.
3	Study of soil sampling tools, collection of representative soil sample, its processing and storage.
4	Determination of moisture content in soil by gravimetric method.
5	Determination of soil colour by Munsell soil colour chart in field.
6	Determination of bulk density (Clod coating method) and particle density by pycnometer and porosity of soil.
7	Determination of soil texture by feel method.
8	Determination of soil texture by Bouyoucos hydrometer method.
9	Demonstration of capillary rise phenomenon of water in soil column.
10	Determination of infiltration rate of soil by double ring infiltrometer.
11	Determination of hydraulic conductivity of soil by constant head method.
12	Determination of soil temperature by using soil thermometer (0-15 and 15-30cm).
13	Determination of soil pH and electrical conductivity of soil.
14	Determination of anion exchange capacity of soil.
15	Determination of cation exchange capacity of soil (By NH_4OAc Method).
15	Study of soil map.
16	Estimation of organic carbon and organic matter content in soil by Walkely and Black method.
17 &18	Study of soil profile in field.

Suggested Reading

1) ISSS. 2009. Fundamentals of Soil Science. 2nd Ed. Indian Society of Soil Science, New Delhi- 110 012. pp. 728.
2) Das D. K. 2011. Introductory Soil Science, 3rd revised and Enlarged Ed, Kalyani Publisher, Ludhiana. pp. 645.
3) Brady, N. C. 2016. The Nature and Properties of Soils. 15th edition Publisher: Pearson Education, ISBN: 978-0133254488
4) Daji J A; Daji J A; Kadam J R; Patil N D.1996. Textbook of Soil Science Bombay Media Promoters and publishers Pvt. Ltd.
5) **Biswas, T.D.; Mukherjee, S. K.** 1995. Text Book of Soil Science 2nd sEd.Tata McGraw Hill Publisher, Delhi pp 433.
6) 6. Somawanshi, et al. 2012. Laboratory Methods for Analysis of Soil, Irrigation Water and Plants.., Department of Soil Science and Agriculturasl Chemistry, MPKV., Rahuri. revised Ed. pp. 307.
7) Jakson, M.L. 1973. Soil Chemical Analysis. Printice Hall, India, Pvt. Ltd. New Delhi. pp 498.
8) Page et. al. 1982. Methods of Soil Analysis, Part 1 and 2. Chemical and Microbiological Properties. 2nd Ed. Soil Science Soc. of America Am. Soc. Agron., Madison, Wisconsin, USA.
9) Klute, A. 1986. Methods of Chemical Analysis, 2nd Ed. American Soc. Agron., Inc. and Soil Science Society of America. Madison, Wisconsin, USA.
10) Piper, C. S. 1966. Soil and Plant Analysis. Inters Science . Hans Publisher, Mumbai.
11) Black, C. A. 1965. Soil Chemical Analysis, Part I and part II. American Soc. Agron., Inc. and Soil Science Society of America. Madison, Wisconsin, USA.
12) Hesse, P. R. 1971. a Text Book of Soil Chemical Analysis. John Murray, London.
13) Richards, L. A. 1968. Diagnosis and Improvement sof Saline Alkali Soils. Oxford andIBH Publication Co. Calcutta.
14) Chora, S. L. and Kanwar, J. S. 1991. Analytical Agricultural Chemistry, Kalyani Publisher New Delhi.
15) *Chapman*, H.D., and P.F. *Pratt*. *1961*. Methods of analysis for soils, plants and waters. Division of Agricultural Sciences, University of California,
16) Mehara, R. K. 2004. Text Book of Soil Science., ICAR, New Delhi.
17) Patil, V. D. and Mali C. V. 2007. Fundamentals of Soil Science, Aman Publication, Meerut.
18) NirankariLal Singh. 2000. Text Book of Soil Science. Aman Publication, Meerut.
19) Dahama, A. K. Organic farming for sustainable agriculture. 19, AgrobotanicaBinaker. Pp 53-98 and 210-255.
20) Tandon H.L.S. 1994. Recycling of Waste in Agriculture. Fertilizer Development t and consultation organization.

Course :	SSAC 242	Credit:	2(1+1)	Semester-IV
Course title:	Problematic Soils and their Management			

Syllabus

Theory

Soil quality and health, Distribution of Waste land and problem soils in India. Theircategorization based on properties. Reclamation and management of Saline and sodic soils, Acidsoils, Acid Sulphate soils, Eroded and Compacted soils, Flooded soils, Polluted soils.Irrigation water – quality and standards, utilization of saline water in agriculture. Remotesensing and GIS in diagnosis and management of problem soils.Multipurpose tree species, bio remediation through MPTs of soils, land capability andclassification, land suitability classification. Problematic soils under different Agro-ecosystems.

Practical

Saturation paste extract, its analysis for pHe and ECe, soluble cations and anions, competition of SAR and RSC. Exchangeable sodium percentages of soil, gypsum requirement of sodic soil, lime requirement of acidic soils. Irrigation water sampling technique, sewage water.Determination of pH, EC, soluble cations and anions. Computation of RSC and SAR, BOD and COD of sewage water, Satellite image analysis of salt affected soils

Teaching schedule

a) Theory

Lecture	Topic	Weightage (%)
1-2	Soil degradation: Concept, types, factors and processes. Soil quality and soil health: definition and concept, soil quality indicators. Characteristics of healthy soils.	6
3-4	Distribution and extent of waste land and problematic soils in India and Maharashtra. Categorization of problem soils based on properties.	6
5-6	Saline soils, alkali Soils, saline-alkali soils, degraded alkali soils, coastal saline soils: definition, formation, characteristics, effect on plant growth, reclamation and management. Acid and acid sulphate soils: definition, formation, characteristics, effect on plant growth, reclamation and management.	12
7-8	Calcareous Soil: definition, formation, characteristics, effect on plant growth, reclamation and management.	8
9	Eroded soils and compacted soils: definition, formation, characteristics, effect on plant growth, reclamation and management.	6
10	Submerged soils and flooded soils: definition, formation, characteristics, effect on plant growth, reclamation and management.	10
11	Polluted soils: definition, sources and their remediation.	10
12	Water pollution: definition, sources and their remediation.	6
13	Quality of Irrigation water and its suitability for irrigation.	6
14	Utilization of saline and sewage water in Agriculture.	6

Lecture	Topic	Weightage (%)
15	Remote sensing and GIS in diagnosis and management of problem soils.	6
16	Multipurpose tree species and bioremediation of soils.	6
17	Land capability classification and Land suitability classification.	6
18	Problematic soils under different Agro-ecosystem.	6
	Total	**100**

b) Practical

Experiment	Topic
1 & 2	Preparation of saturation paste extract.
3	Determination of pH_e and EC_e .
4 & 5	Determination of cations (Ca, Mg, Na and K) and computation of SAR.
6 & 7	Determination of ESP of soils.
8	Determination of gypsum requirement of sodic soil.
9	Determination of calcium carbonate from soil.
10	Determination of lime requirement of acidic soil.
11	Collection of irrigation water and sewage water.
12	Determination pH and EC from irrigation water.
13 & 14	Determination of cations (Ca, Mg, Na and K) from irrigation water.
15 & 16	Determination of anions (CO_3, HCO_3, Cl and SO_4) from irrigation water and RSC and SAR.
17	Determination of BOD and COD.
18	Satellite image analysis by visual method .

Suggested Reading

1) RichardsL. A.. 1954. Diagnosis and Improvement of Saline and Alkali Soils. United State Department of Agriculture.
2) Maliwal, G. La. and SomaniL.L. 2010. Nature Properties and Management of Sine and Alkali Soils. Agrotech Publishing Academy, Udaipur 313 002. pp. 335.
3) Mahendran , et al. Soil Resource Inventory and Management of Problamatic [i.e. Problematic] Soils. Published by Agrotech Publishing Academy (2012) ISBN 10: 818321097X / ISBN 13: 9788183210973
4) Abrol, I. P., Yadav, J. S. P and Massoud, F. I. 1988. Salt-Affected Soils and their Management. FAO SOILS BULLETIN 39. FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, Rome, 1988.
5) Tyagi, N.K. and P.S. Minhas. 1998. Agricultural Salinity Management in India Published by CSRI.,Kernal. (Price Rs. 500/-).
6) Yaduvanshi, N. P. S. 2008. Chemical Changes and Nutrient Transformation in Sodic/ Poor Quality water Irrigated Soils . Published by CSRI.,Kernal.
7) Dey, P. , Gupta, S. K. 2012. Diagnostics, Remediation and Management of Poor Quality Waters: Lectures for Summer School by R. L. Meena, S. K. Gupta, R. K. Yadav and D. K. Sharma, 2011. Salinity Management for Sustainable Agriculture in Canal Commands. Published by CSRI.,Kernal.
8) Twenty five years of research on management of salt affected soils & use of saline water in agriculture, 1998 (Price Rs. 75/-). Published by CSRI.,Kernal.
9) Patil, V. D. and Mali C. V. 2007. Fundamentals of Soil Science, Aman Publication, Meerut.
10) Das, D. K. Introductory Soil Science
11) Brady, N. C. 2016. The Nature and Properties of Soils. 15th edition Publisher: Pearson Education, ISBN: 978-0133254488.
12) The chemistry of Soil – Firman Bear
13) Text Book of Pedology Concepts and Applications – J. Sehgal
14) FAO United Nationss Soils Portal- FAO

Course :	SSAC 353	**Credit:**	3(2+1)	**Semester-V**
Course title:	Manures, Fertilizers and Soil Fertility Management			

Syllabus

Theory

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

Practical

Introduction of analytical instruments and their principles, calibration and applications, Colorimetry and flame photometry.Estimation of 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.

Teaching schedule

a) Theory

Lesson	**Topic**	**Weightage** (%)
1 & 2	History of soil fertility and plant nutrition.	3
3 & 4	Soil as a source of plant nutrients, essential and beneficial nutrients and their role. Criteria of essentiality, forms of nutrients in soil.	5
5, & 6	Introduction and importance of organic manures. Sources of organic matter, recycling, composition and C:N ratio.	5
7, 8 & 9	Definition, properties and classification of bulky and concentrated organic manures, their composition and nutrient availability. Preparation of FYM, composts, different methods of composting, decomposition process and nutrient losses during handling and storage.	6
10 & 11	Vermicomposting, green manuring; types, advantages and disadvantages and nutrient availability.	5
12 & 13	Sewage and sludge, Biogas plant slurry; their composition	5

Lesson	Topic	Weightage (%)
	and effect on soil and plant growth.	
14 & 15	Integrated nutrient management; concept, components and importance.	6
16 & 17	Fertilizer; Definition and their classification; N fertilizers: classification, manufacturing process and properties their fate and reaction in soils.	6
18 & 19	Phosphatic fertilizers, manufacturing process and properties, classification, their fate and reaction in soils.	5
20& 21	Potassic fertilizers: classification, manufacturing process, properties, their fate and reaction in soils. Complex fertilizers their fate and reaction in the soil. Nano fertilizers.	5
22 & 23	Secondary &micronutrient fertilizers: Types, composition, reaction in soil and effect on crop growth. Soil amendments.	5
24	Handling and storage of fertilizers: Fertilizer control order.	3
25 & 26	Mechanism of nutrient transport to plants: Factors affecting nutrient availability to plants. Measures to overcome deficiencies and toxicities.	6
27,28 & 29,	Chemistry of soil N,P, K, calcium, magnesium, sulphur and micronutrients.	6
30 & 31	Soil fertility evaluation and different approaches.	6
32	Soil Testing (Available nutrients) :Chemical methods and critical levels of different nutrients in soil.	6
33	Plant analysis methods : Critical levels of nutrients, DRIS approach, rapid tissue test, indicator plants. Soil test based fertilizer recommendations to crops.	6
34 & 35	Methods and scheduling of nutrient applications for different soils and crops grown under rain fed and irrigated conditions.	6
36	Factors influencing nutrients use efficiency (NUE) in respect of N, P, K, S, Fe and Zn fertilizers.	5
	Total	**100**

b) Practical

Experiment	Topic
1	Principle and application of spectro-photometry / Colorimetry.
2	Principle and application of flame photometry and atomic absorption spectrophotometer (AAS).
3	Determination of moisture from organic manures and its preparation for nutrient analysis.
4	Determination of organic carbon from organic manures by ignition method.
5	Estimation of available nitrogen in soil (Alkaline permanganate method)
6	Estimation of available phosphorus in soil.
7	Determination of available potassium in soil using flame photometer.
8	Determination of exchangeable Ca& Mg in soil by EDTA method.
9	Estimation of available sulphur in soil (Turbidity method).
10	Estimation of DTPA extractable micronutrients from soil using AAS.
11	Estimation of total N from plant sample by Micro Kjeldahl'smethod.
12	Plant analysis for P,K, secondary and micronutrients.
13	Fertilizer adulteration test / identification of adulteration in fertilizer / Detection of adulteration in fertilizers (Rapid test).
14	Determination of nitrate nitrogen content of potassium nitrate.
15	Determination of water soluble phosphorus in superphosphate (Pumberton method).
16	Determination of acid soluble phosphorus from rock phosphate.
17	Determination of total potassium content of muriate of potash (flame photometer).
18	Determination of zinc content from micronutrient fertilizer (EDTA Method).

Suggested Reading

1) Mariakulandi and Manickam: 1975 : Chemistry of fertilizers and manures.
2) Mariakulandi and Manickam (1975) : Chemistry of manures an fertilizers
3) Tandon H. L. S. (1994) : Recycling of crop, animal, human and industrial Wastes in Agriculture. FDCO, Delhi
4) Krishna and Murthy (1978) : Manual on compost and other organic manures .
5) Rakshit A. 2015.Manures Fertilizers and Pesticides Paperback – Import. CBS Publishing; 1ST edition, pp. 266.

6) Zhongqi Heand Hailin Zhang) . 2016 . Applied Manure and Nutrient Chemistry for Sustainable Agriculture and Environment Paperback – Import. Springer. pp. 379.

7) Havlin , John L, Samuel L. Tisdale (Author), Werner L. Nelson (Author), James D. Beaton (2004).Soil Fertility and Fertilizers (8th Edition) 8th Edition. Published July 23rd 2004 by Prentice Hall. pp. 528.

8) Havlin , John L. 2004. Soil Fertility and Fertilizers: An Introduction to Nutrient Management Published July 23rd 2004 by Prentice Hall. pp. 528.

9) James F. Power, Rajendra Prasad. 1997 .Soil Fertility Management for Sustainable Agriculture. CRC Press Tayloer and Francis Group. .Textbook -pp. 384 .ISBN 9781566702546

10) ISSS. 2009. Fundamentals of Soil Science. 2nd Ed. Indian Society of Soil Science, New Delhi- 110 012. pp. 728.

11) Das D. K. 2011. Introductory Soil Science, 3rd revised and Enlarged Ed, Kalyani Publisher, Ludhiana. pp. 645.

12) ICAR Handbook of manures and fertilizers (1971) publication.

13) Yawalkar K.S. Manures & fertilizer: (1992).

14) Somawanshi, et al. 2012. Laboratory Methods for Analysis of Soil, Irrigation Water and Plants.., Department of Soil Science and Agricultural Chemistry, MPKV., Rahuri. revised Ed. pp. 307.

15) Jakson, M.L. 1973. Soil Chemical Analysis. Printice Hall, India, Pvt. Ltd. New Delhi. pp 498.

16) Page et. al. 1982. Methods of Soil Analysis, Part 1 and 2. Chemical and Microbiological Properties . 2nd Ed. Soil Science Soc. of America Am. Soc. Agron., Madison, Wisconsin, USA.

17) *Chapman*, H.D., and P.F. *Pratt*. *1961*. Methods of analysis for soils, plants and waters. Division of Agricultural Sciences, University of California.

18) Brady, N. C. 2016. The Nature and Properties of Soils. 15th edition Publisher: Pearson Education, ISBN: 978-0133254488.

19) ISSS. 2009. Fundamentals of Soil Science. 2nd Ed. Indian Society of Soil Science, New Delhi- 110 012. pp. 728.

20) Das, D. K. 2011. Introductory Soil Science, 3rd revised and Enlarged Ed, Kalyani Publisher, Ludhiana. pp. 645.

21) Tisdale, S. L. and Nelson, W. L. and Beaqton, J. D. 2010. Soil Fertility and fertilizers. 7th Ed. Macmillan Publishing Company, 445 Hutchinson Avenue, Columbus.

22) Yawalkar, K. S. ,Agarwal, J. P. and Bokde, S. 1967. Manures and Fertilizers. Agri-Horticultural Publication.

23) Chopra, S. L. and Kanwar, S. L. and Rakshit, J. S. 2014. Analytical Agricultural Chemistry. Kalyani Publisher.

24) Hand book of fertilizers use (1980) : FAI publication

Course :	ELE SSAC 364	**Credit:**	3(2+1)	**Semester-VI**
Course title:	Agrochemicals			

Syllabus

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 ofagrochemicals for sustainable agriculture.Herbicides-Major classes, properties and important herbicides.Fate of herbicides.Fungicides - Classification – Inorganic fungicides - characteristics, preparation and use ofsulfur and copper, Mode of action-Bordeaux mixture and copper oxychloride.Organic fungicides- Mode of action- Dithiocarbamates-characteristics, preparation and useof Zineb and maneb.Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim,characteristics and use. Introduction and classification of insecticides: inorganic andorganic insecticides Organochlorine, Organophosphates, Carbamates, Synthetic pyrethroidsNeonicotinoids, Biorationals, Insecticide Act and rules, Insecticides banned, withdrawn andrestricted use, Fate of insecticides in soil & plant. IGRs Biopesticides, Reduced risk insecticides,Botanicals, plant and animal systemic insecticides their characteristics and uses.Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing ofammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers.Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparationof bone meal and basic slag.Potassic fertilizers: Natural sources of potash, manufacturing ofpotassiumchloride, potassium sulphate and potassium nitrate.Mixed and complex fertilizers: Sources and compatibility–preparation of major, secondaryand micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates,nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistics and marketing.Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

Practical

Sampling of fertilizers and pesticides.Pesticides application technology to study about variouspesticides appliances.Quick tests for identification of common fertilizers.Identification of anionand cation in fertilizer.Calculation of doses of insecticides to be used.To study and identify variousformulations of insecticide available kin market.Estimation of nitrogen in Urea. Estimation of

120water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate. Estimation of potassium inMuraite of Potash/ Sulphate of Potash by flame photometer.Determination of copper content incopper oxychloride.Determination of sulphur content in sulphur fungicide.Determinationof thiram.Determination of ziram content.

Teaching schedule

a) Theory

Lesson	Topic	Weightage (%)
1	Introduction to agrochemicals, their type and role in agriculture,	2
2	Effect of agrochemicals on environment, soil, human and animal health. Merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture.	4
3	Fertilizers and their classification;	3
4 & 5	N fertilizers : classification, manufacturing process and properties, their fate and reaction	4
6 & 7	Phosphatic fertilizers, manufacturing process and properties	4
8	Potassic fertilizers and complex fertilizers, their fate and reaction in soils.	3
9 & 10	Secondary nutrients and fertilizers, their type, composition, reaction in soils and effect on crop growth.	4
11	Micronutrient fertilizers, their type, composition, reaction in soils and effect on crop growth.	4
12	Liquid fertilizers	3
13	Handling and storage of fertilizers	3
14	Biofertilizers and their role in crop production	4
15	Fertilizer control order and insecticide Act	2
16	Introduction and classification of insecticides:Different types of Classification of insecticides. (Based on toxicity, mode of entry, mode of action, chemical nature)	4
17 & 18	Inorganic and organic insecticides Organochlorine, Organophosphates, Carbamates, Synthetic pyrethroidsNeonicotinoids, Biorationals.	5
19	Insecticide Act and rules. Insecticides banned, withdrawn and restricted use,	2
20	IGRs and Biopesticides. Reduced risk insecticides	2
21	Botanicals, plant and animal systemic insecticides their characteristics and uses.	3
22	Mode of action of insecticides (Pyrethroids, organophosphates, Carbamates and Chitin synthesis inhibitor)	4
23	Fate of insecticides in soil & plant.	3

Lesson	Topic	Weightage (%)
24	Insecticide resistance and its management	3
25	Pesticide residue- Definition, steps involved in determination of residue.	3
26 & 27	Copper fungicides, formulation of Bordeaux mixture and Bordeaux paste. Chemical reaction involved merits and demerits of Bordeaux mixture. Mode of action of copper fungicides	5
28	Sulfur fungicides: Organic and inorganic sulfur fungicides their classification and mode of action. Preparation of lime sulfur mixture and chemical reaction involved.	4
29	Benzimidazle fungicides, their chemical nature, mode of action and their use	3
30	Introduction to new generation fungicides. VizMetalaxyl, fosetyl Al, Triazoles and shawbilirin fungicides	4
31	Herbicide- Classification, Formulations, Methods of application.	3
32	Mode of action of herbicide- Translocation and absorption	3
33	Persistence and fate of herbicides, Residual effect of herbicides	3
34	Introduction to selectivity of herbicide	2
35	Compatibility of herbicides with other Agrochemicals	2
36	Introduction to adjuvants and their use in herbicides	2
	Total	**100**

b) Practical

Experiment	Topic
1	Fertilizer Adulteration test / Identification of Adulteration in fertilizer / Detection of adulteration in fertilizers (Rapid test)
2	Determination of (Amide nitrogen) from urea.
3	Determination of ammoniacal nitrogen content and nitrate nitrogen content from nitrogenous fertilizer
4	Determination of water soluble phosphorus in superphosphate (Pumberton method)
5	Determination of acid soluble phosphorus from rock phosphate
6	Determination of total potassium content of muriate of potash (by flame photometer).
7	Determination of sulphur content from fertilizer (Gravimetric Method)
8	Determination of Zinc content from micronutrient fertilizer (EDTA Method)
9	Study of plant protection appliances
10	Calculation of doses of insecticides
11	Study of formulations of pesticides
12	Study of pesticide application techniques.
13	Herbicide label information and computation of herbicide doses.
14	Equipments used for herbicide application and calibration. Demonstration of methods of herbicide application.
15	Study of phytotoxicity symptoms of herbicides in different crops.
16	Handling and storage of fungicides and Agrochemicals
17	Preparation of Bordeaux mixture and Bordeaux paste and fungicides solutions.
18	Methods of application of fungicides.

Suggested Reading

1) Manures and fertilizers – Yavalkar, Agarwal and Bokde
2) Chemistry of fertilizers and manures – Mariakulandi and Manickam
3) Nature and properties of soil – N.C. Brady
4) Organic manures – Gour, (ICAR publication)
5) Recycling of crop, animal, human and industrial waste in Agriculture – H.L.S. Tondon
6) Handbook of manures and fertilizers – ICAR publication
7) Text book of soil science – Biswas and Mukharjee
8) Fundamentals of soil science – ISSS publication
9) Text Book of fertilizers – RanjankumarBasak
10) Fertilizer Guide – Tondon HLS (1994)
11) Handbook on fertilizer usage – Seetharam S, Priswas, BC, Yadav DS, Matneswaru S. (1996)
12) Fertilizer control order (1985) The fertilizer Association of India
13) The Pesticde manual A world compendium (1995) – British crop production council, UK
14) Outline of organic chemistry: Bahl and Tuli
15) Chemistry of insecticide: SreeRamulu US (1991)
16) Fungicide in plant disease control: Nene YL and Thapliyal
17) Principles of weed science: Rao VS (1992)

B. Sc. (Hons) Agriculture

Animal Husbandry and Dairy Science

- Syllabus
- Teaching Schedule
- Suggested Readings

Animal Husbandry and Dairy science

Sr. No.	Semester	Course No.	Credits	Course Title
1	I	AHDS-111	1+1=2	Livestock Production and Management
2	IV	AHDS-242	1+1=2	Livestock Breeding and Nutrition
3	V	AHDS-353	1+1=2	Sheep, Goat and Poultry Production
4	VI	AHDS-364	1+1=2	Technology of Milk and Milk Products
5	VIII	ELM AHDS 485	10(0+10)	Poultry Production
6	VIII	ELM AHDS 486	10(0+10)	Processing of Milk and Milk Products
		Total		

Course :	AHDS 111	**Credit:**	2(1+1)	**Semester-I**
Course title:	Livestock Production & Management			

Syllabus

Theory

Importance of livestock in the national economy. Livestock development programmes of Govt. of India. Terminology used in livestock management. Important exotic and Indian breeds of cattle and buffalo.Male and female reproductive system of cattle.Measures and factors affecting fertility in livestock, Reproductive behaviour – oestrus and parturition.Mammary gland and milk secretion.Feeding and management of calves, heifers, dry, pregnant, milch animals and breeding bull. Disease – causes, symptoms, preventive and control measures. Feeding and production records. Organic livestock production- definition, importance, principles, standards, certifications, SWOT analysis. Concept of A 1 and A 2 milk.Effect of climate change on livestock production.Integrated livestock farming. Cost of milk production, economical unit of cattle and buffalo.

Practical

External body parts of cattle and buffalo. Routine management practices followed on livestock farm. Methods of handling and restraining of animal.Methods of identification marks and dehorning of animal.Recording of pulse rate, respiration rate and body temperature of animal.Preparation of feeding schedule and feeding different categories of cattle and buffalo.Estimation of age and body weight of animal. Clean and hygienic milk productionand milking methods. Judging of animal for dairy and draft purpose.Study of computerized database on dairy farm.Vaccination and control of ecto and endo parasites in cattle and buffalo.Study of various dairy structures.Collection of semen and artificial insemination in farm animal.Pregnancy diagnosis in farm animal.Utilization of dairy farm wastes i. e. dung, urine, etc.Preparation of viable bank proposal for cattle and buffalo.

Teaching Schedule

a) Theory

Lecture	**Topic**	**Weightage (%)**
1	Importance of Livestock in the national economy and different livestock development programme	10
2	Livestock census and trends of livestock production	5
3	Terminology used in livestock management	5
4 & 5	Important Indian and exotic breeds of cattle and buffalo	7
6	Principles of maximization of livestock production	6
7	Feeding and management of calf, heifer and milking animal	5
8	Feeding and management of dry, pregnant, draft animals and breeding bull	10
9	Diseases and it's preventive, curative measures in cattle and buffalo	6
10	Bovine male and female reproductive system	7
11	Fertility, sterility and reproductive behaviour viz. oestrus and parturition	7
12	Mammary gland and milk secretion	7

Lecture	Topic	Weightage (%)
13	Organic livestock production- definition, importance, principles, standards, certifications, SWOT analysis, A 1 and A 2 milk	8
14	Effect of climate change on livestock production	5
15	Integrated livestock farming	7
16	Cost of milk production, economical unit of cattle and buffalo	5
	Total	**100**

b) Practical

1) External body parts of cattle and buffalo
2) Routine management practices followed on livestock farm
3) Methods of handling and restraining of animal
4) Methods of identification marks and dehorning of animal
5) Recording of pulse rate, respiration rate and body temperature of animal
6) Preparation of feeding schedule and feeding different categories of cattle and buffalo
7) Estimation of age and body weight of animal
8) Clean and hygienic milk production and milking methods
9) Judging of animal for dairy and draft purpose
10) Study of computerized database on dairy farm
11) Vaccination and control of ecto and endo parasites in cattle and buffalo
12) Study of various dairy structures
13) Collection of semen and artificial insemination and pregnancy diagnosis in farm animal
14) Utilization of dairy farm wastes i. e. dung, urine, etc.
15) Preparation of viable bank proposal for cattle and buffalo
16) Visit to dairy farms

Suggested Readings

1) Livestock and paultry Production – Harban Singh and Moore, E. N. (1968)
2) Goat, Sheep and Pig Production and Management – Jagdish Prasad, (1996), Kalyani Publishers 1/1, Rajinder Nagar, Ludhiana
3) Text Book of Animal Husbandry – G. C. Banergee (1999), 9th ed Oxford and IBH Publishers, New Delhi.
4) Dairy Bovine Production – Thomas, C. K. and Sastri, N. S. R., Kalyani Publishers,1/1, Rajinder Nagar, Ludhiana.
5) Text-Book of Buffalo Production – Ranjhan, S. K. and Pathak, N. N. (1979) Vikas, Publishing House Pvt. Ltd. 576, Masjid Road, Jangpura, New Delhi.

Course :	AHDS 242	**Credit:**	2(1+1)	**Semester-IV**
Course title:	Livestock breeding and Nutrition.			

Syllabus

Theory

History and concept of animal breeding.Cell and cell division, spermatogenesis and oogenesis. Gene: Functions and role in animal genetics, gene actions, gene and genotypic frequencies, gene expression and mutation. Mendelian principles and Hardy Weinberg law.Chromosomes and its abnormalities.Laws of probabilities and animal breeding.Variations in economic traits of farm animals.Systems of breeding.Methods of selection and basis for selection.Quantitative and qualitative traits.Composition of plant and animal body.Classification of feeds and fodders.Important food ingredients and their functions in animal body.Digestive system, digestion and absorption of different nutrients in ruminants. Feed supplements and feed additives. Methods of measuring food values.Feeding standard & their principles.Concept in feed processing eg. Complete feed block, enrichment of low quality roughages and use of unconventional feed stuff. Recent trends in animal feed technology.

Practical

Study of animal cell structure.Estimation of gene and genotypic frequency.Estimation of heritability and repeatability.Estimation of genetic and phenotypic correlation by analysis of variance, co- variance.Estimation of most probable producing ability and breeding value of cow.Study of sire index.Estimation of regression coefficient.Estimation of genetic gain. Estimation of heterosis. Identification of feeds and fodders.Study of desirable characteristics of ration.Evaluation of nutritive value of various feeds and fodders. Study of nutritive values DCP, TDN, NR, SE and GE. Nutrient requirement of different classes of animals. Principles of thumb rule. Computation of ration for different classes of livestock.Conservation of fodder viz. Silage making, Hay making, Chaffing of fodders.Studies on processing of low quality roughages.Study of azolla and hydroponics fodder production.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	History and concept of animal breeding	5
2	Cell and cell division, spermatogenesis and oogenesis	5
3	Gene: Functions and role in animal genetics gene actions, gene and genotypic frequencies	6
4	Gene expression and mutation and laws of probabilities	6
5	Mendelian principles and Hardy Weinberg law	8
6	Chromosomes and its abnormalities	8
7	Variations in quantitative and qualitative traits of farm animals	5
8	Systems of breeding	6
9	Methods of selection and basis for selection	6
10	Composition of plant and animal body	6
11	Classification of feeds and fodders	6

Lecture	Topic	Weightage (%)
12	Important nutrients and their functions in animals body	6
13	Digestive system and digestion of different nutrients in ruminants	6
14	Feed supplements and feed additives, method of measuring food values	7
15	Feeding standards and bypass nutrient technology	8
16	Concept in feed processing eg. Complete feed block, enrichment of low quality roughages and use of unconventional feed stuff	6
	Total	**100**

b) Practical

1. A) Study of animal cell structure
   B) Estimation of gene and genotypic frequency
2. A) Estimation of heritability and repeatability
   B) Estimation of genetic and phenotypic correlation by analysis of variance, co-variance
3. Estimation of most probable producing ability and breeding value of cow
4. Study of sire index
5. Estimation of regression coefficient
6. A) Estimation of genetic gain
   B) Estimation of heterosis
7. Identification of feeds and fodders
8. Study of desirable characteristics of ration
9. Evaluation of nutritive value of various feeds and fodders
10. Study of nutritive values DCP,TDN,NR,SE and GE
11. Principles of thumb rule and nutrient requirement of different classes of animals
12. Computation of ration for different classes of livestock
13. Conservation of fodder A) Silage making, B) Hay making, C) Chaffing of fodders
14. Studies on processing of low quality roughages
15. Study of azolla and hydroponics fodder production
16. Visit to forage farms/ laboratory/veterinary dispensary

Suggested Readings

1) Lasley, J. S. (1978) Genetics of livestock improvement, New Delhi, Prentice House of India

2) Kanakraj, P (2001) A text book of Animal Genetics I, International Book Distributing Co. Lucknow, India

3) Jagdish Prasad (1996) Animal Genetics and Breeding practices, International Book Distribution Co. Lucknow, India

4) Rice, V. A. & Andrews F. N. (1964) Breeding and Improvement of Farm Animals 6thedBanergee, G. C.(1998)

5) Feeds & Principles of Animal Nutrition Oxford and IBH Publ. New Delhi.

6) Ranjan, S. K. (1983) Animal Nutrition and Feeding Practices, Kalyani Publ. Ludhiana, New Delhi

7) Maynord L. A. Loosli J. K., Hintz H. F. and Warner R. C. (1979) Animal Nutrition 7th ed. Tata Mc Grow – Hill publishing Co. New Delhi

8) Reddy, B. V. (2001) Principles of Animal Nutrition and Feed technology oxford and IBH Publ. New Delhi

9) Mukherje, D. P. and Banerjee G. C. Genetics and breeding of farm animals. Oxford IBH Publ. Co. Colkota

Course :	AHDS 353	**Credit:**	2(1+1)	**Semester-V**
Course title:	Sheep Goat and Poultry Production			

Syllabus

Theory

Importance of sheep and goat production in national economy.Important Indian and Exotic breeds of sheep and goat. Common terminologies used in sheep and goat production. Classification and study of Indigenous and exotic sheep and goat breeds.Housing requirement of sheep and goat. Rearing methods and housing systems of sheep and goat. Breeding seasons and mating systems of sheep and goat. Principles and practices of sheep and goat feeding, flushing of ewes and does.Care and management of pregnant ewes & does. . Care and management of lambs/kids and rams / bucks. Importance, composition and utilization of sheep and goat milk.Marketing of sheep and goat.Study of diseases of sheep and goat. Vaccination and health cover in sheep and goat.

Importance of poultry production in national economy. Common terminologies used in poultry production. Classification and study of Indigenous and exotic poultry breeds. Digestive system and digestion and absorption of nutrients in fowl. Methods of rearing, feeding and management of chicks, pullets, layers and broilers.Selection, incubation, hatching of eggs and brooding in poultry.Preservation, grading, marketing of eggs and its economics. Vaccination and health cover in poultry.

Practical

Study of body parts of sheep, goat and poultry.Study of differences between sheep and goat.Identification marking in sheep, goat and poultry. Management practices in sheep and goat viz. clipping, spraying, dusting, docking, ringing, etc. Management practices in poultry viz. Debeaking. Feeding habits of sheep and goat. Nutrients requirement for different classes of sheep and goat .Computation of ration for different classes of poultry. Shearing of sheep and grading of wool. Judging and culling of sheep and goat. Preparation of animals for slaughter and different methods of slaughter. Study of different meat cuts, dressing percentage, meat bone ratio and edible and non-edible offal's. Candling of eggs. Study of various farm records maintained at sheep and goat farm. Preparation of viable bank proposal.Vaccination and deworming of sheep and goat.Vaccination of poultry. Visit to sheep, goat and poultry farm

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Importance of sheep, goat and poultry production in national economy	6
2	Common terminologies used in sheep, goat and poultry production	4
3	Classification and study of Indigenous and exotic sheep breeds	6
4	Classification and study of Indigenous and exotic goat breeds	6
5	Classification and study of Indigenous and exotic poultry breeds	6
6	Breeding seasons, mating systems, rearing methods and housing systems of sheep and goat	8
7	Digestive system and digestion absorption of nutrients in fowl	7
8	Principles and practices of sheep and goat feeding, flushing of ewes and doves	7
9	Care and management of pregnant ewes/does, lambs/kids and rams/ bucks	8
10	Methods of rearing, feeding and management of chicks, pullets, layers and broilers	7
11	Importance, composition and utilization of sheep and goat milk	5
12	Marketing of sheep and goat	5
13	Selection of eggs, incubation, hatching and brooding in poultry	5
14	Preservation, grading, marketing of eggs and its economics	8
15	Study of diseases of sheep, goat and poultry	6
16	Vaccination and health cover in sheep, goat and poultry	6
	Total	**100**

b) Practical

1. Study of body parts of sheep, goat and poultry
2. Study of differences between sheep and goat
3. Identification marking in sheep, goat and poultry
4. Management practices in sheep and goat viz. clipping, spraying, dusting, deworming, docking and ringing etc.
5. Management practices in poultry viz. debeaking
6. Feeding habits and Nutrients requirement for different classes of sheep and goat
7. Computation of ration for different classes of poultry
8. Shearing of sheep and grading of wool
9. Judging and culling of sheep and goat
10. Preparation of animals for slaughter and different methods of slaughter

11. Study of different meat cuts, dressing percentage, meat bone ratio and edible and non-edible offal's
12. Candling of eggs
13. Study of various farm records maintained at sheep and goat farm
14. Preparation of viable bank proposal
15. Vaccination of sheep, goat and poultry
16. Visit to sheep, goat and poultry farm

Reference Book

1) Sheep Production and Breeding – C. L. Arora and R. C. Garg
2) Sheep Production in Tropics and subtropics – S. K. Kaushish
3) Goat and Sheep Production in the Tropics – Devendra&Mcleroy
4) Goat, Sheep and Pig Production and management – Jagdish Prasad
5) Livestock and poultry Production – Harban Singh and Moore, E. N. (1968)
6) Goat, Sheep and Pig Production and Management – Jagdish Prasad, (1996), Kalyani
7) Publishers 1/1, Rajinder Nagar, Ludhiana
8) Text Book of Animal Husbandry – G. C. Banergee (1999), 9thed Oxford and IBH

Course :	AHDS 364	**Credit:**	2(1+1)	**Semester-VI**
Course title:	Technology of milk and milk products.			

Syllabus

Theory

Present status of dairy industry in India. Definition and composition of milk.Physico-chemical properties of milk.Microbial quality of raw milk and standards for different market milk.Factors affecting yield and composition of milk.Physico-chemical and microbial standards for different types of milk.Nutritional importance of milk and its constituents.Reception and processing (Platform test, Chilling, Standardization, Homogenization, Pasteurization, Storage, Marketing) of milk. Classification and composition of milk products (Heat coagulated, Heat and acid coagulated, Evaporated, Fermented Frozen and Fat riched products). Quality management standard and system (BIS/ISI standards, PFA rules, AGMARK, HACCP, FSSAI).International requirement for export of milk and milk products.Preservation of milk and milk products by physical, chemical, biological and herbal preservatives. Utilization of dairy by-product: whey and high acid milk. Packaging of milk and milk products with modern techniques.

Practical

Sampling of milk and milk products.Study of platform tests.Determination of fat by Gerber's method.Determination SNF, TS and specific gravity of milk.Determination of acidity of milk.Determination of adulteration in milk and milk products.Standardization of milk by Pearson's method.Study of cream separator and separation of cream. Preparation of flavoured and chocolate milk. Preparation of Khoa, *Basundi*and *Rabri*. Preparation of *Paneer, Channa* and*Rassogolla*.Preparation of *Dahi, Chakka* and *Shrikhand*.Preparation of Butter.Preparation of *Ghee*.Preparation of Ice-cream and *Kulfi*.Preparation of *Pedha* and *Gulabjamun*. Study of cleaning and sanitization of dairy equipments.

Teaching Schedule

a) Theory

Lecture	**Topic**	**Weightage (%)**
1	Present status of dairy industry in India	6
2	Definition of milk, composition of milk of different livestock species	7
3	Physico-chemical properties of milk	6
4	Factors affecting yield and composition of milk	7
5	Microbial quality of raw milk and standards for different market milk	9
6	Nutritional importance of milk and its constituents	4
7	Reception , standardization and homogenization of milk	4
8	Pasteurization of milk and its methods	6

Lecture	Topic	Weightage (%)
9	Chilling, storage and marketing of milk	5
10&11	Classification and composition of Indigenous milk products	10
12	Quality management standard and system (BIS/ISI standards, PFA rules, AGMARK, HACCP, FSSAI)	7
13	International requirements for export of milk and milk products	6
14	Preservation of milk and milk products by physical, chemical, biological and herbal preservatives	7
15	Utilization of dairy by-products like whey and high acid milk	8
16	Packaging of milk and milk products with modern techniques	8
	Total	**100**

b) Practical

1. Study of platform tests and sampling of milk and milk products
2. Determination of fat by Gerber's method
3. Determination SNF, TS, specific gravity and acidity of milk
4. Determination of adulteration in milk and milk products
5. Standardization of milk by Pearson's method
6. Study of cream separator and separation of cream
7. Preparation of flavoured and chocolate milk
8. Preparation of *Khoa, Basundi*and *Rabri*
9. Preparation of *Paneer,Channa* and*Rassogolla*
10. Preparation of *Dahi, Chakka* and *Shrikhand*
11. Preparation of Butter
12. Preparation of *Ghee*
13. Preparation of Ice-cream and *Kulfi*
14. Preparation of *Pedha* and *Gulabjamun*
15. Study of cleaning and sanitization of dairy equipments
16. Visit to milk processing plant.

Suggested Reading

1) Milk and Milk Products – Winton and Winton (1993), Agrobios (India), Agro. House, Behind Nasrani Cinema, Chopsani Road, Jodhapur

2) Milk Testing – Davis J. G. Agrobios (India), Agro. House, Behind Nasrani Cinema, Chopsani Road, Jodhapur.

3) Chemistry of Milk and Milk Products – Singh V. B. (1965), Asian Publishers, New mandi, Muzaffarnagar.

4) Dairying in India – Gupta, H. A. (1997) Kalyani Publisher, 1/1 Rajinder Nagar, Ludhiana.

5) Outlines of Dairy Technology – Sukumar De (2000) Oxford University Press, New Delhi

B. Sc. (Hons) Agriculture

Other Departments

- **Syllabus**
- **Teaching Schedule**
- **Suggested Readings**

B. Sc. (Hons) Agriculture

Departmentwise list of courses

Other courses

Sr. No.	Semester	Course No.	Credits	Course Title
1	I	LANG 111	2(1+1)	Comprehension & Communication Skills in English
2	III	STAT 231	2(1+1)	Statistical Methods
3	III	BIOCHM 231	3(2+1)	Fundamentals of plant biochemistry and biotechnology
6	V	ELE FST 351	3(2+1)	Food Safety and Standards (Elective)
7	VI	FST 362	2(2+0)	Principles of Food Science and Nutrition
8	VI	ELE AGM 361	3(2+1)	System Stimulation and Agro-advisory
9	VIII	ELM FST 483	10(0+10)	Food Processing
		Total		

2) Common Courses

Sr. No.	Semester	Course No.	Credits	Course Title
1	III	EVS 231	3(2+1)	Environmental Studies and Disaster Management
2	II	EXTN 123	2(1+1)	Communication skills and personality Development
3	V	EXTN 355	2(1+1)	Entrepreneurship Development and Business Management
4	III	COMP 231	2(1+1)	Agri-Informatics
		Total	**9(5+4)**	

Course :	LANG 111	Credit:	2(1+1)	Semester-I
Course title:	Comprehension & Communication Skills in English			

Syllabus

Theory

The following Lessons from the textbook—***Current English for Colleges*** (by N Krishnaswamy and T. Sriraman; Macmillan; 2007 Rs. 95/-)—are for the theory classes along with the Exercises at the end of each lesson.

1. Education 2. Employment 3. Unemployment 4. Application 5. Planning 6. Curriculum Vitae 7. Interview 8. Reporting 9. General Knowledge 10. Stress 11. Short Story 12. Environment 13. Computerecy 14. A Dilemma 15. Entertainment 16. You and Your English 17. Usage and Abusage 18. War Minus Shooting

Practical

Vocabulary- Antonym, Synonym, Homophones, Homonyms; Functional grammar: Articles, Prepositions; Verb, Subject-Verb Agreement; Written Skills: Paragraph writing, Precis writing; The Style: Importance of professional writing; Preparation of Curriculum Vitae and Job applications; Interviews: kinds, Importance and process; Listening Comprehension: Listening to short talks lectures, speeches (scientific, commercial and general in nature). Oral Communication: Stress and Intonation, Conversation practice. Reading skills: reading dialogues, rapid reading, intensive reading, improving reading skills. Mock Interviews: testing initiative, team spirit, leadership, intellectual ability. Group Discussions

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Education	5
2	Employment	5
3	Unemployment	5
4	Application	5
5	Planning	5
6	Curriculum Vitae	5
7	Interview	5
8	Reporting	5
9	General Knowledge	5
10	Stress	5
11	Short Story	10
12	Environment	10
13	Computeracy	5
14	A Dilemma	5
15	Entertainment	8
16	You and Your English	8
17	Usage and Abusage	2
18	War Minus Shooting	2

Lecture	Topic	Weightage (%)
	Total	**100**

b) Practical

Exercise	Topic	Weightage (%)
1	Education	5
2	Employment	5
3	Unemployment	5
4	Application	5
5	Planning	5
6	Curriculum Vitae	5
7	Interview	5
8	Reporting	5
9	General Knowledge	5
10	Stress	5
11	Short Story	10
12	Environment	10
13	Computeracy	5
14	A Dilemma	5
15	Entertainment	8
16	You and Your English	8
17	Usage and Abusage	2
18	War Minus Shooting	2
	Total	**100**

Suggested Readings:

1) Krishnaswamy,. N and Sriraman, T. 1995. Current English for Colleges. Macmillan India Ltd. Madras.
2) Balasubrmanyam M. 1985. Business Communication. Vani Educational Books, New Delhi.
3) Naterop, Jean, B. and Rod Revell. 1997. Telephoning in English. Cambridge University Press, Cambridge.
4) Mohan Krishna and Meera Banerjee. 1990. Developing Communication Skills. Macmillan India Ltd. New Delhi.
5) Narayanaswamy V R. 1979. Strengthen your writing. Orient Longman, New Delhi.
6) Sharma R C and Krishna Mohan. 1978. Business Correspondence. Tata McGraw Hill Publishing Company, New Delhi.
7) Carnegie, Dale. 2012. *How to Win Friends and Influence People in the Digital Age*. Simon & Schuster.
8) Covey Stephen R. 1989. *TheSeven Habits of Highly Successful People*. Free Press.
9) Spitzberg B, Barge K &Morreale, Sherwyn P. 2006. *Human Communication: Motivation, Knowledge & Skills*.Wadsworth.
10) Verma, KC. 2013. *The Art of Communication*. Kalpaz.
11) MamathaBhatnagar and NitinBhatnagar. 2011. Effective Communication and Soft Skills. Person Education.
12) Meenakshi Raman, Sangeeta Sharma. Technical Communication Principles and Practice Harold Wallace and Ann Masters. Personality Development. Cengage Publishers

Course :	STAT 231	Credit:	2(1+1)	Semester-III
Course title:	Statistical Methods			

Syllabus

Theory

Definitions of Statistics and its applications in Agriculture, limitations, types of **d**ata, classifications and frequency distribution, Histogram, frequency curve, frequency polygon, cumulative frequency curve (ogive curve)

Arithmetic mean, median, mode, GM, HM, weighted average, quartile, deciles, percentiles, Characteristics of ideal measure, merits and demerits of various measures (grouped and ungrouped data), Range, mean deviation, quartile deviation, standard deviation and variance and respective relative measures (grouped and ungrouped Data), Concept of measures of Skewness and Kurtosis.

Definitions of population, sample, parameter, statistic, need of sampling, sampling versus complete enumeration and introduction to simple random, stratified and multistage sampling methods. Simple random sampling with and without replacement.Use of random number tables for selection of simple random sample.

Random experiment, events (simple, compound, equally likely, complementary, independent) Definitions of probability (mathematical, statistical, axiomatic), addition and multiplication theorem (without proof). Simple problems based on probability, Random variable, discrete and continuous random variable, probability mass and density function, definition and properties of Binomial, Poisson and Normal distributions.

Null and alternate hypothesis, types of errors, degrees of freedom, level of significance, critical region, steps in testing of hypothesis, one sample, two sample and paired 't' test. F test for equality of variance, Large sample tests for one sample mean, two sample means 'Z' tests, Chi-square test of goodness of fit, Chi-square test of independence of attributes in 2 X2 contingency table

Definition of correlation, types, scatter diagram. Karl Pearson's coefficient of correlation and its test of significance. Spearman's rank correlation coefficient, Linear regression equations, definition & properties of regression coefficient, constant, fitting of regression lines, its test of significance, comparison of regression and correlation coefficients

Introduction to analysis of variance, Assumptions of ANOVA, analysis of one way classification and two way classification

Practical

Graphical presentation: Histogram, frequency curve, frequency polygon, cumulative frequency curve (ogive curve)

Computations of arithmetic mean, mode, median, GM and HM, quartiles, deciles&percentiles(Ungrouped data), Computations of arithmetic mean, mode, median, quartiles, deciles& percentiles (grouped data).

Computations of range, mean deviation, quartile deviation, standard deviation and variance and respective relative measures (ungrouped Data), Computations of range, mean

deviation, quartile deviation, standard deviation and variance and respective relative measures (grouped data).

Selection of random sample using simple random sampling.

Computations of Karl Pearson's coefficient of correlation with its test of significance, Spearman's rank correlation, Fitting of simple linear regression equation with test of significance of regression coefficient.

Problems on One sample, two Sample and paired t-test, Chi-Square test of Goodness of Fit. Chi-square test of independence of Attributes for 2 X 2 contingency table.

Analysis of Variance one way and two way classification.

Teaching Schedule:

a) Theory

Lecture	Topic	Weightage (%)
1	**Introduction**: Definitions of Statistics and its applications in Agriculture, limitations, types of **d**ata, classifications and frequency distribution	05
2	**Graphical presentation:** Histogram, frequency curve, frequency polygon, cumulative frequency curve (ogive curve)	04
3	**Measures of central tendency**: Arithmetic mean, median, mode, GM, HM, weighted average, quartile, decilies, percentiles, Characteristics of ideal measure, merits and demerits of various measures (grouped and ungrouped data)	06
4	**Measures of Dispersion:** Range, mean deviation, quartile deviation, standard deviation and variance and respective relative measures (grouped and ungrouped Data).	06
5	Concept of measures of Skewness and Kurtosis.	05
6	**Sampling:** Definitions of population, sample, parameter, statistic, need of sampling, sampling versus complete enumeration and introduction to simple random, stratified and multistage sampling methods. Simple random sampling with and without replacement. Use of random number tables for selection of simple random sample.	08
7&8	**Probability:** Random experiment, events (simple, compound, equally likely, complementary, independent) Definitions of probability (mathematical, statistical, axiomatic), addition and multiplication theorem (without proof). Simple problems based on probability.	08
9&10	**Probability distributions:** Random variable, discrete and continuous random variable, probability mass and density function, definition and properties of Binomial, Poisson and Normal distributions.	08
11 &12	**Test of Significance:** Null and alternate hypothesis, types of	10

Lecture	Topic	Weightage (%)
	errors, degrees of freedom, level of significance, critical region, steps in testing of hypothesis, one sample, two sample and paired 't' test. F test for equality of variance	
13	Large sample tests for one sample mean, two sample means 'Z' tests.	05
14	Chi-square test of goodness of fit, Chi-square test of independence of attributes in 2□□2 contingency table	05
15	**Correlation:** Definition of correlation, types, scatter diagram. Karl Pearson's coefficient of correlation and its test of significance. Spearman's rank correlation coefficient.	10
16	**Regression**: Linear regression equations, definition & properties of regression coefficient, constant, fitting of regression lines, its test of significance, comparison of regression and correlation coefficients.	10
17	**Analysis of Variance:** Introduction to analysis of variance, Assumptions of ANOVA, analysis of one way classification and two way classification.	10
	Total	**100**

b) Practical

Exercise	Topic
1	**Graphical presentation:** Histogram, frequency curve, frequency polygon, cumulative frequency curve (ogive curve)
2	**Measures of central tendency**: Computations of arithmetic mean, mode, median, GM and HM, quartiles, deciles& percentiles(Ungrouped data).
3	Computations of arithmetic mean, mode, median, quartiles, deciles& percentiles (grouped data).
4	**Measures of Dispersion:** Computations of range, mean deviation, quartile deviation, standard deviation and variance and respective relative measures (ungrouped Data).
5	Computations of range, mean deviation, quartile deviation, standard deviation and variance and respective relative measures (grouped data).
6	Selection of random sample using simple random sampling.
7	**Correlation:** Computations of Karl Pearsons coefficient of correlation with its test of significance
8	Spearman's rank correlation
9&10	**Regression**: Fitting of simple linear regression equation with test of significance of regression coefficient.
11	**Test of Significance:** Problems on One sample, two Sample and paired t-test.
12	F test for equality of variance
13 &14	Chi-Square test of Goodness of Fit. Chi-square test of independence of Attributes for 2□□2 contingency table.
15&16	**Analysis of Variance:** Analysis of Variance one way and two way classification.

Suggested Readings:

1) Statistical methods for Agricultural workers by Panse V.G. Sukhatme P.V.
2) Mathematical statistics by Gupta and Kapoor.
3) Statistical Methods by Snedocor and Cochran.
4) A Text book of Agriculture Statistics by R. Rangaswami
5) Statistics for Agriculture Sciences by NageshwarRao G.
6) Experimental Designs by Cochran G.W. and Cox G.W.
7) Design and Analysis of Experiment by Das M.N. and Giri N.C.
8) Statistical procedures for Agricultural Research by Gomez K.A. and Gomez A.A.
9) Applied statistics by Gupta and Kapoor

Course :	BIOCHEM 231	Credit:	3(2+1)	Semester-III
Course title:	Fundamentals of Plant Biochemistry and Biotechnology			

Syllabus

Theory

Importance of Biochemistry.Plant cell structure and function of cell orgenells.Properties of Water and significance of weak interactions and biomolecules.Bioenergetics and significance of redox reactions. Carbohydrate: Structure, classification, properties and functions. Lipid: Structures and properties of fatty acids. Structure, classification, properties and functions. Amino acids and Proteins: Structure, classification, properties and functions. Structural organization of proteins. Enzymes: General properties; Classification; Mechanism of action and enzyme kinetics and inhibition. Enzyme regulation. Nucleic acids: Importance and classification; Structure of Nucleotides, DNA structure and forms of RNA and function.Mitochondrial electron transport and oxidative phosphorylation. Metabolism of carbohydrates, lipids and nucleic acids.Biochemistry of nitrate assimilation and photosynthesis. Introduction to recombinant DNA technology: PCR techniques and its applications.

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 soluble sugars and amino acids. Estimation of starch, total carbohydrate and soluble proteins . Determination of crude fat and qualitative tests of fats and oils. Enzyme assay: Alpha amylase , Nitrate reductase, lipase and protease. Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides.Demonstration on isolation of DNA. Demonstration of gel electrophoresis techniques and DNA finger printing.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Importance of Biochemistry	2
2-3	Properties of Water, pH and Buffer	5
4	Biomolecules - Definition, types, structure, properties and its applications	5

5-7	Carbohydrate: Importance and classification. Structures of Monosaccharides, Reducing and oxidizing properties of Monosaccharides, Mutarotation; Structure of Disaccharides and Polysaccharides.	8
8-9	Lipid: Importance and classification; Structures and properties of fatty acids; storage lipids and membrane lipids.	6
10-12	Proteins: Importance of proteins and classification; Structures, titration and zwitterions nature of amino acids; Structural organization of proteins.	8
13-14	Enzymes: General properties; Classification; Mechanism of action; Michaelis&Menten and Line Weaver Burk equation & plots; Introduction to allosteric enzymes.	8
15	Nucleic acids: Importance and classification; Structure of Nucleotides, A, B & Z DNA; RNA: Types and Secondary & Tertiary structure.	5
16-18	Metabolism of carbohydrates: Glycolysis, TCA cycle, Glyoxylate cycle, Electron transport chain.	8
19-20	Metabolism of lipids: Beta oxidation, Biosynthesis of fatty acids.	5
21	**Biochemistry of nitrate assimilation**	5
22	Photosynthesis	5
23-24	Introduction to recombinant DNA technology: PCR techniques and its applications.	5
25-26	Organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications;	5
28-29	Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization and cybrids	8
30	Somaclonal variation and its use in crop improvement	4
31-32	Physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods	4
33	Marker Assisted Breeding in crop improvement	4
	Total	**100**

b) Practical

Experiment	Topic
1	Preparation of solution, pH & buffers
2-3	Qualitative tests for carbohydrates and amino acids
4	Estimation of reducing sugars by Nelson-Somogyi method
5	Estimation of starch by Anthrone method
6	Determination of soluble protein by folin-lowry method
7	Estimation of free amino acids by Ninhydrin method

8	Determination of total crude fat/oil by Soxhlet method
9	Qualitative tests for oil
10	Determination of alpha amylase activity from germinating seed
11	Determination of invivo nitrate reductase activity from leaf tissue
12	Paper chromatography/ TLC demonstration for separation of amino acids
13	TLC for separation of sugars
14-15	Isolation of genomic DNA from plant. Purification, Quantification and quality determination
16	Amplification of genomic DNA using different primers and resolution of PCR products on agarose gel

Suggested Readings:

1) Bhatia S. C., 1984, Biochemistry in Agricultural Sciences, Shree Publication House, New Delhi.
2) Purohit S.S. 2009, Biochemistry - Fundamentals and Applications, Agrobios, Jodhpur
3) Singh M. 2011, A Textbook of Biochemistry, Dominant Publishers & Distributors, New Delhi
4) Veerkumari L. 2007, Biochemistry, MIP Publishers, Chennai
5) Jain J. L. etal 2005, Fundamentals of Biochemistry, S. Chand & Company Ltd. , New Delhi
6) *Rastogi S. C.*. 2003 - *Biochemistry* Tata McGraw-Hill Education, New Delhi.
7) *Rama RaoA. V. S. S.*, 2002 A *Textbook of Biochemistry*. Edition, 9, illustrated. Publisher, Sangam Books Limited, New Delhi.
8) Com EE &Stumpf PK. 2010.Outlines of Biochemistry.5th Ed. John Wiley Publications.
9) Donald Voet and Judith G. Voet. 2011. Biochemisry, 4th Ed. John Wiley and Sons, Inc., NY, USA.
10) Goodwin, TW & Mercer EI. 1983. Introduction to Plant Biochemistry. 2nd Ed. Oxford, New York.Pergaman Press.
11) David L. Nelson and Michael M. Cox.2012. Lehninger Principles of Biochemisry, 6th Ed .Macmillan Learning, NY, USA
12) Jeremy M. Berg, John L. Tymoczko, LubertStryer and Gregory J. Gatto, 2002.Biochemisry, 7th Ed. W.H. Freeman and Company, NY, USA
13) Jayaram. T. 1981. Laboratory manual in biochemistry, Wiley Estern Ltd. New Delhi:
14) Plummer D. 1988. An Introduction to Practical Biochemistry. 3rd ed. Tata McGraw Hill, New Delhi.
15) Practical biochemistry: R. L. Nath. A treatise on Analysis of Food, Fats and Oils: A. R. Sen, N.K. Pramanik and S.K. Roy
16) *Sadasivam* S, *Manickam* A (1996) *Biochemical methods*. 2nd edition, New Age International (p) Ltd. Publisher, New Delhi..

Course :	ELE FST 351	Credit:	3(2+1)	Semester-V
Course title:	Food Safety and Standards (Elective)			

Syllabus

Theory

Food quality: physical, nutritional, microbial and sensory, quality control; Hazards in supply chain, biological, chemical and physical hazards, natural contaminants, allergens, Food adulteration, toxicities due to hazards, Food infection and intoxication, risk analysis, and detection and epidemiology of food borne pathogens. ISO Food Safety Management Systems.potential risks of food borne bioterrorism, bioterrorism protection measures, Personal hygiene and sanitary food handling.

Quality management and quality assurance: Total quality management, good manufacturing practices, good agricultural practices, good laboratory practices; ISO. HACCP: Principles, implementation; Plan documentation, types of records; Auditing: Surveillance, audit, mock audit, third party quality certifying audit, Certification, certification procedures, certifying bodies, accrediting bodies, international bodies.

Risk assessment and management during food preparation. Microbial standards of fresh and processed foods.

Concept of Quality management systems in India; Sampling procedures and plans; Food Safety and Standards Act, 2006, AGMARK, BIS, Global GAP, Global Food safety Initiative; BRC, SQF, SGS, Food Codex; Export import policy, Labeling issues. export documentation; and food safety.

Practical

Estimation of CFU of water, Estimation of TDS in water.Estimation of *Listeria* and *E. Coli/ Salmonella /Shigella/ Staphylococcus* from food samples.Estimation of fungal toxins from food samples.Heavy metal detection (lead),Estimation of any one commonly used pesticide,HACCP for food industries by taking few models,Study of national and international microbial quality standards,Visit to export oriented food processing industry,

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1-4	Food quality: physical, nutritional, microbial and sensory, quality control	4
5-9	Hazards in supply chain, biological, chemical and physical hazards, natural contaminants, allergens, Food adulteration, toxicities due to hazards,	5
10-12	Food infection and intoxication, risk analysis, and detection and epidemiology of food borne pathogens.	3
13-15	ISO Food Safety Management Systems.potential risks of food borne bioterrorism, bioterrorism protection measures, Personal hygiene and sanitary food handling.	3
16-18	Quality management and quality assurance: Total quality management, good manufacturing practices, good agricultural practices, good	3

Lecture	Topics	Weightage (%)
	laboratory practices; ISO. HACCP: Principles, implementation;	
19-21	Plan documentation, types of records; Auditing: Surveillance, audit, mock audit, third party quality certifying audit, Certification, certification procedures, certifying bodies, accrediting bodies, international bodies.	3
22-23	Risk assessment and management during food preparation. Microbial standards of fresh and processed foods.	2
24-25	Concept of Quality management systems in India; Sampling procedures and plans;	2
26-28	Food Safety and Standards Act, 2006; Domestic regulations; AGMARK, BIS, Global GAP	3
29-30	Global Food safety Initiative; BRC, SQF, SGS, Food Codex; Export import policy, Labeling issues. export documentation; and food safety.	2
	Total	**30**

Practical

Exercise	Topics	No. of Experiments
1	Estimation of CFU of water, Estimation of TDS in water.	2
2	Estimation of *Listeria* and *E. Coli/ Salmonella /Shigella/ Staphylococcus* from food samples.	2
3	Estimation of fungal toxins from food samples.	2
4	Heavy metal detection (lead)	2
5	Estimation of any one commonly used pesticide	2
6	HACCP for food industries by taking few models of food industry	2
7	Study of national and international microbial quality standards	2
8	Visit to export oriented food processing industry	2
	Total	**16**

Suggested Reading:

1) Food Microbiology. W.C. Frazier and D.C. Westhoff, 4th Edn. Tata McGraw-Hill Publishing Company Limited, New Delhi.
2) Food Safety Handbook. Ronald H. Schmidt and Gary E. Rodrick. 2003. John Wiley & Sons, Inc., Hoboken. New Jersey, USA.
3) Food Safety and Food Quality. R.E. Hester and R.M. Harrison. 2001. Royal Society of Chemistry, Cambridge, UK.
4) The Safety of Foods (Sicherheit von Lebensmitteln). GrahamGraham, H. D. (Edit.) 2.
5) Auflage. AVI Publishing Co., Inc., Westport, Connecticut (USA)
6) Food Chemistry (New Edition).Owin R. Fenema
7) Handbook of Food Toxicology. S.S. Deshpande, CRC Press. 2002.
8) Food Hygiene and Sanitation. S. Roday,Tata McGraw-Hill Education
9) Food Microbiology. M.R. Adams and M.O. Moss
10) Food Quality Assurance: Principles and Practices. InteazAlli. 2004. CRC Press, Boca Raton, FL, USA.
11) Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices.Michael M. Cramer. 2013. CRC Press, Boca Raton, FL, USA.
12) Regulatory status of Direct Food Additives. Furia TE.1980. CRC Press.
13) Sensory Evaluation of Food - Theory and Practice. Jellinek G. 1985. Ellis Horwoood.
14) Quality Control in Food Industry. Krammer A &Twigg BA.1973.Vol.I, II. AVI Publ.

Course :	FST 362	Credit:	2(2+0)	Semester-VI
Course title:	Principles of Food Science and Nutrition			

Syllabus

Theory

Concepts of Food Science (Properties of food: physical, chemical and sensory: their measurements); Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives, important reactions); Food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods, Production of fermented foods); Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying, high pressure processing, microwave processing, 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., Fortification and enrichment of food, National programmes and role of national and international agencies in improving nutritional status of the community.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1-5	Concepts of Food Science (Properties of food: physical, chemical and sensory: their measurements)	15
6-10	Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives, important reactions)	15
11-14	Food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods, Production of fermented foods)	10
15-18	Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying, high pressure processing, microwave processing, etc.)	10
19-21	Food and nutrition, Malnutrition (over and under nutrition), nutritional disorders	10
22-23	Energy metabolism (carbohydrate, fat, proteins)	5
24-25	Balanced/ modified diets, Menu planning	5
26-29	New trends in food science and nutrition	10
30-33	Fortification and enrichment of food	10
34-36	National programmes and role of national and international agencies in improving nutritional status of the community.	10
	Total	**100**

Suggested Readings:

1) Owen R, Fennema. 1996. Food Chemistry, 3rd Ed. Marcel Dekker, Inc., New York, USA.
2) M. ShafiurRahman. 2007. Handbook of Food Preservation, 2nd Ed. CRC Press, Boca Raton, FL, USA.
3) James G. Brennan. 2006. Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.
4) Fellows P. 2000. Food Processing Technology: Principles and Practice, 2nd Ed. CRC Press, Boca Raton, FL, USA.
5) William C. Frazier and & Dennis C. Westfoff. 1987. Food Microbiology, 4th Ed. Tata McGraw-Hill Education, New Delhi.
6) Carolyn D. Berdanier, Elaine B. Feldman and Johanna Dwyer. 2008. Handbook of Nutrition and Food, 2nd Ed. CRC Press, Boca Raton, FL, USA.
7) Sehgal, S. and Raghuvanshi, R.S. (2007) Text Book of Community Nutrition. ICAR, New Delhi.
8) Agarwal, A and Udipi, S. (2014). Text Book of Human Nutrition. Jaypee Medical Publication, Delhi.
9) Peter Zeuthen and Leif Bùgh-Sùrensen. 2003. Food Preservation Techniques. CRC Press LLC, Boca Raton, FL, USA.
10) Joshi V.K. and Ashok Pandey. 1999. Biotechnology: Food Fermentation – Microbiology, Biochemistry and Technology, Vol. II. Educational Publishers & Distributors, New Delhi.
11) George J. Banwart. 1989. Basic Food Microbiology, 2nd Ed. Chapman & Hall, New York, USA.
12) Kalia, M. and Sood, S. (2010). Food Preservation and Processing. Revised Edition, Kalyani Publishers, New Delhi.
13) Swaminathan, M. (1999. Food Science, Chemistry and Experimental Foods. 2nded. The Banglore Printing and Publishing Co., Bangalore.

Course :	ELE AGM 361	Credit:	2(1+1)	Semester-VI
Course title:	System Stimulation and Agro-advisory			

Syllabus

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 and forewarning model; 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 agroadvisory.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage(%)
1-2	System Approach for representing soil-plant-atmospheric continuum	6
3	System boundaries for representing soil-plant-atmospheric continuum	4
4-5	Crop models, concepts and techniques	6
6-7	Types of models, data requirements, relational diagrams	6
8-9	Evaluation of crop responses to weather elements	4
10-11	Elementary crop growth models –calibration and validation	6
12-13	Elementary crop growth models -verification and sensitivity analysis	4
14	Potential and achievable crop production- concept	4

Lecture	Topic	Weightage(%)
15	Modelling techniques for potential and achievable crop production estimation	6
16-17	Crop production in moisture and nutrients limited conditions	4
18	Components of soil water and nutrient balance	2
19-20	Weather forecasting, its types, methods and tools	4
21	Techniques of weather forecasting and its verification	6
22	Value added weather forecast	2
23-24	ITK for weather forecast and its validity	3
25	Aerospace science and weather forecast	6
26	Crop-Weather Calendar, Crop-Weather-Pest-Disease Calendar and forewarning model	4
27	Crop weather diagram	4
28-29	Remote sensing- its application in agriculture	6
30	Preparation of agro-advisory bulletin based on weather forecast	4
31	Use of crop simulation model for preparation of Agro-advisory	5
32	Agro-advisory , its effective dissemination	4

b) Practical

Exercise	Topic
1	Preparation of crop weather calendars
2-3	Preparation of agro-advisories based on weather forecast using various approaches
4	Preparation of AAS based on weather forecast using synoptic charts
5-6	Study of crop-weather models using different statistical teqniques
7	Study of simulation models for crop-growth (DSSAT)
8-9	Study of forewarning models for insect pest and disease.
10	Study of crop-weather –pest - disease calendar
11	Study of Simulation with limitations of water and nutrient management options
12	Sensitivity analysis of varying weather and crop management practices
13-14	Use of statistical approaches in data analysis and preparation of historical, past and present meteorological data for medium range weather forecast
15-16	Feedback from farmers about agro-advisory.

Suggested Readings:

1) Applied Agroclimatology by O.P.Bishnoi, Oxford Book Company, Jaipur, India-302108, Edition 2010.
2) Working with Dynamic crop models, Evaluation, Analysis, Parametrization and Applications by D. Wallach, D. Makowshi, J. W. Jones, Elsevier Oxford U.K, First edition 2006.
3) Remote Sensing Techniques in Agriculture by D.D.Sahoo, R.M.Solanki, Agrobios (India), Jodhpur, 2008.
4) Compendium on Crop Moddeling,by M.C. Varshneya and S.S.Salunke. A short Term Training Programme organized by Centre of Advance Studies in Agril. Meteorology, College of Agriculture, Pune-411005 during 14th Sep., - 12th Oct., 1998, Published by MPKV, Rahuri MPKV/EDN./PUB No. 10(99).
5) Database Management Systems by R. Ramkrishnan, Johannes Gehrke, M.C.Grawhill Education (India) Pvt.Ltd, New Delhi, Indian Edition 2014.
6) Introduction to Agrometeorology (Second Edition) by H.S.Mavi, Oxford and IBH Publishing Co. Pvt.Ltd., New Delhi, 1994.
7) Text book of Agril. Meteorology by M.C. Varshneya, P. BalakrishnaPillai, ICAR New Delhi, 2003.
8) Basic Principles of Agril. Meteoorology by V.Radhakrishna Murthy, BS Publication, Hyderabad, 2002.

COMMON COURSES

Course :	EVS 231	Credit:	3(2+1)	Semester-III
Course title:	Environmental Studies and Disaster Management			

Syllabus

Theory

Multidisciplinary nature of environmental studies Definition, scope and importance.Natural Resources: Renewable and non-renewable resources, Natural resources and associatedproblems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timberextraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use andover-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefitsand problems. c) Mineral resources: Use and exploitation, environmental effects of extracting andusing mineral resources, case studies. d) Food resources: World food problems, changes causedby agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, waterlogging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and nonrenewableenergy sources, use of alternate energy sources. Case studies. f) Land resources: Landas a resource, land degradation, man induced landslides, soil erosion and desertification.

• Roleof an individual in conservation of natural resources.

• Equitable use of resources for sustainablelifestyles.

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 andfunction of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desertecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystemdiversity and biogeographical classification of India. Value of biodiversity: consumptive use,productive use, social, ethical, aesthetic and option values. Biodiversity at global, National andlocal levels, India as a mega-diversity nation.Hot-sports of biodiversity. Threats to biodiversity:habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species ofIndia. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.Environmental Pollution: definition, cause, effects and control measures of:a. Air pollutionb. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollutiong. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban andindustrial wastes. Role of an individual in prevention of pollution.

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

variation among nations,population explosion, Family Welfare Programme. Environment and human health: HumanRights, Value Education, HIV/AIDS. Women and Child Welfare.Role of Information Technologyin 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 waterpollution, 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 disastermanagement framework; financial arrangements; role of NGOs, community –based organizationsand 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 environmentalassets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site-Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river,hill slopes, etc.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1.	Environmental studies:- Nature, Definition, scope and importance	3
2	Natural Resources:-Renewable and non-renewable resources, Natural resources and associated problems.	16
3-6	a) Forest resources: Use and over-exploitation, deforestation. 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. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of non-conventional energy sources. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.	
7	Role of an individual in conservation of natural resources.	

Lecture	Topic	Weightage (%)
	Equitable use of resources for sustainable lifestyles.	
8	Ecosystems: -Concept of an ecosystem, Structure and function.	14
9	Study of Producers, Consumers and Decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids.	
10	Types of Ecosystem Introduction, characteristic features, structure and function of Forest, Grassland, Desert and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	
11-12	Biodiversity: - Introduction, definition, genetic, species & ecosystem diversity and bio-geographical classification of India, Value of biodiversity.	
13-14	Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity: Endangered and endemic species of India., Conservation of biodiversity:	12
15-17	Environmental Pollution:- Types of pollution, definition, cause, effects and control measures of Air, Water, Soil, Marine, Noise, Thermal pollutions and Nuclear hazards.	14
18	Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.	
19-20	Carbon Credit: Concept, Exchange of carbon credits. Carbon Sequestration, Importance, Meaning and ways.	08
21-22	Environmental ethics: Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products.	
23-24	Environment (Protection) Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act and Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.	08
25	Human Population and the Environment: Population growth, variation among nations, population explosion. Environment and human health: Human Rights, Value Education.	04
26-27	Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves.	10
28	Climatic change: global warming, Sea level rise, ozone depletion.	
29-30	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.	08
31-32	Disaster Management:-Concept, Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. 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; Police and other organizations.	03
	Total	**100**

b) Practical

Exercise	Topic
1	Study of collection, processing and storage of effluent samples.
2	To estimates solids in water samples.
3	To measure the dissolved O_2 content in pond water by Winkler's method.
4	Estimation of respirable and non respirable dust in the air by using portable dust sampler.
5	Determination of sound level by using sound level meter.
6	Study of community structure.
7	Study of pond / River/ hill slopes ecosystem-abiotic and biotic components.
8	Study of grass land and agro-ecosystem and measurement of their productivity.
9	Crop adaptation to different ecosystems. A. Hydrophytes
10	Crop adaptation to different ecosystems. B. Mesophytes
11	Crop adaptation to different ecosystems. C. Xerophytes
12	Crop adaptation to different ecosystems. D. Halophytes
13	Study and Visit of flora and Fauna.
14	Visit to local polluted site - Urban / Rural: observations and remedial control measures.
15	Visit to local polluted site - Industrial: observations and remedial control measures.
16	Collection, identification, herbarium, maintenance and study of plants grown in various ecosystems.

Suggested Readings:

1 Text book of Environmental Studies for undergraduate courses by ErachBharucha University Grants Commission, New Delhi.

2 Ecology and Environment by P.D. Sharma, Rastogi Publication. Meerut.

3 Environmental Sciences by S.S. Purohit, Q.J. Shammi and A.K. Agrawal, Student Edition, Jodhpur.

4 A text book on Ecology and Environmental Science by M.Prasanthrajan and P.P. Mahendran.,Agrotch Publishing Academy, Udaipur-313002.

5 The biodiversity of India, Maplin Publishing Pvt. Ltd., Ahmadabad.

6 Disaster Management by Sarthak Singh. Oxford Book Company.

7 Disaster – Strengthening community Mitigation and Preparedness by Dr. B.K. Khannna and Nina Khanna. New India Publication Agency.

8 Laboratory Manual of Ecology and Environmental Studies by AmritKaur, Paragon International Publisher, New Delhi.

Course:	EXTEN 123	Credit:	2(1+1)	Semester-II
Course title:	Communication skills and personality Development			

Please refer page No. 148 to 151, under Agricultural Extension Education, for detailed syllabus, Teaching schedules and suggested readings of this course

Course :	EXTN 355	Credit:	3(2+1)	Semester-III
Course title:	Entrepreneurship Development and Business Management			

Please refer page No. 155 to 157, under Agricultural Extension Education, for detailed syllabus, Teaching schedules and suggested readings of this course

Course :	COMP 231	Credit:	2(1+1)	Semester-III
Course title:	Agri-informatics			

Syllabus

Theory

Theory: Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System, definition and Types, Data Representation, Number systems (Binary, Hexadecimal). Difference between ASCII & UNICODE. Applications of MS-Office for creating , Editing and Formatting of Document, Data presentation, Tabulation and Graph creation, statistical analysis, mathematical expressions, Database-Concepts and Types, creating database, uses of DBMS in agriculture, Internet. And World Wide Web(WWW), Concepts, Components and creation of web, HTML, XML, coding.

e- Agriculture, concepts, design and development. ICT for data collection: Formation of development programmes, monitoring and evaluation; Computer models in agriculture: Statistical, weather analysis and crop simulation models- Concepts, structure, files, limitations and advantages. Application for understanding plant processes, sensitivity, verification, calibration and validation; IT application for computation of water and nutrient requirement of crops; computer controlled devices 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. Communication process, Berlo' s model, feedback and barriers to communication.

Practical

Study of Computer Components, accessories, practice of important DOS Commands, Introduction of different operating systems such as MS-Windows, UNIX/ Linux, Creating, Files & Folders, File Management.Use of MS-WORD and MS Power Point for creating, editing and presenting a scientific document. Handling of tabular data; Animation, Video tools, art tool, graphics, template and designs; MS-EXCEL – Creating a spreadsheet, use of statistical tool, writing expressions, creating graphs, analysis of scientific data a; MS-ACCESS: Creating database, preparing queries and reports , Demonstration of agri information system, Introduction to World Wide Web and its components. Demonstration of Scientific websites and identifying components. 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; Use of Smart phones and other devices in agro-advisory and dissemination of market information;Introduction of Geospatial technology; Demonstration of generating information important for agriculture; Hands on practice on preparation of Decision Support system

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	IntroductiontoComputers,Definition:Hardware,Software &firmware. Types of software.	
2	DataRepresentation, Numbersystems (Binary,Hexadecimal). Difference between ASCII & UNICODE (Different EncodingSchemes)	
3	Primary,SecondaryMemory,Unitsusedformeasurement ofmemory,Input Outputdevices	
4	OperatingSystems, definition and types	
5	File Management.	
6	Applications used for document creation &Editing,Data presentation usingslides.	
7	Use of Spreadsheets for statistical analysis,evaluatingmathematical&logicalexpressions.	
8	UseofSpreadsheetsforInterpretationandgraphcreation.	
9	Database, concepts and types, uses ofDBMS/RDBMSin Agriculture	
10	Databasedesign, creation,	
11	Database, concepts and types, uses of DBMS/RDBMSin Agriculture	
12	Databasedesign, creation,	
13	Preparation of presentation. Import export operations, using numerical tabular data/text/graph /slides within different applications usingcut-paste.	
14	SmartphoneAppsinAgricultureforfarmadvises, market price, postharvestmanagement etc; Geospatial technology for generating valuable agri-information	
15	Decisionsupportsystems,concepts,components and applicationsinAgriculture,Agriculture ExpertSystem, SoilInformationSystemsetc for supportingFarm decisions.	
16	Communication process, Berlo's model, feedback and barriers to communication.	
	Total	

b) Practical

Exercise	Topic
1	Studyof Computer Components, accessories
2	practiceof important DOSCommands
3	IntroductionofdifferentoperatingsystemssuchasMS-Windows, Unix/ Linux, Creating, Files &Folders,FileManagement.
4	Word-Processing–1
5	WordProcessing–2
6	Presentation
7	Spreadsheet-1
8	Spreadsheet-2
9	Spreadsheet-3
10	DBMS/RDBMSCreating,Updatingdatabase
11	Querying/Retrievingdata,relation
12	Introduction to World Wide Web (WWW).Demonstration ofAgri-information
13	HandsonCropSimulationModels(CSM)suchasDSSAT/Crop-Info/CropSyst/Wofost; Computation of waterandnutrientrequirementsof crop using CSM andIT tools.
14	Introductionof GeospatialTechnologyforgeneratingvaluable information forAgriculture.
15	Hands on Decision Support System
16	Introduction of programming languages.Preparation ofcontingent crop

Suggested Readings

1) Computer Fundamentals by Pradeep K. Sinha and PritiSinha, III edition, BPB Publications, B-14, Connaught Place, New Delhi – 110 001.
2) Computer Fundamentals by P.K. Sinha, BPB Publications, B-14, Connaught Place, New Delhi – 110 001.
3) Mastering Office Professional for window 95, BPB Publications, B-14, Connaught Place, New Delhi – 110 001.
4) Statistical Methods for Agricultural workers by V.G. Panse and P.V. Sukhatma, ICAR, New Delhi.
5) http://www.tutorialsforopenoffice.org/category_index/base.html
6) http://mkisan.gov.in/downloadmobileapps.aspx
7) http://www.nrsc.gov.in/Agriculture
8) http://iasri.res.in/
9) http://communicationtheory.org/berlos-smcr-model-of-communication/