REVISED SYLLABUS

OF

AGRICULTURE POLYTECHNIC

[English Medium, 3 years, 6 semesters,
on the line of
Agriculture Polytechnic in
Anand Agriculture University Anand (Gujarat)]

Syllabus for Agriculture Polytechnic (Revised)

Agriculture Polytechnic Diploma (3 Years - 6 Semesters, English medium)

List of Departments involved in Agriculture Polytechnic

1) Agronomy
2) Agricultural Botany
3) Horticulture
4) Agricultural Economics
5) Agricultural Extension Education
6) Agriculture Engineering
7) Plant Pathology & Agril. Microbiology
8) Animal Husbandry and Dairy Science
9) Soil Science and Agril. Chemistry
10) Agril. Entomology
11) Social Studies (English, Language)
12) Science (Physics, Chemistry, Biology)
13) Mathematics
14) Computer & Agricultural Statistics
15) Non-gradial courses

A) Layout of Courses

Year - I

Semester - I

Department	Course No.	Title of the Course	Credits	
			T	P
Agronomy	AGRO-111	Agricultural Heritage	1	0
Agronomy	AGRO-112	Fundamentals of Agronomy-I	1	1
Language	LANG-111	English-I	1	1
Science	SCI-111	Physics - 1 & 2	2	1
Agronomy	AGRO-113	Introductory Agro-Meteorology & Climate Change	1	1
Agril. Microbiology	PATH-111	Introductory Microbiology	1	1
Science	SCI-112	Biology- 1 & 2	2	1
Mathematics	MATH-111	Elementary Mathematics	1	1
Agril. Botany	BOT-111	Fundamentals of Crop Physiology	1	1
Horticulture	HORT-111	Fundamentals of Horticulture	1	1
Physical Education	PE- 111	Physical Education & Yoga	0	1*
NSS	NSS-111	NSS	0	1*
		TOTAL	**21 (12+9) 2***	

Semester - II

Department	Course No.	Title of the Course	Credits	
			T	P
Agronomy	AGRO-124	Fundamentals of Agronomy-II	1	1
Agril. Entomology	ENTO-121	Fundamentals of Entomology	1	1
Plant Pathology	PATH-122	Fundamentals of Plant Pathology	2	1
Horticulture	HORT-122	Production Technology of Fruits & Plantation Crops	1	1
Agril. Extension	EXTN-121	Rural Sociology and Educational Psychology	2	0
Science	SCI-123	Chemistry – 1 & 2	2	1
Computer & Agril. Statistics	COMP-121	Introduction to Computer Application & Statistics	1	2
Agril. Botany	BOT- 122	Fundamentals of Genetics	2	1
Agril. Economics	ECON-121	Fundamentals of Agricultural Economics	2	0
Mathematics	MATH-122	Elementary Mathematics-II	1	1
Physical Education	PE-122	Physical Education & Yoga	0	1*
NSS	NSS-111	NSS	0	1*
		TOTAL	**24 (15+9) 2***	

Year - II

Semester – III

Department	Course No.	Title of the Course	Credits	
			T	P
Agronomy	AGRO-235	Crop Production Technology of *Kharif* Crops	1	1
Agril. Botany	BOT-233	Fundamentals of Plant Breeding	2	1
Soil Science	SSAC-231	Fundamentals of Soil Science	2	1
Agril. Entomology	ENTO-232	Integrated Pest Management in Field Crops	1	1
Language	LANG-232	English-II	1	1
Animal Husbandry	AHDS- 231	Livestock Production & Management	2	1
Agril. Extension	EXTN-232	Fundamentals of Agricultural Extension Education	2	1
Plant Pathology	PATH-233	Integrated Disease Management in Field Crops	1	1
Agril. Economics	ECON-232	Farm Management, Production and Resource Economics	1	1
		TOTAL	**22 (13+9)**	

Semester – IV

Department	Course No.	Title of the Course	Credits	
			T	P
Agronomy	AGRO-246	Crop Production Technology of Rabi crops	1	1
Agril. Engg.	ENGG-241	Soil and Water Conservation Engineering	1	1
Agril. Engg.	ENGG-242	Pressurized Irrigation Technology	1	1
Plant Pathology	PATH-244	Integrated Disease Management in Horticultural Crops	1	1
Agril Entomology	ENTO-243	Integrated Pest Management in Horticultural Crops	1	1
Horticulture	HORT-243	Production Technology of Vegetable and Flower Crops	2	1
Soil Science	SSAC-242	Soil Fertility Management	2	1
Agril. Economics	ECON-243	Agricultural Marketing	1	1
Agril. Extension	EXTN-243	Communication Skill and Personality Development	1	1
Botany	BOT-244	Introduction to Forestry	1*	1*
		TOTAL	**20 (11+9) 2***	

Year - III

Semester – V

Department	Course No.	Title of the Course	Credits	
			T	P
Agronomy	AGRO-357	Organic Farming & Sustainable Agriculture	1	1
Botany	BOT-355	Principles of Seed Technology	1	2
Horticulture	HORT-354	Landscape and Gardening	1	1
Agronomy	AGRO-358	Principles and Practices of Weed Management	1	1
Language	LANG-353	Comprehension & Communication Skill in English	1	1
Agril. Engg.	ENGG-353	Farm Power, Machinery and Renewable Energy	2	1
Experiential Learning Modules (Any One)				
Horticulture	HORT-355	Protected Cultivation of Flower / Vegetable	0	6
Horticulture	HORT-356	Commercial Fruit Production Technology	0	6
Horticulture	HORT-357	Commercial Vegetable Production Technology	0	6
Agril. Entomology	ENTO-354	Bio-pesticide / Bio-agent Production Technology	0	6
Agronomy	AGRO-359	Organic Farming Production Technology	0	6
Agril. Botany	BOT-356	Seed Production Technology & Enterprise	0	6
Animal Husbandry	AHDS-352	Dairy Technology	0	6
Soil Science	SSAC-353	Fertilizer Formulation (Fertilizer mixture & briquette etc.)	0	6
		Compulsory Module	14 (7+7)	
		Experiential Learning Modules (Any One)	06 (0+6)	
		TOTAL	**20 (14+6)**	

Semester – VI

Department	Course No.	Title of the Course	Credits	
			T	P
Compulsory Courses				
Agronomy	AGRO-3610	Integrated Farming Systems	1	1
Soil Science	SSAC-364	Problematic Soils and their Management	1	1
Agril. Engineering	ENGG-364	Agro-Processing and Value Addition	1	1
Agril. Extension	EXTN-364	Entrepreneurship Development	1	1
DEG	DEG-361	Democracy, Elections, Good governance	1*	0
HVE	HVE-361	Human values & Ethics	1*	0
ET		Educational Tour	0	1
Experiential Learning Modules (Any One)				
Horticulture	HORT-368	Nursery Technology & Enterprise	0	6
Horticulture	HORT-369	Fruits & Vegetables Processing Technology & Enterprise	0	6
Pathology	PATH-365	Biofertilizer Production Technology	0	6
Soil Science	SSAC-365	Quality Testing Laboratory for Soil, Water, Manures, Fertilizers and Residue analysis	0	6
Entomology	ENTO-365	Sericulture Technology and Enterprise	0	6
Agril. Engg.	ENGG-365	Agriculture Processing and Value Addition Production Technology and Enterprise (Location specific commodities)	0	6
		Compulsory Module	9 (4+5)	
		Experiential Learning Modules (Any One)	06 (0+6)	
		TOTAL	**15 (9+6) 2***	
		SEMESTERWISE TOTAL	**122 (21+24+22+20+20+15)**	
		GRAND TOTAL	**122 + 08* = 130**	

*** Non-gradial course (8 credits).**

Agriculture Polytechnic

1) Agronomy

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

Agronomy

Sr. No.	Semester	Course No	Credit	Course Title
1	I	AGRO-111	1 (1+0)	Agricultural Heritage
2	I	AGRO-112	2 (1+1)	Fundamentals of Agronomy-I
3	I	AGRO-113	2 (1+1)	Introductory Agro-Meteorology and Climate Change
4	II	AGRO-124	2 (1+1)	Fundamentals of Agronomy-II
5	III	AGRO-235	2 (1+1)	Crop Production Technology of *Kharif* Crops
6	IV	AGRO-246	2 (1+1)	Crop Production Technology of Rabi Crops
7	V	AGRO-357	2 (1+1)	Organic Farming & Sustainable Agriculture
8	V	AGRO-358	2 (1+1)	Principles and Practices of Weed Management
9	V	AGRO-359 (E)	6 (0+6)	Organic Farming Production Technology
10	V	AGRO-3610	2 (1+1)	Integrated Farming Systems
Total Credit Load			**23(9+14)**	

1.	**Course :**	AGRO-111	**Credit:**1 (1+0)	**Semester-I**
	Course title:	Agricultural Heritage		

Syllabus

Theory

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

Teaching Schedule

Theory

Lecture	Topics	Weightage (%)
1	Introduction of Indian agricultural heritage	9
2	Ancient agricultural practices, Relevance of heritage to present day agriculture	11
3	Past and present status of agriculture and farmers in society	11
4	Journey of Indian agriculture and its development from past to modern era	10
5	Plant production and protection through indigenous traditional knowledge	8
6	Crop voyage in India and world; Agriculture scope	9
7	Importance of agriculture and agricultural resources available in India	8
8	Crop significance and classifications	9
9	National agriculture setup in India	9
10	Current scenario of Indian agriculture	8
11	Indian agricultural concerns and future prospects	8
	Total	**100**

Suggested Readings

1) **Hand book of Agriculture.** 2013. ICAR Publication.
2) **Crop production and field experimentation.** 2005. Vaidya, V.G., Sahasrabuddhe, K.R. and Khuspe V.S., Continental Prakashan, Vijaynagar, Pune.
3) **History of Agriculture Vol. I, II, III & IV.** By Randhawa, M. S., ICAR, New Delhi.

2.	**Course :**	AGRO-112	**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	Topics	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
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
	Total	**100**

b) Practical

Practicals	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 and 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 text and practice of seed treatments in different field crops.
12	Preparation methods of FYM and compost (Computation of weed indices).
13	Preparation methods of vermi-compost and green manuring.
14-15	Study of different methods of manure and fertilizers 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) **Modern techniques of raising field corps**. Chhidda Singh, Oxford and IBH Publishing Co. Ltd., Bangalore.

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

3) **Hand book of Agriculture**, ICAR Publication.

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

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

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

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

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

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

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

3.	**Course :**	AGRO-113	**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, long wave 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

a) Theory

Lecture	Topics	Weightage (%)
1	Meaning and scope of agricultural meteorology;	4
2	Earth atmosphere- its composition, extent and structure; Atmospheric weather variables; change and its impact on regional and national Agriculture.	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
5	Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave 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, vapor 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	10
	Total	**100**

b) Practical

Practicals	Topic
1	Visit of Agro-meteorological Observatory.
2 & 3	Site selection of observatory, exposure of instruments and weather data recording.
4	Measurement of air temperatures, it's tabulation and variation.
5	Measurement of soil temperature.
6 & 7	Measurement of rain fall.

8	Measurement of wind speed and wind direction.
9	Measurement of evaporation with the help open pan evaporation.
10	Measurement of evapo-transpiration.
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 Assmanns psychrometer.
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.** 2014. G.S.L.H.V. Prasad Rao, Kerala Agricultural University Publications.
2) **Text book of Agricultural Meteorology.** 2004. M. C. Varshneya and P. Balkrishna Pillai, Directorate of Information and Publication of Agriculture (DIPA).
3) **Introduction to Agro-meteorology**- H. S. Mavi
4) **Our Atmosphere**- Smita Bhutani
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

4.	**Course :**	AGRO-124	**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	Topics	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,	6

	Moisture extraction patterns and SPAC	
8-9	Water requirement, Irrigation Requirement, Gross Irrigation, Net Irrigation, Irrigation interval and Methods of estimation of water requirement and factors affecting it.	12
10	Water requirement of different Agronomic crops	6
11-12	Evaporation, Transpiration, Evapo-transpiration Potential- Evapo-transpiration, 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
	Total	**100**

b) Practical

Practicals	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 irrigation system, Fertigation, Care and Maintenance of Drip system,
13	Study of pressurized irrigation system, sprinkler, raingun
14	Installation of various measuring devices and Measurement of Irrigation water.
15	Visit to Atomized Irrigation Unit,
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

5.	**Course :**	AGRO-235	**Credit:** 2 (1+1)	**Semester-III**
	Course title:	Crop Production Technology of *Kharif* Crops		

Syllabus

Theory

Cereals : Rice, Maize, Sorghum - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield. Pearl millet and Finger millet - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield. **Pulses:** Pigeonpea, Greengram and Blackgram - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield. **Oilseeds:** Groundnut, Sesame, Sunflower and Soybean, Niger -- Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield. **Fiber crops:** Cotton and Jute - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield. **Forage crops:** Sorghum, Cowpea and Napier hybrid and Fodder maize - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield. **Cash crop**: Sugarcane - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield. **Green manure Crops:** Sunhemp and Dhaincha - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.

Practical

Identification of seed and crops. Field layout of different method of rice nursery including /SRI. Seed treatment and sowing of major crops. Effect of seed size on germination and seedling vigour of *Kharif* crops. Effect of sowing depth and methods of germination crops. Study of growth and yield contributing characters of *Kharif* crops. Visit to the agronomic and forage experiments. Numerical exercises on fertilizer, seed requirement and plant population. Study of water management practices of different *Kharif* crops. Preparation of Balance sheet & cost cultivation of Important *Kharif* crops. Identification of different water soluble and actual foliar application on different agronomical *kharif* crops. Preparation of Balance sheet & cost cultivation of important *kharif* crops.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1-2	**Cereals :** Rice, Maize, Sorghum - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	10
3-4	Pearl millet and Finger millet - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	8
5-6	**Pulses:** Pigeonpea, Greengram and Blackgram - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	17
7-8	**Oilseeds:** Groundnut, Sesame, Sunflower and Soybean, Niger -- Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	18
9-10	**Fiber crops:** Cotton and Jute - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	13
11-12	**Forage crops:** Sorghum, Cowpea and Napier hybrid and Fodder maize - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	12
13-14	**Cash crop**: Sugarcane - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	12
15-16	**Green manure Crops:** Sunhemp and Dhaincha - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	10
	Total	**100**

b) Practical

Practicals	Topic
1	Identification of seed and crops
2	Field layout of different method of rice nursery including /SRI
3	Seed treatment and sowing of major crops
4	Effect of seed size on germination and seedling vigour of *kharif* crops
5	Effect of sowing depth and methods of germination crops
6	Study of growth and yield contributing characters of *kharif* crops
7	Visit to the agronomic and forage experiments
8	Numerical exercises on fertilizer, seed requirement and plant population
9	Study of water management practices of different *kharif* crops.
10	Preparation of Balance sheet & cost cultivation of Important *kharif* crops.
11	Identification of different water soluble and actual foliar application on different agronomical *kharif* crops.
12	Preparation of Balance sheet & cost cultivation of important *kharif* crops.

Suggested Readings

1) **Hand Book of Agriculture.** 2013. ICAR Publication.
2) **Crop Production and Field Experimentation.** 2005. Vaidya, V.G., Sahasrabuddhe, K.R. and Khuspe V.S., Continental Prakashan, Vijaynagar, Pune.
3) **Textbook of Field Crop Production.** 2012. Vol. I, Food Grain Crop. Prasad, R.
4) **Textbook of Field Crop Production.** 2013. Vol. II Commercial Crop. Prasad, R.
5) **Principle and Practices of Agronomy**. 2011. S. S. Singh. Kalyani Publisher.

6.	**Course :**	AGRO-246	**Credit:** 2 (1+1)	**Semester-IV**
	Course title:	Crop Production Technology of Rabi Crops		

Syllabus

Theory

Cereals: Wheat, Barley and Maize - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield. **Pulses :** Chickpea, Lentil and Peas - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield. **Oilseed:** Rapeseed, Mustard, Linseed and Safflower - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield. **Sugar crops:** Sugarcane and Sugar beet- Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield. **Forage crops:** Oat, Lucerne and Barsim - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield. **Spice crops**: Coriander, Ajwain and Turmeric - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.

Practical

Identification of crops and seed. Sowing methods of wheat and sugarcane & its applications. Seed treatment of different Rabi crops & its applications. Effect of sowing depth and methods on germination of crops. Study of growth and yield contributing characters. Numerical exercises on seed and seed requirement. Judging the maturity and harvesting techniques. Study of water management practices of different rabi crops. Identification of different water soluble and actual foliar application on different agronomical rabi crops. Preparation of Balance sheet & cost cultivation of important rabi crops. Measurement of field emergent count of different rabi season crops.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1-3	**Cereals:** Wheat, Barley and Maize - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	20
4-6	**Pulses:** Chickpea, Lentil and Peas - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	20
7-11	**Oilseed:** Rapeseed, Mustard, Linseed and Safflower - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	18
12-13	**Sugar crops:** Sugarcane and Sugar beet- Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	18
14-15	**Forage crops:** Oat, Lucerne and Barsim - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	12
16-17	**Spice crops**: Coriander, Ajwain and Turmeric - Origin, classification, geographical distribution, economic importance, soil and climatic requirements, seed rate and spacing, varieties with their specialties, cultural practices and yield.	12
	Total	**100**

b) Practical

Practicals	Topic
1	Identification of crops and seed.
2	Sowing methods of wheat and its applications.
3	Sowing methods of sugarcane and its applications.
4	Seed treatment of different rabi crops & its applications.
5	Effect of sowing depth and methods on germination of crops
6	Study of growth and yield contributing characters
7	Numerical exercises on seed requirement, plant population and seed index
8	Judging the maturity and harvesting techniques
9	Study of water management practices of different rabi crops.
10	Identification of different water soluble and actual foliar application on different agronomical rabi crops
11	Preparation of Balance sheet & cost cultivation of important Rabi Crops.
12	Measurement of field emergent count of different rabi season crops.

Suggested Readings

1) **Hand book of Agriculture.** 2013. ICAR Publication.
2) **Crop production and field experimentation.** 2005. Vaidya, V.G., Sahasrabuddhe, K.R. and Khuspe V.S., Continental Prakashan, Vijaynagar, Pune.
3) **Modern technique of raising field crops**. 2003. Chidda Singh, Singh P., Singh, R. Oxford and IBH Publ. Co.
4) **Techniques of Management of Field Crop Production**. P. S. Rathod, Agrobios (India).
5) **Principle and Practices of Agronomy.** 2011. S. S. Singh. Kalyani Publisher.

7.	**Course :**	AGRO-357	**Credit:** 2 (1+1)	**Semester-V**
	Course title:	Organic Farming and Sustainable Agriculture		

Syllabus

Theory

Organic Farming, Definition, Principles, Present Scenario & its scope in India. Initiative taken by Govt., NGO & organization for promotion of organic agriculture. Organic Nutrients Management its resources, organic ecosystem & their concepts. Weed Management in organic mode of production. Organic Certification process, National standards of organic farming, Different certification agencies. Restriction to nutrient use in organic farming. Choice of crops & varieties in organic farming. Sustainable Agriculture: Definition, Principles, Goals, Problems and its importance in Agriculture, Sustainability Index and conservation agriculture. Integrated Farming System, historical background, characteristics, objectives, components and its advantages. Farming systems in relation to environment, its resource cycling and flow of energy. Development of site specific (IFS) integrated farming system models for different Agro climatic zones, its resource use efficiency and recycle of resources.

Practical

Visit to an Organic farm to study the various components & their utilization. Study of preparation of different compost. Study of preparation methods for vermicompost & vermiwash. Study of bio fertlizers & bio-inoculants. Study of quality analysis of compost & vermicompost. Study of post harvest management in organic farming. Study of crop residue management & Green manuring. Study of seed treatment with biofertilizers and *beejamrut*. Preparation of *Beejamrut* & it's uses. Preparation of *Jeevamrut* and *Ghanjeevamrut* & it's uses. Preparation of *Panchagavya* & it's uses. Preparation of *Dashparni Arka & Neemarka* & it's uses. Study of preparation methods of biopesticides and biofungicides. Study of preparation of enriched compost (Biodynamic, NADEP Compost). Visit to organic IFS model. Study of procedure for organic certified plot.

Teaching Schedule

Theory

Lecture	Topic	Weightage (%)
1	Organic Farming, Definition, Principles, Present Scenario & its scope in India.	9
2-3	Initiative taken by Govt., NGO & organization for promotion of organic agriculture.	10
4	Organic Nutrients Management its resources, organic ecosystem & their concepts.	8
5	Weed Management in organic mode of production	8
6-7	Organic Certification process, National standards of organic farming, Different certification agencies.	10
8	Restriction to nutrient use in organic farming.	8
9	Choice of crops & varieties in organic farming.	8
10 & 11	Sustainable Agriculture: Definition, Principles, Goals, Problems and its importance in Agriculture, Sustainability Index and conservation agriculture	10
12	Integrated Farming System, historical background, characteristics, objectives, components and its advantages.	10
13	Farming systems in relation to environment, its resource cycling and flow of energy	10
14	Development of site specific (IFS) integrated farming system models for different Agro climatic zones, its resource use efficiency and recycle of resources.	9
	Total	**100**

Practical

Practicals	Topic
1	Visit to an Organic farm to study the various components & their utilization.
2	Study of preparation of different compost.
3	Study of preparation methods for vermicompost & vermiwash.
4	Study of bio fertilizers & bio-inoculants.
5	Study of quality analysis of compost & vermicompost.
6-7	Study of post harvest management in organic farming.
8	Study of crop residue management & Green manuring.
9	Study of seed treatment with biofertilizers and *beejamrut*.
10	Preparation of *Beejamrut* & it's uses.
11	Preparation of *Jeevamrut* and *Ghanjeevamrut* & it's uses.
12	Preparation of *Panchagavya* & it's uses.
13	Preparation of *Dashparni Arka & Neemarka* & it's uses.
14	Study of preparation methods of biopesticides and biofungicides.
15	Study of preparation of enriched compost (Biodynamic, NADEP Compost).
16	Visit to organic IFS model.
17	Study of procedure for organic certified plot.

Suggested Readings

1) **Organic Farming for Sustainable Agriculture.** 2003. Dahama. A.K., Agrobios Publication.

2) **Cropping Systems in Tropics – Principles and Practices**. 2006. Palanniappan, S.P., New Age International (P) Ltd. Publishers, New Delhi.

3) **Handbook of Organic Farming**. 2002. A. K. Sharma. Agrobios India Agro House, Jodhpur.

4) **Handbook of Composite Organic Farming**. 2008. Himadri Panda, Dharamvir Vota. Gene-Tech Books, New Delhi.

5) **Farming System : Principle and Practices**. 2008. C. Jayanthi, P. Devasenapati and C. Venilla. Satish Serial P:ublishing House, New Delhi.

6) **Research in Farming Systems**. 2014. B. Gagawar, J. P. Singh, A. K. Prusty and Kamta Prasad., Today & Tomorrows Printers and Publishers.

7) **Textbook of Farming System and Sustainable Agriculture.** Aniket Kalhapure, Madhukar Dhonde, Balasaheb Shete, Universal Prakashan, Pune.

8) **Cropping System Management.** 2012. Gangwar. Agrotech Publisher.

8.	**Course :**	AGRO-358	**Credit:** 2 (1+1)	**Semester-V**
	Course title:	Principles and Practices of Weed Management		

Syllabus

Theory

Weeds: Introduction, definition, harmful and beneficial effects, uses of weeds, Classification, crop weed competition and allelopathy, Principles, factors and objectives of weed controls, Preventive weed control measures – physical / mechanical, cultural methods of wee control, Chemical and biological methods of weed control – bio herbicides - integrated weed management, Herbicides – definition - advantages and limitations of herbicide usage in India- classification of herbicides based on chemical nature - time and method of application, Bio-herbicides – definition - advantages and limitations of usage in India- mode of action and method of application, Integrated weed management- meaning, concepts, definition, scope, importance and advantages and disadvantages, Integrated weed management- objective and characteristics, Introduction to mode of action of herbicides and selectivity resistance of herbicides, Integration of herbicides with non-chemical method of weed management, Allelopathy and their application in integrated weed management, Herbicide resistance, persistency and its management in integrated weed management, Principles integrated of weed management, Introduction to adjuvants and their use in herbicides; compatibility of herbicides with other agro chemicals, Integrated weed management in different crops and cropping systems – rice – nursery – upland rice – low land rice – wheat – sorghum – maize – redgram – black gram – groundnut – sunflower, Integrated weed management in different crops and cropping systems – sugarcane – cotton - tobacco, vegetables (tomato, onion, chilli and brinjal) and orchards (mango, banana and citrus), Relationship of chemical herbicides with tillage, fertilizers and irrigation in integrated weed management.

Practical

Collection and identification of different weed and their seeds, Preparation of weed album, Mechanical and cultural method of weed control, use of tools, implements and mechanical weeders, Identification and classification of different chemical herbicides and their mode of action, Identification and classification of different biological herbicides and their mode of action, Workout the different chemical herbicides application, calibration and preparation of spray fluid, Workout the different biological herbicides application, calibration and preparation of spray fluid, Study of different sprayers and nozzles, Assessment of different biological and chemical herbicides toxicity and residue by bioassay method, Estimation of weed control efficiency of integrated weed management, Workout the economics of different weed control methods, Integrated weed management in different crops, Control of noxious, perennial, problematic and parasitic weeds in integrated weed management, Control of aquatic and weeds on non- cropped areas in integrated weed management.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Weeds: Introduction, definition, harmful and beneficial effects, uses of weeds.	3
2	Classification, crop weed competition and allelopathy.	4
3	Principles, factors and objectives of weed controls.	6
4	Preventive weed control measures – physical / mechanical, cultural methods of weed control.	6
5	Chemical and biological methods of weed control – bio herbicides - integrated weed management.	6
6	Herbicides – definition - advantages and limitations of herbicide usage in India- classification of herbicides based on chemical nature - time and method of application.	6
7	Bio-herbicides – definition - advantages and limitations of usage in India- mode of action and method of application	6
8	Integrated weed management- meaning, concepts, definition, scope, importance and advantages and disadvantages.	6
9	Integrated weed management- objective and characteristics	6
10	Introduction to mode of action of herbicides and Selectivity resistance of herbicides	6
11	Integration of herbicides with non-chemical method of weed management	5
12	Allelopathy and their application in integrated weed management	6
13	Herbicide resistance, persistency and its management in integrated weed management.	6
14	Principles integrated of weed management	5
15	Introduction to adjuvants and their use in herbicides; compatibility of herbicides with other agro chemicals.	5
16	Integrated weed management in different crops and cropping systems – rice – nursery – upland rice – low land rice – wheat – sorghum – maize – redgram – black gram – groundnut – sunflower.	6
17	Integrated weed management in different crops and cropping systems – sugarcane – cotton - tobacco, vegetables (tomato, onion, chilli and brinjal) and orchards (mango, banana and citrus).	6
18	Relationship of chemical herbicides with tillage, fertilizers and irrigation in integrated weed management.	6
	TOTAL	**100**

b) Practical

Practicals	Topic
1	Collection and identification of different weed and their seeds.
2	Preparation of weed album.
3	Mechanical and cultural method of weed control, use of tools, implements and mechanical weeders.
4	Identification and classification of different chemical herbicides and their mode of action.
5	Identification and classification of different biological herbicides and their mode of action.
6	Workout the different chemical herbicides application, calibration and preparation of spray fluid.
7	Workout the different biological herbicides application, calibration and preparation of spray fluid.
8	Study of different sprayers and nozzles
9	Assessment of different biological and chemical herbicides toxicity and residue by bioassay method.
10	Estimation of weed control efficiency of integrated weed management
11	Workout the economics of different weed control methods.
12	Integrated weed management in different crops.
14	Control of noxious, perennial, problematic and parasitic weeds in integrated weed management.
15	Control of aquatic and weeds on non-cropped areas in integrated weed management.

Suggested Readings

1) **Principles in Weed Management.** 1997. Aldrich, R. J. and Kramer R. J., Panima Corporation, New Delhi.
2) **Weed management Principles and Practices.** 2007. Gupta O.P., Agrobios (India) Agro House, Jodhpur.
3) **Principles of Weed Science.** 2006. Rao V.S., Oxford & IBH, New Delhi.
4) **Weed Science, Basics and Applications.** 2012. Das T. K., Jain Brothers, New Delhi.

10.	**Course :**	AGRO-3610	**Credit:** 2 (1+1)	**Semester-VI**
	Course title:	Integrated Farming Systems		

Syllabus

Theory

Farming System- Definition, scope, importance and goals, Farming systems – classification according to type of rotation, intensity of rotation, degree of commercialization, water supply and enterprises, Integrated Farming System- Definition, scope, importance, objective and goals. Different components of IFS, Advantages and disadvantages of IFS, Development of different integrated farming system models for large and medium farmers for irrigated areas, Development of different integrated farming system models for large and medium farmers for rainfed areas, Development of different integrated farming system models for small and marginal farmers for irrigated areas, Development of different integrated farming system models for small and marginal farmers for rainfed areas, Methods of composting in integrated farming system, Concept of sustainability in integrated farming systems and its techniques for sustainability, Value addition in IFS models, Criteria for evaluation of IFS models, Climates smarts organic IFS models, components of organic IFS models.

Practical

Study the existing Integrated Farming System in local areas, Preparation of integrated farming system model for irrigated areas, Preparation of integrated farming system model for rainfed areas, To study the farm records of integrated farming system models, Study of preparation of different methods of composting in IFS models, Study of preparation of vermicompost and vermiwash in IFS models, Details study of preparation different organic formulation in IFS models, Details study of poultry component in IFS model, Details study of mixed fruit crop under rainfed and irrigated IFS models, Details study of mushroom production in IFS models, Value addition from fruits and vegetable crops and livestock component in IFS model, Study the different forage crops for livestock component in IFS models, Study the water productivity of each components in IFS models, Role of vertical farming, kitchen gardening in IFS model, Visit to various integrated farming system research projects, Visit to organic IFS models.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Farming System- Definition, scope, importance and goals.	5
2&3	Farming systems – classification according to type of rotation, intensity of rotation, degree of commercialization, water supply and enterprises.	6
4	Integrated Farming System- Definition, scope, importance, objective and goals.	8
5	Different components of IFS.	6
6	Advantages and disadvantages of IFS.	5
7	Development of different integrated farming system (ifs) models for large and medium farmers for irrigated areas.	8
8	Development of different integrated farming system (ifs) models for large and medium farmers for rainfed areas.	8
9	Development of different integrated farming system (ifs) models for small and marginal farmers for irrigated areas.	8
10	Development of different integrated farming system (ifs) models for small and marginal farmersforrainfed areas.	8
11	Methods of composting in integratedfarming system.	8
12	Concept of sustainability in integrated farming systems and its techniques for sustainability.	8
13	Value addition in IFS models.	8
14	Criteria for evaluation of IFS models.	6
15&16	Climates smarts organic IFS models, components of organic IFS models.	8
	TOTAL	**100**

b) Practical

Practicals	Topic
1	Study the existing Integrated Farming System in local areas.
2	Preparation of integrated farming system model for irrigated areas.
3	Preparation of integrated farming system model for rainfed areas.
4	To study the farm records of integrated farming system models.
5	Study of preparation of different methods of composting in IFS models.
6	Study of preparation of vermicompost and vermiwash in IFS models.
7	Details study of preparation different organic formulation in IFS models.
8	Details study of poultry component in IFS model
9	Details study of mixed fruit crop under rainfed and irrigated IFS models.
10	Details study of mushroom production in IFS models.
11	Value addition from fruits and vegetable crops and livestock component in IFS model.
12	Study the different forage crops for livestock component in IFS models
13	Study the water productivity of each components in IFS models
14	Role of vertical farming, kitchen gardening in IFS model.
15	Visit to various integrated farming system research projects.
16	Visit to organic IFS models.

Suggested Readings

1) **Hand Book of Agriculture.** 2013. ICAR Publication.
2) **Crop Production and Field Experimentation.** 2005. Vaidya, V.G., Sahasrabuddhe, K.R. and Khuspe V.S., Continental Prakashan, Vijaynagar, Pune.
3) **Cropping Systems Theory and Practice.** 1997. Chatterjee B.N. and Maiti S., Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4) **Cropping Systems in Tropics – Principles and Practices.** 1985. Palanniappan, S. P., John Wiley & Sons (Asia) Pvt. Ltd.

Agriculture Polytechnic

2) Agricultural Botany

(Genetics, Plant Breeding & Crop Physiology)

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

Agricultural Botany

Sr.No.	Semester	Course No	Credit	Course Title
1	I	BOT-111	2 (1+1)	Fundamentals of Crop Physiology
2	II	BOT-122	3 (2+1)	Fundamentals of Genetics
3	III	BOT-233	3 (2+1)	Fundamentals of Plant Breeding
4	IV	BOT-244	2 (1+1)*	Introduction to Forestry
5	V	BOT-355	3(1+2)	Principles of Seed Technology
6	V	BOT-356 (E)	6 (0+6)	Seed Production Technology & Enterprise
Total Credit Load			**17 (6+11) 2***	

* = Non-gradial course.

1.	**Course :**	BOT-111	**Credit:** 2 (1+1)	**Semester-I**
	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. Photosynthesis: Light and Dark reactions. C_3, C_4 and CAM plants. Respiration: Glycolysis. Physiological roles and agricultural uses. Physiological aspects of growth and development of major crops. Growth analysis. Role of Physiological growth parameters in crop productivity. Ascent of sap and antitranspirants. Photoperiodism. Photorespiration and Vernalization. Translocation of solutes. Auxins, hormones and plant growth regulators. Climate changes, factors and effect on crop growth.

Practical

Study of plant cells and structure. Study of imbibitions. Study of diffusion and osmosis. To study the plant water relationships- Ψp, Ψs, Ψg, Ψm, Ψw, etc. Rate of water absorption and translocation. Study of different solutions – Molal, Molar, Per cent, etc. Rate of transpiration in plants. Studies on light absorption and rate of photosynthesis. To estimate chlorophyll content in plants. To determine light and CO_2 necessary for photosynthesis. To demonstrate O_2 released during photosynthesis. Studies on leaf number, leaf area and leaf area concept. Effect of plant growth regulators on plant growth – IAA, GA and Kinetin. To estimate dry matter production and it's distribution in component parts of plant. To estimate growth parameters- AGR, RGR, CGR, NAR, LAD, LAR, etc. To estimate biological yield, economic yield and harvest index. To study the effect of moisture stress on plant growth and estimation of stress parameters – per cent reduction, stress index, stress susceptibility index, stress tolerance efficiency, mean productivity, tolerance, etc.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Introduction to Crop Physiology and its importance in Agriculture	4
2	Plant cell : An Overview	6
3	Diffusion and Osmosis	6
4	Absorption of water	5
5	Transpiration and Stomatal Physiology	6
6	Mineral nutrition of Plants	5
7	Photosynthesis: Light and Dark reactions	6
8	C_3, C_4 and CAM plants	6
9	Respiration : Glycolysis	5
10	Physiological roles and agricultural uses	5
11	Physiological aspects of growth and development of major crops	5
12	Growth analysis	5
13	Role of Physiological growth parameters in crop productivity	4
14	Ascent of sap and antitranspirants	6
15	Photoperiodism	5
16	Photorespiration and Vernalization	5
17	Translocation of solutes	5
18	Auxins, hormones and plant growth regulators	6
19	Climate changes, factors and effect on crop growth	5
	Total	**100**

b) Practical

Practicals	Topic
1	Study of plant cells and structure.
2	Study of imbibitions.
3	Study of diffusion and osmosis.
4	To study the plant water relationships- Ψp, Ψs, Ψg, Ψm, Ψw, etc.
5	Rate of water absorption and translocation.
6	Study of different solutions – Molal, Molar, Per cent, etc.
7	Rate of transpiration in plants.
8	Studies on light absorption and rate of photosynthesis.
9	To estimate chlorophyll content in plants.
10	To determine light and CO_2 necessary for photosynthesis.
11	To demonstrate O_2 released during photosynthesis.
12	Studies on leaf number, leaf area and leaf area concept.
13	Effect of plant growth regulators on plant growth – IAA, GA and Kinetin.
14	To estimate dry matter production and it's distribution in component parts of plant.
15	To estimate growth parameters- AGR, RGR, CGR, NAR, LAD, LAR, etc.
16	To estimate biological yield, economic yield and harvest index.
17	To study the effect of moisture stress on plant growth and estimation of stress parameters – per cent reduction, stress index, stress susceptibility index, stress tolerance efficiency, mean productivity, tolerance, etc.

Suggested Readings

1) **A Text Book Plant Physiology.** 2009. Dr. V. Verma, Emkay Publisher, Delhi- 110 051.
2) **Plant Physiology.** 2000. S. N. Pandey & B. K. Sinha, Vikas Publ.House, New Delhi-110 014
3) **Plant Physiology.** 2005. H. S. Shrivastava, Rustogi Publications, Meerut-250 002
4) **Crop Physiology.** 2008. C. N. Chore, S. R., Ghadekar & R. K. Patil, Agromet Publisher, Nagpur-440 010

2.	**Course :**	BOT -122	**Credit :** 3 (2+1)	**Semester-II**
	Course title:	Fundamentals of Genetics		

Syllabus

Theory

Introduction to Genetics and milestones in the history Darwinism, Lamarckism and important terminology e.g. genotype, phenotype. Cell division: Mitosis and Meiosis, difference between these. Qualitative and quantitative traits in general versus in terms of Genetics. Inheritance of qualitative traits-Mendelian principles of heredity mono, di & trihybrid ratios, test cross ratios. Study of basic chromosome structure/ morphology. Allelism, Multiple alleles, symbolization and characteristics. Genetics of human blood groups, its clinical importance/blood banks. Gene interactions as exception to Mendelian inheritance. Interactions without modification of F_2 ratios. Gene interactions with modification of F_2 ratios- inheritance of complementary, supplementary factors and single factor lethal interaction. Linkage as exception to Mendelian inheritance, linkage groups, phases and estimation of linkage. Crossing over mechanisms of breaking linkage, types and subtypes, mechanism/theories. Linkage map. Sex determination, mechanisms and criss-cross inheritance. Sex limited and sex influenced traits. Polygenes, continuous variation and multiple factor hypothesis. Maternal/Cytoplasmic inheritance, organells responsible, primary detection, difference from Mendeleian inheritance. Inheritance and exploitation of cytoplasmic male sterility. Mutataion-classification, charecteristics, mutagens, their classification with examples. Methods of inducing mutations i.e. mutagenesis and cib technique. Structural and numerical changes in chromosome terminology and symbolization. General effects of auto polyploidy, Simplified evolution of tetraploid cotton and hexaploid wheat. Gene concept- gene structure and functions. Nature, structure and replication of genetic material, types of nucleic acids, genetic code/codons properties and facts. Basic structure of Protein, Protein synthesis-transcription and translation. Gene regulation- Lac and Trp operons.

Practical

Study of Microscope and micrometry. Study of cell structure and functions of organelles. Practice on mitotic cell division under microscope. Study of Meiosis & it stages under microscope. Concept and rules of probability. Methods of finding out gametes and gametic combinations, Phenotypic combinations and recombinations, completion of checker boards with normal gametic probabilities. Experiment/Problems on monohybrid & dihybrid ratios with gametic probabilities. Chi-square test of monohybrid and dihybrid ratios by actual count in lab samples Chi-square Tables. Chi-square test of the count of male sterile/fertile plants in F_2 of CGMS based sorghum hybrid *in situ.* Gene interactions-I : a) Interaction without modification of F_2 ratio, b) Interaction with modification ratio i.e. complementary and supplementary. Gene interactions-II : Duplicate factors, epistatic and inhibitory factors. Polymerism and single gene interaction i.e. lethal factors. Determination of linkage, dihybrid F_2 checker boards with differential gametic probabilities. Study of test crosses a) Normal monohybrid and dihybrid test cross b) Test crosses under each digenic and monogenic gene interaction, c) Test cross under linkage. Problems on the inheritance of multiple alleles and blood groups. Problems on sex linked inheritance.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Introduction to Genetics and milestones in the history Darwinism, Lamarckism and important terminology e.g. genotype, phenotype	4
2	Cell division: Mitosis and Meiosis, difference between these	4
3	Qualitative and quantitative traits in general versus in terms of Genetics	4
4	Inheritance of qualitative traits-Mendelian principles of heriditymono, di & trihybrid ratios, test cross ratios	4
5	Study of basic chromosome structure/ morphology	4
6	Allelism, Multiple alleles, symbolization and characteristics Genetics of human blood groups, its clinical importance/blood banks	4
7	Gene interactions as exception to Mendelian inheritance. Interactions without modification of F_2 ratios	4
8	Gene interactions with modification of F_2 ratios- inheritance of complementary, supplementary factors and single factor lethal interaction	4
9	Linkage as exception to Mendelian inheritance, linkage groups, phases and estimation of linkage	4
10	Crossing over mechanisms of breaking linkage, types and subtypes, mechanism/theories	4
11	Linkage map	4
12	Sex determination, mechanisms and criss-cross inheritance	4
13	Sex limited and sex influenced traits	4
14	Polygenes, continuous variation and multiple factor hypothesis	4
15	Maternal/Cytoplasmic inheritance, organells responsible ,primary detection, difference from Mendeleian inheritance	4
16	Inheritance and exploitation of cytoplasmic male sterility	4
17	Mutataion- classification, charecteristics, mutagens, their classification with examples	4
18	Methods of inducing mutations i.e. mutagenesis and cib technique	4
19	Structural and numerical changes in chromosome terminology and symbolozation	4
20	General effects of autopolyploidy, Simplified evolution of tetraploid cottonand hexaploid Wheat	4
21	Gene concept- gene structure and functions	4
22	Nature, structure and replication of genetic material, types of nucleic acids, genetic code/codons properties and facts	4
23	Basic structure of Protein, Protein synthesis-transcription and translation	4
24 & 25	Gene regulation- Lac and Trp operons	4
	Total	**100**

b) Practical

Practicals	Topic
1	Study of Microscope and micrometry.
2	Study of cell structure and functions of organelles.
3	Practice on mitotic cell division under microscope.
4	Study of Meiosis & it stages under microscope.
5	Concept and rules of probability.
6	Methods of finding out gametes and gametic combinations, Phenotypic combinations and recombinations, completion of checker boards with normal gametic probabilities.
7	Experiment/Problems on monohybrid & dihybrid ratios with gametic probabilities.
8	Chi-square test of monohybrid and dihybrid ratios by actual count in lab samples Chi-square Tables.
9	Chi-square test of the count of male sterile/fertile plants in F_2 of CGMS based sorghum hybrid *in situ.*
10	Gene interactions-I : a) Interaction without modification of F_2 ratio, b) Interaction with modification ratio i.e. complementary and supplementary.
11	Gene interactions-II : Duplicate factors, epistatic and inhibitory factors.
12	Polymerism and single gene interaction i.e. lethal factors.
13	Determination of linkage, dihybrid F_2 checker boards with differential gametic probabilities.
14	Study of test crosses a) Normal monohybrid and dihybrid test cross b) Test crosses under each digenic and monogenic gene interaction, c) Test cross under linkage.
15	Problems on the inheritance of multiple alleles and blood groups.
16.	Problems on sex linked inheritance.

Suggested Readings

1) **Fundamentals of Genetics.** 2007**.** B.D.Singh, Kalyani Publication, New Delhi - 110 051.
2) **Elements of Genetics.** 2011**.** Phundan Singh, Kalyani Publication, New Delhi - 110 051.
3) **Principles of Genetics** 2013**.** E.W.Sinnot; L.C.Dunn and T. Dobzhansky, Tata McGraw Hill.
4) **Textbook of Genetics.** 2015**.** R.C.Dalela and S.R.Verma, Jay Prakash Nath & Co.
5) **Genetics (Schaumm International Series).** William Stansfield, Schaumm International Series.

3.	**Course :**	BOT-233	**Credit:** 3 (2+1)	**Semester-III**
	Course title:	Fundamentals of Plant Breeding		

Syllabus

Theory

Historical milestones. Concepts of Plant Breeding; nature and role of plant breeding, new variety as the cheapest input in Agriculture. Major achievements including dwarf varieties, hybrid varieties, green revolution. Modes of reproduction and apomixes, contrivances for self and cross pollination, estimation of cross pollination, list of self, cross and often cross pollinated crops. Systems of pollination control-Self- incompatibility and male sterility, classification and inheritance. Domestication, plant introduction, procedure, exploration, gene banks, world collections, active/working collections, acclimatization, achievements Symbolization. Roll and organization of NBPGR. A Pl. introduction agencies in India, abroad, Basics of Biodiversity Act. Law of homologous series, Centres of origin/diversity with proper name, geographical area and crops originated. Gene microcentres. Systems of mating and their genetic consequences, single, double, three way cross, MAGIC/ multiple crosses. Genetic basis and breeding methods in self-pollinated crops/often cross pollinated crops. Vilmorin isolation principle and Johannsen's Pure Line Theory, characteristics of pure line and causes of impurities. Mass and pure line selection, source population, definition, procedure, schemes/diagrams, merits, demerits/ limitations, achievements. Hybridization techniques and handling of segregating population, pedigree, bulk, SSD methods, Suneson's method, definition, procedure, schemes/diagrams, merits, demerits/ limitations, achievements. Back cross methods- definition, procedure, schemes/ diagrams, merits, demerits/ limitations, achievements) transfer of male sterility, partial/limited back crosses. Multiline concept, characteristics, procedure and achievements, R. I. L. Concept of open pollinated population, Hardy Weinberg Law and heritability; Genetic basis and methods of breeding cross-pollinated crops. Heterosis and inbreeding depression, theories, types, Luxuriance. Development of inbred lines, ABR lines and hybrids. Exploitation of heterosis in sorghum, bajra, maize [double and three way cross hybrids], and cotton. Mass selection, Ear to row method, line breeding, history and classification of recurrent selection schemes with definitions/ abbreviations. Additional ways of exploitation of heterosis-Composite and synthetic varieties, definition, procedure, schemes/diagrams, merits, demerits/ limitations, achievements including

development in forage crops. Polyploidy in relation to plant breeding, induction, confirmation, optimum ploidy level, Triangle of U, polyploidy in chillies, achievements through polyploidy breeding, Success story in bajra x Napier grass at CC Rahuri. Definition and characteristics of clone, clonal crops comparison with inbred and pure line. Clonal selection and hybridization, seedling selection in pomegranate at Rahuri. Sugarcane and potato breeding. Breeding for tolerance to important biotic stresses. Breeding for tolerance to important abiotic stresses. National and International Crops Research Institutes, NRCs, All India Project Directorates and Centres of Excellence of Research in [Crop/Subject] e.g. Wheat, Plant Physiology etc.

Practical

Study of Plant Breeder's kit. Concept of floral biology/systems of selfing/inbreeding/ hybridization. Study of floral biology and hybridization technique in cotton. Study of floral biology and hybridization technique in brinjal, chillies and tomato. Study of floral biology and hybridization technique in sorghum and pegion pea. Study of floral biology and hybridization technique in cross pollinated crops viz., maize and onion. Study of floral biology and hybridization technique in wheat and safflower. Study of floral biology and hybridization technique in summer groundnut and gaur. Study of floral biology and hybridization technique in monoecious vegetables-khira and red pumpkin or sponge gourd. To work out the amount of cross pollination in often or cross pollinated crop and iodine test of pollen sterility under microscope. Demonstration of genetic variability and selection in readily available F_2 from cotton or sorghum or maize hybrid. Visit to hybrid seed production plot of maize and sorghum at flowering. Visit to germplasm of chick pea, sorghum, bamboo, forage cactus and multiplication plots of bajra x Napier grass. Visit to Gene Bank Project at Rahuri and DNA conservation facility at SLBTC. Study of the components of genetic variation, heritability and genetic advance and their estimation. Study of Descriptor of DUS characters of wheat or maize or chick pea.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Historical milestones	3
2	Concepts of Plant Breeding; nature and role of plant breeding, new variety as the cheapest input in Agriculture	3
3	Major achievements including dwarf varieties, hybrid varieties, green revolution	3
4	Modes of reproduction and apomixes, contrivances for self and cross pollination, estimation of cross pollination, list of self, cross and often cross pollinated crops	4
5	Systems of pollination control-Self- incompatibility and male sterility, classification and inheritance	4
6	Domestication, plant introduction, procedure, exploration, gene banks, world collections, active/working collections, acclimatization, achievements Symbolization,	4
7	Roll and organization of NBPGR. A Pl. introduction agencies in India, abroad, Basics of Biodiversity Act,	3
8	Law of homologous series, Centres of origin/diversity with proper name, geographical area and crops originated. Gene microcentres	4
9	Systems of mating and their genetic consequences, single, double, three way cross, MAGIC/ multiple crosses	3
10	Genetic basis and breeding methods in self-pollinated crops/often cross pollinated crops. Vilmorin isolation principle and Johannsen's Pure Line Theory, characteristics of pure line and causes of impurities	4
11	Mass and pure line selection, source population, definition, procedure, schemes/diagrams, merits, demerits/limitations, achievements	4
12	Hybridization techniques and handling of segregating population, pedigree, bulk, SSD methods, Suneson's method, definition, procedure, schemes/diagrams, merits, demerits/ limitations, achievements	4
13	Back cross methods- definition, procedure, schemes/ diagrams, merits, demerits/ limitations, achievements) transfer of male sterility, partial/limited back crosses	4

14	Multiline concept, characteristics, procedure and achievements, R.I.L.	4
15	Concept of open pollinated population, Hardy Weinberg Law and heritability; Genetic basis and methods of breeding cross-pollinated crops	4
16	Heterosis and inbreeding depression, theories, types, Luxuriance,	4
17	Development of inbred lines, ABR lines and hybrids	3
18	Exploitation of heterosis in sorghum, bajra, maize [double and three way cross hybrids], and cotton	4
19	Mass selection, Ear to row method, line breeding, history and classi-fication of recurrent selection schemes with definitions/ abbreviations	3
20	Additional ways of exploitation of heterosis-Composite and synthetic varieties, definition, procedure, schemes/diagrams, merits, demerits/ limitations, achievements including development in forage crops	4
21	Polyploidy in relation to plant breeding, induction, confirmation, optimum ploidy level, Triangle of U, polyploidy in chillies, achievements through polyploidy breeding, Success story in bajra x Napier grass at CC Rahuri	4
22	Definition and characteristics of clone, clonal crops comparison with inbred and pure line,	3
23	Clonal selection and hybridization, seedling selection in pomegranate at Rahuri	4
24	Sugarcane and potato breeding	4
25	Breeding for tolerance to important biotic stresses	4
26	Breeding for tolerance to important abiotic stresses	4
27	National and International Crops Research Institutes, NRCs, All India Project Directorates and Centres of Excellence of Research in [Crop/Subject] e.g. Wheat, Plant Physiology etc	4
	Total	**100**

b) Practical

[Assuming the course of 4th Sem i.e. in rabi season]

Practicals	Topic
1	Study of Plant Breeder's kit.
2	Concept of floral biology/systems of selfing/inbreeding/hybridization.
3	Study of floral biology and hybridization technique in cotton.
4	Study of floral biology and hybridization technique in brinjal, chillies and tomato.
5	Study of floral biology and hybridization technique in sorghum and pegion pea.
6	Study of floral biology and hybridization technique in cross pollinated crops viz., maize and onion.
7	Study of floral biology and hybridization technique in wheat and safflower.
8	Study of floral biology and hybridization technique in summer groundnut and gaur.
9	Study of floral biology and hybridization technique in monoecious vegetables-khira and red pumpkin or sponge gourd.
10	To work out the amount of cross pollination in often or cross pollinated crop and iodine test of pollen sterility under microscope.
11	Demonstration of genetic variability and selection in readily available F_2 from cotton or sorghum or maize hybrid.
12	Visit to hybrid seed production plot of maize and sorghum at flowering
13	Visit to germplasm of chick pea, sorghum, bamboo, forage cactus and multiplication plots of bajra x Napier grass
14	Visit to Gene Bank Project at Rahuri and DNA conservation facility at SLBTC.
15	Study of the components of genetic variation, heritability and genetic advance and their estimation.
16	Study of Descriptor of DUS characters of wheat or maize or chick pea.

Suggested Readings

1. **Introduction to Plant Breeding.** R. C. Choudhary Oxford & IBH. Publishing Company, New Delhi.
2. **Plant Breeding: Principles and Methods.** 1990. B. D. Singh. Kalyani Publication, New Delhi.
3. **Essentials of Plant Breeding.** 2009. Phundan Singh, Kalyani Publication, New Delhi
4. **Breeding Asian Field Crops.** 1969. Poehlman, M. and Borethakur, Oxford and IBH.
5. **DUS Descriptor of Wheat/Maize.** ICAR-IIWBR, Karnal, or ICAR-IIMR, IARI, N. Delhi

4.	**Course :**	BOT-244	**Credit:** 2 (1+1)*	**Semester-IV**
	Course title:	Introduction to Forestry		

Syllabus

Theory

Introduction – definitions of basic terms related to forestry, objectives of silviculture, forest classification, salient features of Indian Forest Policies. Forest regeneration, Natural regeneration - natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers; Artificial regeneration – objectives, choice between natural and artificial regeneration, essential preliminary considerations. Crown classification. Tending operations – weeding, cleaning, thinning – mechanical, ordinary, crown and advance thinning.

Forest mensuration – objectives, diameter measurement, instruments used in diameter measurement; Non instrumental methods of height measurement - shadow and single pole method; Instrumental methods of height measurement - geometric and trigonometric principles, instruments used in height measurement; tree stem form, form factor, form quotient, measurement of volume of felled and standing trees, age determination of trees.

Agroforestry – definitions, importance, criteria of selection of trees in agroforestry, different agroforestry systems prevalent in the country, shifting cultivation, taungya, alley cropping, wind breaks and shelter belts, home gardens. Cultivation practices of two important fast growing tree species of the region.

Practical

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

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1 & 2	Definitions of basic terms related to forestry, Definition of Silviculture, objectives of silviculture, forest classification- 16 Major types of forest with species composition.	5
3	Salient features of Indian Forest Policies	5
4	Natural regeneration - natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers with examples	10
5	Artificial regeneration – objectives, choice between natural and artificial regeneration, essential preliminary considerations for AR	10
6	Crown classification of trees	5
7	Tending operations – weeding, cleaning, thinning – mechanical, ordinary, crown and advance thinning	5
8	Forest mensuration – objectives, diameter measurement, instruments used in diameter measurement	5
9	Non instrumental methods of height measurement - shadow and single pole method; Instrumental methods of height measurement - geometric and trigonometric principles, instruments used in height measurement	10
10	Tree stem form, form factor, form quotient	5
11	Measurement of volume of felled and standing trees, age determination of trees.	5
12 & 13	Agroforestry – definitions, importance, Classification of Agroforestry systems, criteria of selection of trees in agroforestry	10
14	Different agroforestry systems prevalent in the country	5
15	Shifting cultivation, taungya, alley cropping, wind breaks and shelter belts, home gardens with regional examples	10
16 & 17	Cultivation practices of two important fast growing tree species of the region.	10
	Total	**100**

b) Practical

Experiment	Topic
1	Identification of tree-species of the Campus and its classification according to uses and preparation of herbarium
2	Measurements of diameter-girth and basal area of trees using Calipers, Tape, Ruler, Pentaprism Tree Caliper etc.
3	Measurement of height using non instrumental method and Instrumental methods like Hypsometer, Ravi Multimeter, Abney level
4	Volme estimation of logs and standing trees using Quarter girth formula
5	Study of Natural regeneration in forest area and mode of regeneration
6	Planning and layout of forest plantations, Choice of species, methods of planting and after care
7	Exercise on tree nursery practice- seed collection, seed pre-treatment, bed preparation and sowing
8	Field exercise on various tending operations in forest/plantations like thining, pruning, climber removal etc.
9	Study of Traditional agroforestry systems in the region and visits to some the local agroforestry systems and recording its components.
10	Study of Tree Architecture, structure and growth of trees, crown and root architecture
11	Identification of trees suitable for Windbreaks & Shelterbelts, Fodder etc.
12	Visit to forest plantation and study of its growth and general condition of plantation.

Suggested Readings

1. **Textbook of Silviculture.** 1993. Dwivedi.A.P. International Book Distributors.
2. **Principles and Practice of Silviculture.** 1989. Khanna,L.S., Khanna Bandhu, 7 Tilak Marg, Dehradun.
3. **Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry**. Volume 3. 2006. Kumar, B. and Nair, P.K.R. (eds) in the Book Series "Advances in Agroforestry". Springer Science, the Netherlands
4. **Forest Mensuration and Biometry** (5^{th} edition). 2011. Chaturvedi, A.N and L.S. Khanna. KhannaBandhu. Dehra Dun. 364 pp.
5. **Forest Mensuration** (4^{th} edition). 2002. Husch, B., Beers, T.W. and Kershaw, J. J.A. John Wiley & Sons, Nature.456 pp.
6. **An Introduction to Agroforestry**. 1993. Nair, P.K.R. Kluwer Academic Publishers, Dordrecht, The Netherlands.
7. **Agroforestry: Potentials and Opportunities**. 2003. Pathak P.S. and Ram Newaj (eds.). Agrobios, Jodhpur.
8. **Text Book of Agroforestry.** Chundawat B S and S K Gautam.Oxford and IBH Publishing New Delhi.
9. **Principles and Practices of Agroforestry**. Dwivedi A P .

5.	**Course :**	BOT -355	**Credit :** 3 (1+2)	**Semester-V**
	Course title:	Principles of Seed Technology		

Syllabus

Theory

Seed and seed technology : introduction, definition and importance. Seed quality : definition. Characters of good quality seed. Different classes of seed. Foundation and certified seed production of important cereals **(Jawar, Bajra,** Maize**).** Foundation and certified seed production of important pulses (Pea, Tur). Foundation and certified seed production of important oil seeds (Soybean, Groundnut). Foundation and certified seed production of important vegetable crops (Onion). 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. Seed drying, processing and their steps. Seed testing for quality assessment. Structure of seeds, type of seed and seed dormancy. 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.

Practical

Seed production in major cereals : Wheat. Seed production in : Sorghum. Seed production in : Maize. Seed production in major pulses : Green gram. Seed production in pulses : Gram and Field pea. Seed production in major oil Seeds : Soybean. Seed production in vegetable crops : Onion. Seed production in : Pumpkin. Seed sampling and testing procedure. Physical purity test. Seed moisture test. Germination test – types of germination. Seed viability test. Seed and seedling vigour test. Visit to seed testing laboratories. Study of seed extraction and processing in cereals, cotton (ginning, acid delinting and seed coating) and vegetables.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Seed and seed technology : introduction, definition and importance	7
2	Seed quality : definition. Characters of good quality seed	6
3	Different classes of seed.	6
4	Foundation and certified seed production of important cereals **(Jawar, Bajra,** Maize**)**	7
5	Foundation and certified seed production of important pulses (Pea, Tur,)	8
6	Foundation and certified seed production of important oil seeds (Soybean, Groundnut)	7
7	Foundation and certified seed production of important vegetable crops (Onion)	6
8	Seed certification, phases of certification, procedure for seed certification, field inspection	9
9	Seed Act and Seed Act enforcement.	7
10	Duty and powers of seed inspector, offences and penalties. Seeds control order 1983.	7
11	Seed drying, processing and their steps. Seed testing for quality assessment.	8
12	Structure of seeds, type of seed and seed dormancy	7
13	Seed treatment, its importance, method of application and seed packing.	7
14	Seed storage : general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage	8
	Total	**100**

b) Practical

Practicals	Topic
1	Seed production in major cereals : Wheat
2	Seed production in : Sorghum
3	Seed production in : Maize.
4	Seed production in major pulses : Green gram
5	Seed production in pulses : Gram and Field pea
6	Seed production in major oil Seeds : Soybean
7	Seed production in vegetable crops : Onion
8	Seed production in : Pumpkin
9	Seed sampling and testing procedure,
10	Physical purity test
11	Seed moisture test
12	Germination test – types of germination
13	Seed viability test
14	Seed and seedling vigour test
15	Visit to seed testing laboratories
16	Study of seed extraction and processing in cereals, cotton (ginning, acid delinting and seed coating) and vegetables.

Suggested Readings

1) **Hand book of Agriculture.** 2013. ICAR Publication.

2) **Principles of Seed Technology.** 2013. Phundan Singh**.** Kalyani Publication, New Delhi.

3) **Seed Technology.** 2017. R. L. Agrawal, Oxford and IBH Publishing Company, New Delhi.

Agriculture Polytechnic

3) Horticulture

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

Horticulture

Sr. No.	Semester	Course No	Credit	Course Title
1	I	HORT-111	2 (1 + 1)	Fundamentals of Horticulture
2	II	HORT-122	2 (1 + 1)	Production Technology of Fruits & Plantation Crops
3	IV	HORT-243	3 (2 + 1)	Production Technology of Vegetable and Flower Crops
4	V	HORT-354	2 (1 + 1)	Landscape and Gardening
5	V	HORT-355 (E)	6 (0 + 6)	Protected Cultivation of Flowers / Vegetables
6	V	HORT-356 (E)	6 (0 + 6)	Commercial Fruit Production Technology
7	V	HORT-357 (E)	6 (0 + 6)	Commercial Vegetable Production Technology
8	VI	HORT-368 (E)	6 (0 + 6)	Nursery Technology and Enterprise
9	VI	HORT-369 (E)	6 (0 + 6)	Fruits and Vegetables Processing Technology and Enterprise
Total Credit Load			**39 (5+34)**	

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

Syllabus

Theory

Definition of Horticulture and branches of Horticulture, Scope & importance of Horticultural crops. Area, production, productivity and export-import scenario of Horticultural crops. Classification of Horticultural crops. Soil and climatic requirements of Horticultural crops. Methods of propagation of Horticultural crops and propagating structures, Seed dormancy & germination. Principles of orchard establishment. Principles and methods of training and pruning in Horticultural crops. Bahar treatments of fruit crops. Juvenility and flower bud differentiation in Horticultural crops, unfruitfulness; pollination, pollinizers and pollinators, fertilization and parthenocarpy in Horticultural crops. Kitchen gardening. Garden types and parts; Lawn making and its maintenance. Importance of plant bio-regulators in Horticulture. Irrigation & Fertilizer application in horticultural crops.

Practical

Identification of garden tools and implements. Identification of important Horticultural crops. Layout & preparation of nursery beds for raising seedlings. Study of sexual and asexual methods of propagation including micro-propagation. Layout and planting systems of orchard. Study of different methods of training and pruning of fruit trees. Propagation media and containers. Potting mixture, potting, repotting, depotting and transplanting. Study of different methods of application of fertilizers in Horticultural crops. Study of different irrigation methods in Horticultural crops. Preparation and methods of application of bio-regulators. Preparation of Bordeaux mixture and Bordeaux paste and its application. Visit to micro propagation laboratory, commercial orchard and nursery unit.

Teaching Schedule

a) Theory

Lesson No.	Topic	Weightage of Marks
1	Definition of Horticulture and branches of Horticulture, Scope & importance of Horticultural crops	10
2	Area, production, productivity and export-import scenario of Horticultural crops	5
3	Classification of Horticultural crops	10
4	Soil and climatic requirements of Horticultural crops	10
5-6	Methods of propagation of Horticultural crops and propagating structures, Seed dormancy & germination	10
7	Principles of orchard establishment	05
8	Principles and methods of training and pruning in Horticultural crops	05
9	Bahar treatments of fruit crops	05
10-11	Juvenility and flower bud differentiation in Horticultural crops, unfruitfulness; pollination, pollinizers and pollinators, fertilization and parthenocarpy in Horticultural crops	10
12	Kitchen gardening	05
13	Garden types and parts; Lawn making and its maintenance	10
14	Importance of plant bio-regulators in Horticulture	05
15-16	Irrigation & Fertilizer application in horticultural crops	10
	Total	100

b) Practical

Practicals	Topic
1	Identification of garden tools and implements
2	Identification of important Horticultural crops
3	Layout & preparation of nursery beds for raising seedlings
4 – 7	Study of sexual and asexual methods of propagation including micro-propagation
8	Layout and planting systems of orchard
9	Study of different methods of training and pruning of fruit trees
10	Propagation media and containers
11	Potting mixture, potting, repotting, depotting and transplanting
12	Study of different methods of application of fertilizers in Horticultural crops
13	Study of different irrigation methods in Horticultural crops
14	Preparation and methods of application of bio-regulators
15	Preparation of Bordeaux mixture and Bordeaux paste and its application
16	Visit to micro propagation laboratory, commercial orchard and nursery unit

Suggested Readings

1) **Hand book of Horticulture.** 2014. ICAR Publication.

2) **Principles of Horticulture and Fruit Growing.** 2014. Kunte and Yawalkar

2.	**Course :**	HORT-122	**Credit:** 2 (1+1)	**Semester-II**
	Course title:	Production Technology of Fruits & Plantation Crops		

Syllabus

Theory

Importance and scope of fruit and plantation crop industry in Maharashtra. High density planting, Advantages, Techniques. Use of rootstocks. Production technologies: botanical name, family, origin, area, production, productivity, export, soil and climate, improved varieties, propagation and planting, after care, irrigation, weed management, nutritional management, use of PGR's, physiological disorders and their remedies, special horticultural practices, harvesting and yield of following fruit and plantation crops: Mango, Grape, Citrus, Banana, **G**uava, Papaya, Pomegranate, **S**apota, **Dragon Fruit**, Custard apple, Fig, Temperate fruits – Apple, **P**each, **P**ear, **K**iwi, **P**lum, Jackfruit, Strawberry, Pineapple, Ber and Jamun, Aonla, Tamaind. **Plantation Crops (Tabular Form) -** Coconut, Arecanut, **C**ashew, Tea, Coffee & Rubber.

Practical

Description and identification of fruit and plantation crops. Methods of breaking seed dormancy: Stratification and Scarification. Propagation of fruit and plantation crops. Preparation and application of Plant bio-regulators in fruit and plantation crops. Identification of important pests, diseases and physiological disorders in fruit and plantation crops. Training and pruning of major fruit and plantation crops. Fertilizer application and irrigation management in fruit and plantation crops. Rejuvenation of old and senile orchards & special horticultural practices in fruit crops. Mulching and methods of irrigation in fruit and plantation crops. Maturity indices, harvesting and marketing of fruits and plantation crops. Visit to commercial fruit and plantation orchards.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Importance and scope of fruit and plantation crop industry in Maharashtra	6
2	High density planting, Advantages, Techniques	6
3	Use of rootstocks	6
	Production technologies: botanical name, family, origin, area, production, productivity, export, soil and climate, improved varieties, propagation and planting, after care, irrigation, weed management, nutritional management, use of PGR's, physiological disorders and their remedies, special horticultural practices, harvesting and yield of following fruit and plantation crops:	0
4	Mango, Grape, Citrus	**16**
5	Banana, **G**uava	10
6	Papaya, Pomegranate, **S**apota	**12**
7	**Dragon Fruit**, Custard apple, Fig	10
8	Temperate fruits – Apple, **P**each, **P**ear, **K**iwi, **P**lum	**12**
9	Jackfruit, Strawberry, Pineapple, Ber and Jamun, Aonla, Tamaind	**12**
	Plantation Crops (Tabular Form) -	
10	Coconut , Arecanut, **C**ashew, Tea, Coffee & Rubber	10
	Total	**100**

b) Practical

Practicals	Topic
1-2	Description and identification of fruit and plantation crops
3	Methods of breaking seed dormancy: Stratification and Scarification
4-6	Propagation of fruit and plantation crops
7	Preparation and application of Plant bio-regulators in fruit and plantation crops
8-9	Identification of important pests, diseases and physiological disorders in fruit and plantation crops
10-11	Training and pruning of major fruit and plantation crops
12	Fertilizer application and irrigation management in fruit and plantation crops
13	Rejuvenation of old and senile orchards & special horticultural practices in fruit crops
14	Mulching and methods of irrigation in fruit and plantation crops
15	Maturity indices, harvesting and marketing of fruits and plantation crops
16	Visit to commercial fruit and plantation orchards

Suggested Readings

1) **Hand book of Horticulture.** 2014. ICAR Publication.
2) **Vegetable Crops.** 2002. T. K. Bose, M. G. Som and T. Kabir. Naya Udyog, Calcutta.

3.	**Course :**	HORT-243	**Credit:** 3 (2+1)	**Semester-IV**
	Course title:	Production Technology For Vegetable and Flower Crops		

Syllabus

Theory

Scope and importance of vegetable and flower crops and types of garden and classification of vegetables. **Production technologies**-Origin, area, production and productivity, soil and climate, improved varieties, sowing and transplanting techniques, planting distance, fertilizers and irrigation management, weed management, use of growth regulators, harvesting and yield, physiological disorders, disease and pest control and seed production of important vegetable crops: **Fruit vegetables**- Tomato, brinjal, chillies, and okra; **Cucurbitaceous vegetables**-Cucumber, watermelon, muskmelon, ridge gourd, bottle gourd, bitter gourd, ash gourd, snake gourd; **Cole crops**- Cabbage, cauliflower and knol-khol; **Bulb crops**- Onion and garlic; **Peas and beans**-French beans, cluster beans, dolichos beans, peas and cowpea; **Root vegetables-**Radish, carrot, beet root; **Tuber crops**-Potato, sweet potato, tapioca, colocasia, yams; **Leafy vegetables**-Amaranths, palak, fenugreek, coriander; **Perennial vegetables**- drumstick, coccinia and curry leaf; **Flower crops**- Rose, tuberose, chrysanthemum, aster, gaillardia, marigold and gladiolus.

Practical

Planning and layout of kitchen garden; identification of important vegetable and flower seeds and plants; raising of vegetable nurseries; transplanting of vegetable seedlings; intercultural operations in vegetable and flower crops; preparation of plant growth regulators in vegetable and flower crops; vegetables & flowers seed extraction; harvesting & preparation for market of vegetables and flowers; seed production in vegetable and flower crops; harvesting indices of different vegetable and flower crops; grading and packing of vegetables and flowers; shelf life of vegetables and cut flowers; visit to commercial vegetables and flower gardens; economics of vegetable and flower cultivation (one crop each).

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1 - 2	Importance of vegetables and flowers in national economy	05
3 - 4	Types of vegetable garden and classification of vegetable crops	10
	Production technologies- Origin, area, production and productivity, soil and climate, improved varieties, sowing and transplanting techniques, planting distance, fertilizers and irrigation management, weed management, special horticultural practices, use of growth regulators, harvesting and yield, physiological disorders, disease and pest control and seed production of important vegetable crops:	
5 - 8	**Major crops**: **Fruit vegetables** : Brinjal, Tomato, Chilli, Okra	10
8 - 11	**Cucurbitaceous vegetables**-Cucumber, Watermelon, Muskmelon, Ridge gourd, Bottle gourd, Bitter gourd, Ash gourd, Snake gourd	10
12 - 14	**Cole crops**- Cabbage, Cauliflower and Knol-khol	15
15 - 17	**Bulb crops**- Onion and Garlic	
17 - 19	**Peas and beans**-Peas, French beans, Cluster beans, Dolichos beans and Cowpea	10
20 - 21	**Root vegetables**-Radish, Carrot, Beet root	10
22 - 24	**Tuber crops**-Potato, Sweet potato, Tapioca, Colocasia, Yams	
25	**Leafy vegetables**- Amaranths, Palak, Fenugreek, Coriander	10
26	**Perennial vegetables**- Drumstick, Coccinia and Curry leaf	
27 - 29	**Flower crops**-I- Rose, Tuberose, Chrysanthemum	10
29 - 32	**Flower crops**-II- Aster, Gaillardia, Marigold and Gladiolus	10
	Total	**100**

b) Practical

Practicals	Topic
1	Identification of vegetables and their seeds.
2	Identification of flowers and their seeds.
3	Study of morphological characters of different vegetables and flowers.
4	Seed treatment, raising and transplanting of vegetable seedlings.
5	Seed treatment, raising and transplanting of flower seedlings.
6	Planning and layout of kitchen garden.
7	Methods of fertilizer application and irrigation for vegetable crops.
8	Methods of fertilizer application and irrigation for flower crops.
9	Special horticulture practices in vegetable and flower cultivation.
10	Physiological disorders in vegetable crops and their remedies.
11	Preparation and application of plant growth regulators in vegetable crops. Preparation and application of plant growth regulators in flower crops.
12 - 13	Maturity indices and harvesting of vegetable crops. Maturity indices and harvesting of flower crops.
14	Grading, packaging and export standards for vegetable crops. Grading, packaging and export standards for flower crops.
15	Economics of vegetable and flower garden cultivation (one crop each).
16	Visit to commercial vegetable garden and market.

Suggested Readings

1. **Vegetables**.1992. B. Choudhary
2. **Vegetable Crops** (Revised ed.) 2003. T. K. Bose, M. G. Som and T. Kabir.
3. **Textbook of Vegetables Tuber Crops & Spices.** 2014. S & Narendra Singh Thamburaj.
4. **Production Technology of Vegetable Crops.** 1989. S. P. Singh, ARCC Publication.
5. **Vegetables Production Technology.** 2016. Haldavnekar, P. C.; Parulekar, Y. R.; Mali, P. C. and Haldankar, P.M., Astral International Publication

4.	**Course :**	HORT-354	**Credit:** 2 (1+1)	**Semester-V**
	Course title:	Landscape and Gardening		

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, repotting and maintenance of house plants; 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. Visit to important gardens/ parks/ institutes.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Importance and scope of landscaping.	5
2 - 3	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 station, townships, river banks, hospitals, play grounds, airports, industries, institutions.	15
30	Bonsai: principles and management.	05
31	Lawn: establishment and maintenance.	05
32	CAD application	05
	Total	**100**

b) Practical

Practicals	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.** 1935. Gopalswamiengar
2) **Complete Home Gardening.** 2012. Dey, S. C.
3) **Floriculture and Landscaping.** 2002. Bose, T.K.
4) **Floriculture and Landscaping.** 2015. Deshraj
5) **Floriculture in India.** 2012. Randhawa and Mukhopadhyay
6) **Introduction to Landscaping, Designing, Construction and Maintenance.** 2002. Ronald J. Biondo and Charles B. Schroder
7) **Landscape Gardening & Design with Plants.** 2012. Supriya Kumar Bhattacharjee
8) **Landscaping Principles and Practices.** 2009. Jack E. Ingels

Agriculture Polytechnic

4) Agricultural Economics

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

Agricultural Economics

Sr.No.	Semester	Course No	Credit	Course Title
1	II	ECON-121	2 (2 + 0)	Fundamentals of Agricultural Economics
2	III	ECON-232	2 (1 + 1)	Farm Management, Production and Resource Economics
3	IV	ECON-243	2 (1 + 1)	Agricultural Marketing
Total Credit Load			**6 (4+2)**	

1.	**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 macro economics, positive and normative analysis. Nature of economic theory. Rationality assumption, concept of equilibrium. Economic laws as generalization of human behavior. Basic concepts: Goods and services, desire, want, demand, utility. Cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition. Characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country. *Demand:* meaning, law of demand, demand schedule and demand curve. Consumer surplus – Meaning, assumptions, explanation, difficulties in measuring consumer surplus, importance. Determinants, utility theory; law of diminishing marginal utility, equi- marginal utility principle. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Production: process, creation of utility. Factors of production, input output relationship. *Laws of returns*: Law of variable proportions and law of returns to scale. *Cost:* Cost concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, supply schedule. Supply curve, determinants of supply, elasticity of supply. Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit. *National income:* Meaning and importance, circular flow. Concepts of national income accounting and approaches to measurement, difficulties in measurement. 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. *Economic systems:* Concepts of economy and its functions. Socialistic and mixed economies, elements of economic planning. Public revenue and public expenditure.

Teaching Schedule

Theory

Lecture	Topics	Weightage (%)
1	*Economics:* Meaning, scope and subject matter, definitions, activities.	4
2	Approaches to economic analysis; micro and macro economics, positive and normative analysis.	4
3	Nature of economic theory.	3
4	Rationality assumption, concept of equilibrium.	3
5	Economic laws as generalization of human behavior.	3
6	Basic concepts: Goods and services, desire, want, demand, utility.	3
7	Cost and price, wealth, capital, income and welfare.	3
8	Agricultural economics: meaning, definition.	3
9	Characteristics of agriculture, importance and its role in economic development.	4
10	Agricultural planning and development in the country.	3
11	*Demand:* meaning, law of demand, demand schedule and demand curve	4
12	Consumer surplus – Meaning, assumptions, explanation, difficulties in measuring consumer surplus, importance.	3
13	Determinants, utility theory; law of diminishing marginal utility, equi- marginal utility principle	4
14	Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity	4
15	Production: process, creation of utility.	3
16	Factors of production, input output relationship	4
17	*Laws of returns*: Law of variable proportions and law of returns to scale	4
18	*Cost:* Cost concepts, short run and long run cost curves	3
19	Supply: Stock v/s supply, law of supply, supply schedule,	3
20	Supply curve, determinants of supply, elasticity of supply	3

21	Distribution theory: meaning, factor market and pricing of factors of production	3
22	Concepts of rent, wage, interest and profit	3
23	*National income:* Meaning and importance, circular flow	4
24	Concepts of national income accounting and approaches to measurement, difficulties in measurement	4
25	Socio-economic determinants, current policies and programmes on population control	3
26	Money: Barter system of exchange and its problems, evolution, meaning and functions of money	3
27	Classification of money, money supply, general price index,	3
28	*Economic systems:* Concepts of economy and its functions,	3
29	Socialistic and mixed economies, elements of economic planning	3
30	Public revenue and public expenditure.	3
	Total	**100**

Suggested Readings

1) **Agricultural Economics.** 2004. Subba Reddy, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

2) **Principles of Agricultural Economics.** 2011, 2014. Nagpure S.C., and Patil E.R., by, Agroment Publishers, 52 B, Indraprasta, Opp. Asha Mangal, Dharampeth, Nagpur-440010 (MS)India.

2.	**Course :**	ECON-232	**Credit:** 2(1+1)	**Semester-III**
	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
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	3
	property resources of land, water, pasture and forest resources, etc.	
	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.** 1964. Heady, Earl O, Prentice Hall of India, Private Limited, New Delhi.
2) **Introduction to Agricultural Economic Analysis.** 1958. Bishop, C.E., & Toussaint, W.D., New York, John Wiley and Sons, Inc., London.
3) **Fundamentals of Farm Business Management**. S.S. Johl, J.R. Kapur, Kalyani Publishers, New Delhi.
4) **Agricultural Economics**. 2006. Subba Reddy S., Raghuram P., NeelakantaSastry T.V., Bhavani Devi I., Oxford and IBH Publishing Company, Private Limited, New Delhi.
5) **Farm Management Economics**. 1954. Heady Earl O and Herald R. Jenson, Prentice Hall, New Delhi,
6) **Elements of Farm Management Economics**. I.J. Singh, Affiliated East-West press, Private Limited, New Delhi.
7) **Introduction to Farm Management**. 1983. Sankhayan, P.L., Tata – Mc Graw – Hill Publishing Company Limited, New Delhi.
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.** 1997. 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.
14) **Environmental Economics.** 2001. Sankar U, Oxford University Press.
15) **Environmental and Natural Resource Economics**. 6th Ed. 2003.Tietenberg T., Addison Wesley

3.	**Course :**	ECON-243	**Credit:** 2(1+1)	**Semester-IV**
	Course title:	Agricultural Marketing		

Syllabus

Theory

Market and Marketing – Meaning – Definitions – Components of market. Agricultural Marketing – Meaning – Definition – Scope – Subject matter. Importance of Agricultural Marketing in economic development. Classification of markets – On the basis of location, Area of coverage, time span, volume of transaction, nature of transaction. Classification of markets – number of commodities, degree of competition, nature of commodities, stage of marketing, extent of public intervention. Producers surplus – meaning and it's types, factors affecting marketing surplus. Marketing functionaries– types and importance, meaning and definitions. Marketing channels for different products. Marketing process and functions - concentration, dispersion and equalization. Marketing functions – Meaning -exchange functions – buying and selling, Physical functions – storage, transport and processing. Facilitative functions – packaging, branding, grading, quality control and labeling (Agmark). Market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits & demerits. Market integration and marketing efficiency – meaning, definition and types, marketing cost, margins and price spread. Role of Govt. in agricultural marketing- Remedial measures- Regulated markets-definition-important features of regulated markets, functions, progress and defects. Risk in marketing: Types of risk in marketing & its management.

Practical

Visit to a local market to study various marketing functions. Visit to a local market to study various marketing agencies. Identification of marketing channels for food grains, pulses, oilseeds, fruits, vegetables, flowers, milk and poultry. Study of malls / Supermarkets. Estimation of marketing cost and price spread for food grains, pulses, fruits and vegetables. Study of factors affecting marketing cost. Study of reasons for higher marketing cost of agricultural commodities and ways for reducing marketing cost of farm produce.

Teaching Schedule

a) Theory

Lecture	Topic/Lesson	Weightage %
1	Market and Marketing – Meaning – Definitions – Components of market.	6
2	Agricultural Marketing – Meaning – Definition – Scope – Subject matter.	8
3	Importance of Agricultural Marketing in economic development.	7
4	Classification of markets – On the basis of location, Area of coverage, time span, volume of transaction, nature of transaction.	8
5	Classification of markets – number of commodities, degree of competition, nature of commodities, stage of marketing, extent of public intervention.	9
6	Producers surplus – meaning and it's types, factors affecting Marketable surplus.	6
7	Market functionaries- Meaning, definition and types. Marketing channels – Meaning, definition, channels for different Agril. Commodities and its importance.	6
8	Marketing process and functions - concentration, dispersion and equalization.	6
9	Marketing functions – Meaning -exchange functions – buying and selling.	7
10	Physical functions – storage, transport and processing.	6
11	Facilitative functions – packaging, branding, grading, quality control and labeling (Agmark).	6
12	Market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits & demerits.	6
13	Market integration and marketing efficiency – meaning, definition and types, marketing cost, margins and price spread.	6
14	Role of Govt. in agricultural marketing- Remedial measures- Regulated markets-definition-important features of regulated markets, functions, progress and defects.	6
15	Risk in marketing - Types of risk in marketing & its management.	7
	Total	**100**

b) Practical

Practicals	Topic
1	Visit to a local market to study various marketing functions
2	Visit to a local market to study various marketing agencies
3	Identification of marketing channels for fruits
4	Identification of marketing channels for fresh vegetables
5	Identification of marketing channels for Onion & Potato
6	Identification of marketing channels for Flowers
7	Identification of marketing channels for foodgrains, pulses & oilseeds
8	Analysis on contract farming.
9	Supply chain management of different agricultural commodities, milk and poultry products
10	Study of malls / Supermarkets
11	Estimation of marketing cost and price spread for food grains.
12	Estimation of marketing cost and price spread for pulses.
13	Estimation of marketing cost and price spread for fruits and vegetables.
14	Study of factors affecting cost of marketing.
15	Study of reasons for higher marketing cost of agricultural commodities and ways for reducing marketing cost of farm produce.

Suggested Readings

1) **Agricultural Marketing in India**. 2006. Acharya S.S and Agarwal NL, Oxford & IBH Publishing Co.Pvt. Ltd. New Delhi

2) **Agricultural Economics.** 2010. Subba Reddy, S., P. Raghu Ram., P. Sastry, T.V.N. and Bhavani Devi, I. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Agriculture Polytechnic

5) Agricultural Extension Education

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

Agricultural Extension Education

Sr.No.	Semester	Course No	Credit	Course Title
1	II	EXTN-121	2 (2+0)	Rural Sociology and Educational Psychology
2	III	EXTN-232	3 (2+1)	Fundamentals of Agricultural Extension Education
3	IV	EXTN-243	2 (1+1)	Communication Skill and Personality Development
4	VI	EXTN-364	2 (1+1)	Entrepreneurship Development
Total Credit Load			**9 (6+3)**	

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1.	**Course :**	EXTN -121	**Credit:** 2(2 +0)	**Semester - II**
	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 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. 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

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
4, 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, 18	Social Institutions :Meaning, definition, major institutions in rural society : Marriage, family, and religion, functions and their role in agricultural extension.	5
19, 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, 27	Personality : Meaning, definition, types, factors influencing personality.	7
28, 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.	15
31	Perception: Meaning, definition, role of perception in agricultural extension	7
32	Motivation : Meaning, definition, role of motivation in agricultural extension	6
	Total	**100**

Suggested Readings

1) **Extension Communication and Management.** 2003. Ray, G. L., Kalyani Publishers. Fifth revised and enlarged edition.

2) **Education and Communication for Development.** 2003. Dahama, O.P. and Bhatnagar, O.P., Oxford and IBH Publishing Co. Pvt. Ltd.

3) **Textbook on Agricultural Communication: Process and Methods.** 1993. Sandhu, A.S., Oxford and IBH Publishing Co. Pvt. Ltd.

4) **Introductory Rural Sociology.** 2008. Chitambar, J.B., New Age International (P) Limited.

5) **An Introduction to Sociology.** Sachdeva, D. R. and Bhushan, V (2007). Kitab Mahal Agency.

6) **Introductory Rural Sociology.** 1973.Chitambar, J.B., John Wilex and Sons., New York

7) **Rural Sociology in India.** 5th Rev. ed. 1978. Desai, A.R., Popular Prakashan, Bombay.

8) **Rural Sociology.** 2007. Doshi, S.L. Rawat Publishers, Delhi.

9) **Rural Sociology.** 2002. Jayapalan, N., Altanic Publishers, New Delhi.

10) **Rural society in India.** 1997. Sharma, K.L., Rawat Publishers, Delhi.

2.	**Course :**	EXTN-232	**Credit:** 3 (2 +1)	**Semester - III**
	Course title:	Fundamentals of Agricultural Extension Education		

Syllabus

Theory

Education: Meaning, definition and types – Formal, informal and non formal education. **Extension Education-** Meaning, definition, need, scope and process; **Extension Programme Planning-** Meaning, process, principles and steps in programme development. **Extension systems in India:** Extension efforts in pre-independence era : Sriniketan, Marthandam, Firka Development Scheme, Post-independence era : Etawah Pilot Project, 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 District Programme (IADP). High Yielding Varieties Programme (HYVP). Operational Research Project (ORP). National Agricultural Technology Project (NATP). National Agricultural Innovation Project (NAIP). Rashtriya KrishiVikasYojana (RKVY). **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). Integrated Watershed Development Programme (IWDP). Providing Urban Amenities in Rural Area (PURA). Rashtriya MahilaKosh – (National Credit Fund for Women). Mahila Arthik Vikas Mahamandal (MAVIM). **Community Development. :** Meaning, definition, concept, principles and philosophy. **Democratic Decentralization (Panchayati Raj) :** Meaning, Constitution and functions. **Transfer of technology programmes :** Lab to Land programme. (LLP), Front Line Demonstration (FLD), Krishi Vigyan Kendras (KVK). **Capacity building of extension personnel and farmers** : Meaning, Training and Education, Types of training, Training institutes in Maharashtra, 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 need, process, electronic media, Agrovan. **Diffusion and adoption of innovation:** Concept and meaning, Attributes of innovation, Innovation decision process, adopter categories.

Practical

Study of state is Agriculture university extension system. Organizing group discussion- on given topic. Handling and use of digital camera & LCD projector. Handling and use of Public Address System. Preparation of extension literature – leaflet, folder, pamphlet. Preparation of effective power point presentations. Writing of news story / success story for news paper. To study grampanchayat of the village & its working. Visit to village to understand PRA techniques and their application in village development planning. To study the community radio / television studio & understanding the process of programme production. Video Recording & anchoring for Agriculture News in electronic media on given topic. Preparation of script for radio / television on given topic.

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;	8
5, 6	**Extension Programme Planning-** Meaning, process, principles and steps in programme development	5
7, 8	**Extension systems in India:** Extension efforts in pre-independence era : Sriniketan, Marthandam, Firka Development Scheme, Post-independence era : Etawah Pilot Project, 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) High Yielding Varieties Programme (HYVP) Operational Research Project (ORP) National Agricultural Technology Project (NATP) National Agricultural Innovation Project (NAIP) Rashtriya KrishiVikasYojana (RKVY).	15
11, 12, 13	**Various rural development programmes launched by Government of India** : Introduction, Objectives and salient features Swarnajayanti Gram SwarojgarYojana (SGSY) Indira Awas Yojana (IAY) Mahatma Gandhi National Rural Employment Guarantee Act Prime Ministers' Rozgar Yojana (PMRY) Integrated Watershed Development Programme (IWDP) Providing Urban Amenities in Rural Area (PURA) Rashtriya Mahila Kosh – (National Credit Fund for Women) Mahila Arthik Vikas Mahamandal (MAVIM)	15
14	**Community Development. :** Meaning, definition, concept, principles and philosophy	3
15	**Democratic Decentralization (Panchayati Raj) :** Meaning, Constitution and functions	2
16,17	**Transfer of technology programmes:** Lab to Land programme (LLP), Front Line Demonstration (FLD), Krishi Vigyan Kendras (KVK)	5
18,19	**Capacity building of extension personnel and farmers** : Meaning, Training and Education, Types of training, Training institutes in Maharashtra, Concept of Human Resource Development	5
20,21,22	**Extension Teaching Methods and Audio-Visual Aids** : Meaning, definition, importance, classification, media mix strategies; Factors affecting selection and use of methods and aids	10
23,24	**Communication: Meaning and definition;** elements, selected models and barriers to communication	10
25	**Agriculture journalism** : Meaning, definitions, news writing need, process, electronic media, Agrovan	10
26,27	**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 state is Agriculture university extension system.
2	Organizing group discussion- on given topic.
3 & 4	Handling and use of digital camera & LCD projector.
5	Handling and use of Public Address System.
6	Preparation of extension literature – leaflet, folder, pamphlet.
7	Preparation of effective power point presentations.
8 & 9	Writing of news story / success story for news paper.
10	To study grampanchayat of the village & its working.
11	Visit to village to understand PRA techniques and their application in village development planning.
12 & 13	To study the community radio / television studio & understanding the process of programme production.
14 & 15	Video Recording & anchoring for Agriculture News in electronic media on given topic.
16 & 17	Preparation of script for radio / television on given topic.

Suggested Readings

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

3.	**Course:**	EXTN-243	**Credit :** 2 (1 +1)	**Semester - IV**
	Course Title:	Communication Skill and Personality Development		

Syllabus

Theory

Definition and Basics of Personality. Analyzing Strength and Weakness. **Personality Development :** Concept and Process. **Body Language** – Meaning, Definition, Use of body language - Gesture, Posture, Eye contact, facial expression. Preparation of Self -Introduction. **Communication Skills:** Listening, writing, speaking skills. **Communication Barriers;** Overcoming these barriers. Building Self-Esteem and Self- Confidence. **Attitudes:** Meaning, Types - Assertive, Aggressive and Submissive; Positive, Negative, Neutral Introduction to Leadership; Leadership Styles; Group Dynamics. **Team Building :** Meaning, Steps. Interpersonal **Communication and Relationship;** Use of verbal and non verbal communication. Conflict Management: Introduction, Levels of Conflict and Managing Conflict. **Time Management:** Concept, Importance and Need, Steps towards better Time Management. **Public Speaking:** Introduction, Increasing Vocabulary, Voice Modulation, Social Graces. Email and Telephone Etiquettes

Practical

One-on-One Sessions for Individual Personality Traits. Role Play and Impromptu Conversation/Public Speaking Practice focusing on Body Language; Vocabulary Practices: Developing a repertoire of words in various fields like Agriculture, Politics, Economics, Family, Personal Grooming etc. Role Play for Self Introduction in the class; Listening to recorded Shot. Questionnaires for Building Self-Esteem and Self Confidence; Case Studies based on Development of Attitudes; Case Studies on Leadership Development; Case Studies on Leadership Development; Group Games, Ice breakers, Warm-ups and Energizers Team Building Activities. Practice of Non-Verbal Communication Skills: Dumb Charades and Dubsmash Practice; Exercise on Mutually Acceptable Proximity; and Eye Contact; Time Management Games to Practice and Experience the Importance of Planning /Delegating Work among them to properly manage time and complete the task in the shortest time possible; Public Speaking Games: (Introducing a friend with his/her life style; Describing a funny image provided by the teacher; Continuing a Story starting with one student and others try to continue with it and try to complete it Take any object available and try to make a commercial for it; Practice of Emails.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Definition and Basics of Personality	5
2	Analyzing Strength and Weakness	5
3	Personality Development : Concept and Process	5
4	Body Language – Meaning, Definition, Use of body language - Gesture, Posture, Eye contact, facial expression	10
5	Preparation of Self -Introduction	5
6	Communication Skills: Listening, writing, speaking skills	10
7	Communication Barriers; Overcoming these barriers	5
8	Building Self-Esteem and Self- Confidence	5
9	Attitudes: Meaning, Types - Assertive, Aggressive and Submissive; Positive, Negative, Neutral	10
10	Introduction to Leadership; Leadership Styles; Group Dynamics Team Building : Meaning, Steps	5
11	Interpersonal Communication and Relationship; Use of verbal and non verbal communication	5
12	Conflict Management: Introduction, Levels of Conflict and Managing Conflict	10
13	Time Management: Concept, Importance and Need, Steps towards better Time Management	5
14	Public Speaking: Introduction, Increasing Vocabulary, Voice	5
15	Modulation, Social Graces	5
16	Email and Telephone Etiquettes	5
	Total	**100**

b) Practicals

Practicals	Topic
1	One-on-One Sessions for Individual Personality Traits
2	Role Play and Impromptu Conversation/Public Speaking Practice focusing on
3	Body Language
4	Vocabulary Practices: Developing a repertoire of words in various fields like Agriculture, Politics, Economics, Family, Personal Grooming etc
5	Role Play for Self Introduction in the class
6	Listening to recorded Shot
7	Questionnaires for Building Self-Esteem and Self Confidence
8	Case Studies based on Development of Attitudes
9	Case Studies on Leadership Development
10	Group Games, Ice breakers, Warm-ups and Energizers Team Building Activities
11	Practice of Non-Verbal Communication Skills: Dumb Charades and Dubsmash Practice
12	Exercise on Mutually Acceptable Proximity; and Eye Contact
13	Time Management Games to Practice and Experience the Importance of Planning / Delegating Work among them to properly manage time and complete the task in the shortest time possible

14	Public Speaking Games: (Introducing a friend with his/her life style; Describing a funny image provided by the teacher; Continuing a Story starting with one student and others try to continue with it and try to complete it Take any object available and try to make a commercial for it
15	Practice of Emails
16	Presentations by the students

Suggested Readings

1) **Textbook of Phonetics for Indian Students.** 1989. Balasubramanian T. A. Orient Longman, New Delhi.
2) **Business Communication.** 1985. Balasubrmanyam, M., Vani Educational Books, New Delhi.
3) **Telephoning in English.** 1997. Naterop, Jean, B. and Rod Revell. Cambridge University Press, Cambridge.
4) **Developing Communication Skills.**1990. Mohan Krishna and Meera Banerjee. Macmillan India Ltd. New Delhi.
5) **Current English for Colleges.** 1995. Krishnaswamy,. N and Sriraman, T. Macmillan India Ltd., Madras.
6) **Strengthen your writing.** 1979. Narayanaswamy V R., Orient Longman, New Delhi.
7) **Business Correspondence.**1978. Sharma R C and Krishna Mohan. Tata McGraw Hill publishing Company, New Delhi.
8) **How to Win Friends and Influence People in the Digital Age.** 2012 .Carnegie, Dale. Simon & Schuster.
9) **The Seven Habits of Highly Successful People.** 1989. Covey Stephen R., Free Press.
10) **Human Communication: Motivation,Knowledge& Skills.** 2006. Spitzberg B, Barge K & Morreale, Sherwyn P Wadsworth.
11) **The Art of Communication.** 2013. Verma, K C. Kalpaz.
12) **Effective Communication and Soft Skills.** 2011. Mamatha Bhatnagar and Nitin Bhatnagar. Person Education.
13) **Technical Communication Principles and Practice.** Meenakshi Raman, Sangeeta Sharma.
14) **Personality Development**. Harold Wallace and Ann Masters. Cengage Publishers.
15) **Communication Skills for Technology.** Andrea J. Rutherford. Basic Pearson Education.
16) **English for College.** 1986. Carroll, B.J., Macmillan India Ltd., New Delhi
17) "**The Internet complete reference**". Hahn, TMH
18) **Guide to patterns and usage in English**. 1975. Hornby, A.S., Oxford University, New Delhi.
19) **A University Grammar**. 2002. Qurik, R and Green Baum, S.

4.	**Course:**	EXTN-364	**Credit :** 2 (1 +1)	**Semester - VI**
	Course Title:	Entrepreneurship Development		

Syllabus

Theory

Entrepreneurship : Meaning, Definition, Potential & Importance in Agriculture sector. Characteristics of ideal entrepreneurs and Entrepreneurial Competencies, Entrepreneurship Development Cycle. Main Functions of Entrepreneurs: a) Entrepreneurial Functions: risk bearing, organizing, and innovation; b) Managerial Functions: Planning, Organizing, Staffing, Directing, Controlling,, Budgeting, Reporting; c) Promotional Functions: Identification and Selection of Business Idea, Preparation of Business Plan or Project Report, Preparation of Finance Requirements; d) Commercial Functions: Production / Manufacturing- site selection, site design and layout, types of products to be produced, research and development, and design of the product; Marketing-market or consumer research, product planning and development, standardization, packaging, pricing, storage, promotional activities, distribution channel, etc.; Accounting-Recording the Transactions, Classifying the Transactions, Summarising the Transactions, Preparing the Final Accounts, Analysing and Interpreting the Results. Identification of entrepreneurial opportunities in Agriculture Sector. Crop Cultivation related entrepreneurial opportunities in Agriculture Sector. Input Marketing related entrepreneurial opportunities in Agriculture Sector. Product Marketing related entrepreneurial opportunities in Agriculture Sector. Processing & Value-addition related entrepreneurial opportunities in Agriculture Sector. Laws & Ethics in Entrepreneurship. Technical & Financial Feasibility Analysis of Agri-enterprises. Development of Agri-Business Model. Development of Agri-Business Plan. Project Preparation for small agricultural enterprise

Practical

Study on Market Potential Analysis of an Agri-enterprises. Study on Technical & Financial Feasibility Analysis of an Agri-enterprises. Exposure to Handling of Business Books & Record Keeping. Case Study on Agri-Business Model Development. Case Study on Agri-Business Plan Development. Practical exposure with successful agro-enterprise. Practical exposure with successful poultry enterprise. Practical exposure with successful dairy enterprise. Practical exposure with Agro-service provider entrepreneur e.g. Pest Control Service Provider/ Kitchen Garden Service Provider/Agro-export consultant. Study on site selection, site design and layout of an agro-enterprise. Study on Market Chain Analysis of an agro-product. Study of Accounting Functions & Record keeping. Project Preparation & Presentation on a selected idea related to Agri-enterprises.

Teaching Schedule

b) Theory

Lecture	Topic	Weightage (%)
1	Entrepreneurship: Meaning, Definition , Potential & Importance in Agriculture sector	10
2-3	Characteristics of ideal entrepreneurs and Entrepreneurial Competencies, Entrepreneurship Development Cycle	10
4-5	Main Functions of Entrepreneurs: a) Entrepreneurial Functions: risk bearing, organizing, and innovation; b) Managerial Functions: Planning, Organizing, Staffing, Directing, Controlling, Budgeting, Reporting; c) Promotional Functions: Identification and Selection of Business Idea, Preparation of Business Plan or Project Report, Preparation of Finance Requirements; d) Commercial Functions: Production / Manufacturing- site selection, site design and layout, types of products to be produced, research and development, and design of the product; Marketing-market or consumer research, product planning and development, standardization, packaging, pricing, storage, promotional activities, distribution channel, etc.; Accounting- Recording the Transactions, Classifying the Transactions, Summarising the Transactions, Preparing the Final Accounts, Analysing and Interpreting the Results.	15
4	Identification of entrepreneurial opportunities in Agriculture Sector	5
5	Crop Cultivation related entrepreneurial opportunities in Agriculture Sector	5
6	Input Marketing related entrepreneurial opportunities in Agriculture Sector	5
7	Product Marketing related entrepreneurial opportunities in Agriculture Sector	5
8	Processing & Value-addition related entrepreneurial opportunities in Agriculture Sector	5
9	Laws & Ethics in Entrepreneurship	10
10-11	Technical & Financial Feasibility Analysis of Agri-enterprises	10
12-13	Development of Agri-Business Model	10
14-15	Development of Agri-Business Plan	10
16-17	Project Preparation for small agricultural enterprise	10
18	SWOT analysis of agro-based enterprise	5
19	Entrepreneurship development process	5
	Total	**100**

c) Practical

Practicals	Topic
1	Study on Market Potential Analysis of an Agri-enterprises
2	Study on Technical & Financial Feasibility Analysis of an Agri-enterprises
3	Exposure to Handling of Business Books & Record Keeping
4	Case Study on Agri-Business Model Development
5	Case Study on Agri-Business Plan Development
6	Practical exposure with successful agro-enterprise
7	Practical exposure with successful poultry enterprise
8	Practical exposure with successful dairy enterprise
9	Practical exposure with Agro-service provider entrepreneur e.g. Pest Control Service Provider/Kitchen Garden Service Provider/Agro-export consultant
10	Study on site selection, site design and layout of an agro-enterprise
11	Study on Market Chain Analysis of an agro-product
12	Study of Accounting Functions & Record keeping
13-16	Project Preparation & Presentation on a selected idea related to Agri-enterprises

Suggested Readings

1) **Dimension of Extension Education**. 2006. Lakhan Singh Roy Barman, Aman Publishing House, Meerut.
2) **Entrepreneurship Development and Communication Skills**. 2012. Dr. R. R. Chole, Dr. P. R. Deshmukh, Dr. P. S. Kapse. Scientific Publishers (India), Jodhpur.
3) **Textbook of Entrepreneurship and Rural Development**. 2012. Sagar Mondal and G. L. Ray. Kalyani Publishers, New Delhi.

Agriculture Polytechnic

6) Agricultural Engineering

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

Agriculture Engineering

Sr.No.	Semester	Course No	Credit	Course Title
1	IV	ENGG-241	2 (1 + 1)	Soil and water Conservation Engineering
2	IV	ENGG-242	2 (1 + 1)	Pressurized Irrigation Technology
3	V	ENGG-353	3 (2 + 1)	Farm Power, Machinery and Renewable Energy
4	VI	ENGG-364	2 (1+1)	Agro-Processing and Value Addition
5	VI	ENGG-365 (E)	6 (0+6)	Agriculture Processing and Value Addition Production Technology and Enterprise (Location specific commodities)
Total Credit Load			**15 (5+10)**	

1.	**Course :**	ENGG-241	**Credit:** 2 (1+1)	**Semester-IV**
	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	Topics	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
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

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

2.	**Course :**	ENGG-242	**Credit:** 2 (1+1)	**Semester-IV**
	Course title:	Pressurized Irrigation Technology		

Syllabus

Theory

Micro-irrigation Systems : Definition, characteristics. Advantages and limitations. Types of micro-irrigation systems. Different components of the systems. Selection of emitter. Wetting pattern of emitters. Fertigation scheduling : Advantages and procedure. Irrigation scheduling : water requirement and time of operation. Filtration, causes of clogging. Types and selection of filters. Design aspects and layout of the system. Pump selection. Maintenance of drip irrigation system : Cleaning of filters, flushing of pipes, acidification and chlorination. Evaluation. Automation in drip irrigation.

Sprinkler irrigation system : Adoptability and prospects. Types of sprinkler irrigation systems, components, selection nozzle. Design aspects and layout of sprinkler irrigation system. Evaluation and maintenance.

Practical

Study of different micro irrigation systems, different components of the system, wetting pattern of soil under emitter, water requirement of crop under drip irrigation, application of drip irrigation, design of drip irrigation-data collection, design of drip irrigation for orchard, drip irrigation layout, cleaning of filters and flushing of main, submains and laterals, acidification and chlorination of drip irrigation system, emission uniformity of drip irrigation system, scheduling of fertigation, different components of sprinkler irrigation system, data collection for designing sprinkler irrigation, layout of sprinkler irrigation system, uniformity coefficient of sprinkler irrigation.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Present and future need of micro irrigation systems. Role of Government for promotion of micro irrigation in India.	6
2	Advantage and limitations of micro irrigation system.	7
3	Types of different micro irrigation systems.	8
4	Details of different components of micro irrigation systems.	5
5	Selection of emitter of drip irrigation system. Wetting pattern of soil under emitter.	6
6 & 7	Scheduling of soluble fertilizers for crops through drip irrigation system.	7
8	Estimation of water requirement of crop and operation time under drip irrigation.	7
9	Design considerations and layout of drip irrigation systems.	8
10	Selection of pump for drip irrigation system. Automation.	6
11	Maintenance of drip irrigation system. Flushing of different pipes and cleaning of filters.	8
12	Acidification and chlorination for cleaning the drip irrigation system.	6
13	Different types of sprinkler irrigation systems with different components.	7
14	Selection of proper size of sprinkler nozzle.	5
15	Design considerations and layout of sprinkler irrigation system.	7
16	Evaluation and maintenance of sprinkler irrigation system.	7
	Total	**100**

b) Practical

Practicals	Topic
1	Study of different micro irrigation systems.
2	Different components of the system.
3	Study of different types of filters.
4	Wetting pattern of soil under emitter.
5	Scheduling of Fertigation to the crop.
6	Estimation of water requirement of crop under drip irrigation.
7	Application of drip irrigation to the crop.
8	Design of drip irrigation by collecting required data.
9	Preparation of drip irrigation layout in the field.
10	Cleaning of filters and flushing of main, submains and laterals.
11	Acidification of chlorination of drip irrigation system.
12	Determination of emission uniformity of drip irrigation system.
13	Study of different components of sprinkler irrigation system.
14	Preparation of layout of sprinkler irrigation system.
15	Determination of uniformity coefficient of sprinkler irrigation.
16	Design of sprinkler irrigation by collecting required data.

Suggested Readings

1) **Irrigation : Theory and Practice.** 2012. Michael, A. M., Vikas Publishing House, New Delhi.
2) **Principles of Sprinkler Irrigation Systems.** 2007. Mane, M. S., Ayare, B. L, Jain Brothers, New Delhi.
3) **Principles of Drip Irrigation Systems.** 2007. Mane, M. S., Ayare, B. L. and Magar, S. S., Jain Brothers, New Delhi.
4) **Design and Evaluation of Irrigation Methods.** Michael, A. M., Shri Mohan and Swaminathan, K. R., (IARI Monograph No. 1), Water Technology Center, New Delhi.

3.	**Course :**	ENGG-353	**Credit:** 3 (2+1)	**Semester-V**
	Course title:	Farm Power, Machinery and Renewable Energy		

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. Sources of renewable energy and scope of renewable energy in agriculture. Principles and construction of bio-gas plant, gasifier : principles and application, introduction to wind and solar energy. Application of wind and solar energy.

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. Principles and construction of bio-gas plant. Gasifiers : Principles and application. Application of wind and solar energy.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Sources of farm power in Human, Animal, Mechanical, electrical, solar, Wind Power, Scope of Mechanization.	5
2-5	Principle of operation of I.C. engine- I.C. engine working principles Two and Four stroke engine, Engine terminology and examples	10
6-8	I.C. Engine systems -Fuel supply system, cooling system, Air cleaner, lubrication of tractor.	10
9-11	Tractor -Tractor types and their selection, fixed and operating cost of tractor power and attached implements with examples	10
12-13	Tillage - Tillage, objectives of tillage, classification & types of tillage, Tillage implements	6
14-15	Primary tillage implements - M. B. plough and Disc plough, Rotavator, with examples	5
16	Secondary tillage implements - Harrows, cultivators & examples	5
17-18	Implements for inter-culturing operations - Hand tools, Improved hoes, Wheel hoe, Multipurpose hoe, Tractor drawn intercultural equipments	10
19-21	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	6
22-23	Study of planter -Planter, Functions, seed metering devices, type of planters, solved examples	5
24-25	Plant protection equipments - Classification, types of spraying and types of dusting machines.	6
26-27	Harvesting and threshing equipments -Definition of harvesting and threshing, harvesting /threshing methods implements, mower and combine harvester-thresher, solved examples	6
28	Sources of renewable energy and scope of renewable energy in agriculture.	2
29	Principles and construction of bio-gas plant,	4
30	Gasifier : principles and application	4
31-32	Introduction to wind and solar energy. Application of wind and solar energy.	6
	Total	**100**

b) Practical

Practicals	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 and C. I. engines
5	Study of Air Cleaning and Cooling systems of an engine
6	Study of Lubrication system
7	Study of clutch, Gear box and differential unit of the tractor
8	Study of primary tillage implements: mould board plough and disc plough
9	Study of secondary tillage implements- harrows, cultivators and inter-culturing tools and implements.

10	Study of seed-cum-fertilizer drill and calibration of seed drill.
11	Study of sprayers and dusters
12	Study of harvesting and threshing machinery
13	Study of power tiller- important parts and attachments
14	Principles and construction of bio-gas plant
15	Gasifiers : Principles and application.
16	Application of wind and solar energy

Suggested Readings

5) **Principles of Agricultural Engineering** Vol. 1. Reprint Edition: 2012. T. P. Ojha, A. M. Michael, Jain Brothers, New Delhi
6) **Elements of Agricultural Engineering.** Forth Edition, 2010. Jagadishwar Sahay, Standard Distributor and Publishers, New Delhi
7) **Agricultural Engineering.** 2011. O P Singhal. Aman Publishing House, Meerut
8) **Elements of Farm Machineries**. A C Srivastava, Oxford and IBH Publishing Co Pvt Ltd, New Delhi
9) **Farm Tractor -Repair and Maintenance**. S.C. Jain and C.R. Rai.
10) **Principles of Farm Machineries**. 2000. R A Kepner, R Bainer, E C Barger, CBS Publishers and Distributors, Delhi
11) **Farm Engines and Tractors**. 2001. H E Gulvin, McGraw Hill, New York
12) **Servicing and Maintenance of Farm Tractors**. 2005. E J Johnson and A H Hollenburg, McGraw Hill, New York
13) **Tractor Implement System**. 1986. Alcock and Ralph, Athe AVI Publishing Co. Inc Springer, New York.
14) **Non-conventional Energy Sources.** 5th Edition. G. D Rai. Khanna Pubhishers, Delhi
15) **Renewable Energy Theory and Practice.** N.S. Rathore, N.L. Panwar, A.K. Kurchania. Himanshu Publications, Udaipur.
16) **Solar Energy: Principles of Thermal Collection and Storage.** 3rd Edition. S.P. Sukhatme & J.K. Nayak, McGraw Hill Education, Delhi.
17) **Biotechnology and Other Alternative Technologies for Utilization of Biomass and Agricultural Wastes.** Amlendu Chakravarti.
18) **Biogas Technology; A practical Handbook**. 1986. K. C. Khandalwal and S.S Mahdi.

4.	**Course :**	ENGG-364	**Credit:** 2 (1+1)	**Semester-VI**
	Course title:	Agro-processing and Value Addition		

Theory

Processing of cereals, pulses and oil seeds. Cleaning, grading of cereals, pulses and oil seeds, types of cleaners and graders. Drying of food grains, types of dryers. Storage of grains, types of storage structures. Milling. Processing of fruits and vegetables. Equipments for processing of oil seeds. Farm structures : Steel, bamboo, polyhouse, greenhouse, shednets. Study of maturity indices and properties of fruits and vegetables. Handling and processing of fruits and vegetables. Value added product preparation from fruits and vegetables. Machineries and tools required for processing of fruits and vegetables. Agricultural waste recycling and by-product utilization.

Practicals

Cleaning and grading of grains. Drying of grains/fruits/vegetables.Types of graders. Study of oil extraction. Study of dal milling. Study of onion grading. Study of grain storage structure. Study of polyhouse, shednet and green houses. Study of low cost cold storage structures. Study of physical properties of fruits and vegetables. Study of chemical properties of fruits and vegetables. Study of handling and processing tools and machineries required for processing of fruits and vegetables. Preparation of jam, jelly, juice, powder, pickle, sauce from fruits and vegetables. Preparation of agricultural waste by-products and utilization.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
1	Processing of cereals, pulses and oil seeds.	5
2 & 3	Cleaning, grading of cereals, pulses and oil seeds, types of cleaners and graders.	8
4 & 5	Drying of food grains, types of dryers,	15
6	Storage of grains, types of storage structures.	10
7	Milling.	6
8	Processing of fruits and vegetables.	5
9	Equipments for processing of oil seeds.	5
10	Farm structures : Steel, bamboo, polyhouse, greenhouse, shednets.	6
11	Study of maturity indices and properties of fruits and vegetables.	7
12	Handling and processing of fruits and vegetables.	8
13 & 14	Value added product preparation from fruits and vegetables.	13
15	Machineries and tools required for processing of fruits and vegetables.	5
16	Agricultural waste recycling and by-product utilization.	7
	Total	**100**

b) Practical

Practicals	Topic
1	Cleaning and grading of grains.
2	Drying of grains/fruits/vegetables.
3	Types of graders.
4	Study of oil extraction.
5	Study of *dal* milling.
6	Study of onion grading.
7	Study of grain storage structure.
8	Study of polyhouse, shednet and green houses.
9	Study of low cost cold storage structures.
10	Study of physical properties of fruits and vegetables.
11	Study of chemical properties of fruits and vegetables.
12	Study of handling and processing tools and machineries required for processing of fruits and vegetables.
13 & 14	Preparation of jam, jelly, juice, powder, pickle, sauce from fruits and vegetables.
15 & 16	Preparation of agricultural waste by-products and utilization.

Suggested Readings

1) **Unit Operations of Agricultural Processing**. 2002. Sahay, K. M. and K. K. Singh. Vikas Publishing House Pvt. Ltd., 576, Majjid Road, Jangpura, New Delhi-110014.
2) **Post Harvest Technology of Cereals, Pulses and Oilseeds**. A. Chakraverty. Oxford and IBH Publ. Co. Pvt. Ltd., 66, Janapath, New Delhi-110 001.
3) **Principles and Practices of Post Harvest Technology**. 2007. Pande, P. H. Kalyani Publishers, Ludhiana.
4) **Post Harvest Technology of Fruits and Vegetables**. Vol.1. L. R. Verma and V. K. Joshi, Indus Pub. Co., New Delhi.
5) **Processing of Fruits and Vegetables**. Giridharilal, G. S. Siddappa and G. L. Tandan. ICAR Pub., New Delhi.
6) **Post Harvest Physiology, handling and Utilization of Tropical and Sub-tropical Fruits and Vegetable**s. 1975. Pantastico, E. C. B.
7) **Food, Feed and Fuel from Biomass**. 1991. Chahal, D. S. Oxford and IBH Pub. Co.
8) **Agricultural Waste Management Field**. Handbook, 1992. USDA.

Agriculture Polytechnic

7) Plant Pathology

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

Plant Pathology & Agril. Microbiology

Sr.No.	Semester	Course No	Credit	Course Title
1	I	PATH-111	2 (1 + 1)	Introductory Microbiology
2	II	PATH-122	3 (2 + 1)	Fundamentals of Plant Pathology
3	III	PATH-233	2 (1 + 1)	Integrated Disease Management in Field Crops
4	IV	PATH-244	2 (1 + 1)	Integrated Disease Management in Horticultural Crops
5	VI	PATH-365(E)	6 (0 + 6)	Biofertilizer Production Technology
Total Credit Load			**15 (5+10)**	

1.	**Course :**	PATH-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 Macro elements, 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	Topics	Weightage (%)
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

Practicals	Topic
1	Acquaintance with microscope and other laboratory 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
13	Isolation of Patash solubilizing microbes
14	Isolation of Mycorrhiza
15	Isolation of cellulolytic microbes from agro waste management
16	Isolation of Pectin degrading microbes from agro water management

Suggested Readings

1. **General Microbiology.** 2007. R. P. Singh, Kalyani Publishers.
2. **Beneficial Microbes as Biofertilizers and it's Production Technology.** 2015. Borkar, S. G., Woodhead Publisher, New Delhi, India.
3. **Biology of Microorganisms.** 14th Edn. 2014. M T Madigan, and J M Martinko.
4. **Microbiology** 5th Edn., 1998. Pearson, M J, Pelczer. Tata McGrow Hill Education Pvt. Ltd.
5. **General Microbiology**. 2002. Strainer, R., Palgrave Macmillan. Edward Alchano.
6. **Introduction to Microbiology**. Jones and Bartlett hearing.
7. **Introductory Microbiology**. 2008. J Heritage, E G V Evans, R A Killington., Cambridge University Press.
8. **Microbiology**. 1996. Pelczar, jr. M.J.E.C.S. Chan and Krieg, N.R., McGraw Hill Publishers, Newyork.
9. **Microbiology**. (5ed). 2002. Prescott, L.M. Harley, J.P. and Klein, D.A., McGraw Hill Publishers, Newyork.
10. **General Microbiology**. 2006. Jamaluddin, M. Malvidya, N. and Sharma, A., Scientific Publishers, Washington.
11. **General Microbiology**. 1998. Sullia, S.B, and Shantaram, Oxford and IBH.
12. **Mushroom, A nutritive food and its cultivation.** 2016. Borkar, S. G. and Patil N. M., Astral International Pvt. Ltd., New Delhi
13. **Biology of Microorganisms** (10 ed.). 2003. Madigan, M. Martinkoj, M. and Parker., Prentice Hall of India Pvt. Ltd., New Delhi.

2.	**Course :**	PATH-122	**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. Causes and factors affecting disease development. Disease triangle and classification of plant diseases. Important plant pathogenic organisms (different groups). Fungi , bacteria, viruses. Protozoa and phanerogamic plant parasites with example of diseases caused by them. Diseases and symptoms due to abiotic causes. Pathogenesis, Role of enzymes in disease development. Toxins and growth regulators in disease development. Defence mechanism in plants. Epidemiology: Factors affecting disease development. Fungi: General characters, Classification. 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. 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. Growth and reproduction of plant pathogens. Liberation, dispersal and survival of plant pathogens. Types of parasitism and variability in plant pathogens. Fungicide residue.

Practical

Acquaintance with various laboratory equipments. Preparation of synthetic media. Preparation of non-synthetic media. Isolation of fungi. Isolation of bacteria. General study of different structures of fungi. Study of morphology of bacteria. Study of symptoms of various plant diseases caused by fungi. Study of symptoms of various plant diseases caused by bacteria. Study of symptoms of various plant diseases caused by virus. Staining and identification of plant pathogenic bacteria. Transmission of plant viruses. Study of phanerogamic plant parasites. Study of fungicides and their formulations. Methods of pesticide application and their safe use. Calculation of fungicide sprays concentrations.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Introduction: Importance of plant diseases	3
2	Scope and objectives of Plant Pathology	3
3	History of Plant Pathology with special reference to Indian work	4
4	Terms and concepts in Plant Pathology	3
5	Causes and factors affecting disease development	4
6	Disease triangle and classification of plant diseases	4
7	Important plant pathogenic organisms (different groups)	4
8	Fungi , bacteria, viruses.	4
9	Protozoa and phanerogamic plant parasites with example of diseases caused by them	4
10	Diseases and symptoms due to abiotic causes	3
11	Pathogenesis, Role of enzymes in disease development	4
12	Toxins and growth regulators in disease development	4
13	Defence mechanism in plants	4
14	Epidemiology: Factors affecting disease development	4
15	Fungi: General characters, Classification	3
16	Definition of fungus, somatic structures	4
17	Types of fungal thalli, fungal tissues	4
18	Modifications of thallus, reproduction (asexual and sexual)	4
19	Nomenclature, Binomial system of nomenclature	4
20	Rules of nomenclature.	3
21	Key to divisions, sub-divisions, orders and classes	3
22	Bacteria and mollicutes: General morphological characters	4
23	Basic methods of classification and reproduction	3
24	Viruses: Nature, architecture, multiplication and transmission	4
25	Growth and reproduction of plant pathogens	3
26	Liberation, dispersal and survival of plant pathogens	3
27	Types of parasitism and variability in plant pathogens	3
28	Fungicide residue	3
	Total	**100**

b) Practical

Practicals	Topic
1	Acquaintance with various laboratory equipments.
2	Preparation of synthetic media.
3	Preparation of non-synthetic media.
4	Isolation of fungi.
5	Isolation of bacteria.
6	General study of different structures of fungi.
7	Study of morphology of bacteria.
8	Study of symptoms of various plant diseases caused by fungi.
9	Study of symptoms of various plant diseases caused by bacteria.
10	Study of symptoms of various plant diseases caused by virus.
11	Staining and identification of plant pathogenic bacteria.
12	Transmission of plant viruses.
13	Study of phanerogamic plant parasites.
14	Study of fungicides and their formulations.
15	Methods of pesticide application and their safe use.
16	Calculation of fungicide sprays concentrations.

Suggested Readings

1) **Plant Diseases.** 8th Ed. 2008. Singh R. S., Oxford & IBH. Pub. Co.
2) **Introduction to Principles of Plant Pathology.** 2013. Singh R. S., Oxford and IBH Pub. Co.
3) **Plant Pathology.** 7th Ed. 2007. Mehrotra R. S. & Aggarwal A., Tata McGraw Hill Publ. Co. Ltd.

3.	**Course :**	PATH-233	**Credit:** 2(1+1)	**Semester-III**
	Course title:	Integrated Disease Management in Field Crops		

Syllabus

Theory

Symptoms, etiology, disease cycle and integrated management of major diseases of following crops. **Kharif Field crops** i.e. Rice : blast, brown spot, bacterial blight, false smut; Maize: leaf spots, Sorghum: smuts and grain mold; Bajra: downy mildew and ergot; Finger millet: Blast. **Pulses in Kharif season** i.e. Soybean: rust and mosaic; Pigeonpea : wilt and sterility mosaic; Black & green gram: leaf spot and anthracnose, powdery mildew. **Rabi Field crops** i.e. Wheat: Rusts, loose smut and leaf blight, **Oilseed** i.e. Groundnut: early and late leaf spots; Sunflower: Sclerotinia stem rot and blight; Mustard : Alternaria blight, White rust, Downy mildew . **Pulses in Rabi Crops** i.e. Gram: wilt and Ascochyta blight; Pea: Powdery mildew and Rust. **Cash Crops** i.e. Cotton: Root rot, Wilt and Anthracnose, 2-4-D injury; Sugarcane: Red rot, Smut, Grassy shoot and Pokka Boeng.

Practical

Identification of selected diseases of field crops and its integrated management. **Field crops :** Rice, Wheat, Maize, Finger millet, Sorghum, Pearl millet. **Cash Crops :** Cotton, Sugarcane. **Pulses :** Soybean, Black & green gram, Pigeaon pea and Chick pea. **Oilseed :** Groundnut, Sunflower, Mustard. Field visit for the diagnosis of field problems

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
	Symptoms, etiology, disease cycle and integrated management of major diseases of following crops	0
	Kharif Field crops	0
1,2	Rice: blast, brown spot, bacterial blight, false smut	9
3	Maize: leaf spots, Sorghum: smuts and grain mold	9
4	Bajra: downy mildew and ergot.	
5	Finger millet: Blast	6
	Pulses in Kharif season	0
6,7	Soybean: rust and mosaic, Pigeonpea: wilt and sterility mosaic	12
8	Black & green gram: leaf spot, anthracnose and powdery mildew	12
	Rabi Field crops	0
9	Wheat: Rusts, loose smut, leaf blight	9

	Oilseed	0
10	Groundnut: early and late leaf spots	6
11	Sunflower: leaf blight	3
12	Mustard: Alternaria blight, White rust and Downy mildew	6
	Pulses in Rabi Crops	0
13	Gram: wilt and Ascochyta blight	6
14	Pea: Powdery mildew, Rust, wilt	6
	Cash Crops	
15	Cotton: Root rot, Wilt and Anthracnose, 2-4-D injury	8
16	Sugarcane: Red rot, Smut, Grassy shoot and Pokka Boeng	8
	Total	100

b) Practical

Practicals	Topic
	Identification of selected diseases of field crops and its integrated management.
	Field crops
1	Rice
2	Wheat
3	Maize
4	Finger millet
5	Sorghum
6	Pearl millet
	Cash Crops
7	Cotton
8	Sugarcane
	Pulses
9	Soybean
10	Black & green gram
11	Pigeaon pea
12	Chickpea
	Oilseed
13	Groundnut
14	Sunflower
15	Mustard
16	Field visit for the diagnosis of field problems

Suggested Readings

1) **Plant Diseases.** 8th Ed. 2008. Singh R. S., Oxford & IBH. Pub. Co.
2) **Plant Pathology.** 7th Ed. 2007. Mehrotra R.S & Aggarwal A., Tata McGraw Hill, Publ. Co. Ltd.
3) **Diseases of Field Crops and their Management.** 2007. T. S. Thind., Daya Publishing House, New Delhi.

4.	**Course :**	PATH-244	**Credit:** 2 (1+1)	**Semester-IV**
	Course title:	Integrated Disease Management in Horticultural Crops		

Syllabus

Theory

Symptoms, etiology, disease cycle and its integrated management of major diseases of following crops.

Fruit Crops : Mango : Anthracnose, Mango-malformation, powdery mildew, Spongy tissue and Loranthus. Citrus : Citrus canker, Gummosis, Citrus greening, Tristeza. Grape vine: Downy mildew, Powdery mildew, Anthracnose. Guava: wilt and canker; Papaya: foot rot, leaf curl and Papaya ring spot. Banana: Panama wilt, Sigatoka and bunchy top. Pomegranate: bacterial blight and wilt.

Vegetables Crops : Cucurbits: Downy mildew, powdery mildew, Mosaic. Cruciferous vegetables: Alternaria leaf spot and black rot. Potato: Early and late blights. Tomato: early blight, leaf curl and mosaic. Brinjal: little leaf. Okra: Yellow Vein Mosaic, Beans: anthracnose. Onion: Purple blotch. Chilli : Anthracnose and leaf curl. Turmeric and Ginger: soft rot.

Flower Crops : Marigold : Alternaria blight. Rose: Dieback, Powdery mildew and Black leaf spot.

Practical

Identification 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):

Horticultural Crops : Mango, Citrus, Grape, Guava, Banana, Papaya, Pomegranate.

Vegetables : Tomato, Potato, Brinjal, Okra, Beans, Onion, Chilli.

Field visit for the diagnosis of field problems.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
	Symptoms, etiology, disease cycle and its integrated management of major diseases of following crops.	
	Fruit Crops	0
1,2	Mango: Anthracnose, Mango-malformation, powdery mildew and Spongy tissue, Loranthus	8
3	Citrus : Citrus canker, Gummosis, Citrus greening, Tristeza	8

4,5	Grape vine: Downy mildew, Powdery mildew, Anthracnose,	8
6	Guava: canker; Papaya: foot rot, leaf curl and Papaya ring spot	8
7	Banana: Panama wilt, Sigatoka and bunchy top	6
8	Pomegranate: bacterial blight ,wilt	6
	Vegetables Crops	0
9	Cucurbits: Downy mildew, powdery mildew and Mosaic	8
10	Cruciferous vegetables: Alternaria leaf spot and black rot,	5
11	Potato: Early and late blight	5
12	Tomato: early blight, leaf curl and mosaic	8
13	Brinjal: little leaf	3
14	Okra: Yellow Vein Mosaic, Beans: anthracnose	5
15	Onion: Purple blotch	3
16	Chilli : Anthracnose and leaf curl	5
17	Turmeric and Ginger: Rhizome soft rot	3
	Flower Crops	0
18	Marigold : Alternaria blight	3
19	Rose: Dieback, Powdery mildew and Black leaf spot	8
	Total	**100**

b) Practical

Practicals	Topic
	Identification 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).
	Horticultural Crops
1	Mango
2	Citrus
3	Grape
4	Guava
5	Banana
6	Papaya
7	Pomegranate
	Vegetables: cucurbits and crucifers
8	Tomato
9	Potato
10	Brinjal, Okra
11	Beans
12	Onion
13	Turmeric and Ginger
14	Chilli
15	Field visit for the diagnosis of field problems

Suggested Readings

1) **Diseases of Horticultural Crops Fruits.** 1999. Verma L. R. and Sharma R.C., Indus Publishing Company, New Delhi.
2) **Diseases of Fruit Crops.** 1986. V. N. Pathak, Oxford & IBH Publication, New Delhi.
3) **Diseases of Vegetables Crops.** 1987. R. S. Singh, Oxford & IBH Publication, New Delhi.
4) **Diseases of Fruit Crops.** 1987. R. S. Singh, Oxford & IBH Publication, New Delhi.

Agriculture Polytechnic

8) Animal Husbandry & Dairy Science

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

Animal Husbandry & Dairy Science

Sr.No.	Semester	Course No	Credit	Course Title
1	III	AHDS-231	3 (2 + 1)	Live Stock Production & Management
2	V	AHDS-352 (E)	6 (0 + 6)	Dairy Technology
Total Credit Load			**9 (2+7)**	

1.	**Course :**	AHDS-231	**Credit:** 3 (2+1)	**Semester-III**
	Course title:	Livestock Production & Management		

Syllabus

Theory

Domestication and utility of farm animals and their role in Indian economy. History and Importance of co-operative movement of dairy sector in Maharashtra. Animal husbandry methods in India / Maharashtra. Common terms pertaining to different species of livestock. Utility classification of breeds of Indian cattle. Familiarization with cattle breeds of Maharashtra. Buffaloes breeds of Maharashtra. Sheep and goat breeds of Maharashtra. Common feeds and fodders their classification and utility, Feeding standards. Preservation of fodders. Storage of fodder/forage as silage. Hay and haylage. Reproduction in farm animals (Ruminants). Housing principles for small & large ruminants. Space requirements for different species of livestock (Ruminants). Management of calves. Growing heifers management. Dry and pregnant animals and milch animals management. Important diseases of livestock and control measures.

Practical

Study of body parts and points of cattle, buffalo, sheep, goat and their significance. Study of common material used in different animals production. Planning and layout of housing for different types of livestock. Identification of common feeds and fodders. Computation of ration. Determination of age in farm animals. Measuring and weighing of farm animals (large and small ruminants). System of identification of livestock. Study of daily routine farm operations and farm records. Clean milk production and milking methods. Demonstration of silage making. Demonstration of deworming and vaccination.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Domestication and utility of farm animals and their role in Indian economy	5
2	History and Importance of co-operative movement of dairy sector in Maharashtra.	5
3	Animal husbandry methods in India / Maharashtra	4
4	Common terms pertaining to different species of livestock	5
5	Utility classification of breeds of Indian cattle	5
6	Familiarization with cattle breeds of Maharashtra	5
7	Buffaloes breeds of Maharashtra	4
8	Sheep and goat breeds of Maharashtra	5
9	Common feeds and fodders their classification and utility, Feeding standards	10
10	Preservation of fodders.	5
11	Storage of fodder/forage as silage	5
12	Hay and haylage	5
13	Reproduction in farm animals (Ruminants)	5
14	Housing principles for small & large ruminants	5
15	Space requirements for different species of livestock (Ruminants)	5
16	Management of calves	4
17	Growing heifers management	4
18	Dry and pregnant animals and milch animals management	5
19	Important diseases of livestock and control measures	9
	Total	**100**

b) Practical

Practicals	Topic
1	Study of body parts and points of cattle and buffalo and their significance.
2	Study of body parts and points of sheep, goat and their significance.
3	Study of common material used in different animals production.
4	Planning and layout of housing for different types of livestock.
5, 6 & 7	Identification of common feeds and fodders. Computation of ration.
8	Determination of age in farm animals.
9 & 10	Measuring and weighing of farm animals (large and small ruminants).
11	System of identification of livestock.
12 & 13	Study of daily routine farm operations and farm records.
14	Clean milk production and milking methods.
15	Demonstration of silage making.
16	Demonstration of deworming and vaccination.

Suggested Readings

1) **Text Book of Animal Husbandry.** 9th edn. 1999. G. C. Banerjee, Oxford and IBH Publishers, New Delhi.

2) **Text-Book of Buffalo Production.** 1979. Ranjhan, S. K. and Pathak, N. N., Vikas Publishing House Pvt. Ltd. 576, Masjid Road, Jangpura, New Delhi.

Agriculture Polytechnic

9) Soil Science and Agricultural Chemistry

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

Soil Science and Agricultural Chemistry

Sr.No.	Semester	Course No	Credit	Course Title
1	III	SSAC-231	3 (2 + 1)	Fundamentals of Soil Science
2	IV	SSAC-242	3 (2 + 1)	Soil Fertility Management
3	V	SSAC-353(E)	6 (0 + 6)	Fertilizer Formulation (Fertilizer mixture & briquette etc.)
4	VI	SSAC-364	2 (1+1)	Problematic Soils and their Management
5	VI	SSAC-365 (E)	6 (0 + 6)	Quality Testing Laboratory for Soil, Water, Manures, Fertilizers and Residue Analysis
Total Credit Load			**20 (5+15)**	

1.	**Course :**	SSAC-231	**Credit:** 3 (2+1)	**Semester-III**
	Course title:	Fundamentals of Soil Science		

Syllabus

Theory

Soil, definition & importance. 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- Methods of particle size analysis. Structure of Soil. Density and porosity of Soil. Soil colour. Consistence and plasticity. Elementary knowledge of soil taxonomy classification and soils of India. Soil water retention. Movement and availability of Water. Soil air, composition, importance. Flow of heat in soil. Soil temperature and plant growth. Soil reaction-pH. Soil acidity and alkalinity. Effect of pH on nutrient availability. Soil colloids - inorganic and organic. Silicate clays. Constitution and properties of silicate clays. Sources of charge on soil colloids and ion exchange. Cation exchange capacity. Base saturation. Soil organic matter: composition & Importance. Influence of soil organic matter on soil properties. Humic substances - nature and properties. Soil organisms: macro and micro organisms. Beneficial and harmful micro organisms.

Practical

Study of soil sampling tools, collection of representative soil sample. Identification of soil forming rocks and minerals. Study of soil profile in field. Determination of soil moisture content and maximum water holding capacity. Determination of soil texture by feel method. Studies of capillary rise phenomenon of water in soil column. Determination of soil colour. Determination of soil pH and electrical conductivity. Estimation of organic carbon content of soil. Study of Soil map of Maharashtra. Determination of particle size analysis. Determination of bulk density of soil. Determination of soil temperature. Determination cation exchange capacity of the soil.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Soil , definition & importance	3
2	Pedological and edaphological concepts of soil	3
3	Soil genesis: soil forming rocks and minerals, weathering	4
4	Processes and factors of soil formation	3
5	Soil profile	3
6	Components of soil	3
7	Soil physical properties	3
8	Soil texture- Methods of particle size analysis	3
9	Structure of Soil	3
10	Density and porosity of Soil	3
11	Soil colour	3
12	Consistence and plasticity	3
13	Elementary knowledge of soil taxonomy classification and soils of India	4
14	Soil water retention	3
15	Movement and availability of Water	3
16	Soil air, composition, importance	4
17	Flow of heat in soil	3
18	Soil temperature and plant growth	3
19	Soil reaction-pH	3
20	Soil acidity and alkalinity	3
21	Effect of pH on nutrient availability	3
22	Soil colloids - inorganic and organic	3
23	Silicate clays	3
24	Constitution and properties of silicate clays	3
25	Sources of charge on soil colloids and ion exchange	3
26	Cation exchange capacity	3
27	Base saturation	3
28	Soil organic matter: composition & Importance	4
29	Influence of soil organic matter on soil properties	3
30	Humic substances - nature and properties	3
31	Soil organisms: macro and micro organisms	3
32	Beneficial and harmful micro organisms	3
	Total	**100**

b) Practical

Practicals	Topic
1	Study of soil sampling tools, collection of representative soil sample.
2	Identification of soil forming rocks and minerals
3	Study of soil profile in field.
4	Determination of soil moisture content and maximum water holding capacity.
5	Determination of soil texture by feel method.
6	Studies of capillary rise phenomenon of water in soil column.
7	Determination of soil colour
8	Determination of soil pH and electrical conductivity
9	Estimation of organic carbon content of soil
10	Study of Soil map of Maharashtra
11 & 12	Determination of particle size analysis.
13	Determination of bulk density of soil.
14	Determination of soil temperature.
15 & 16	Determination cation exchange capacity of the soil.

Suggested Readings

1) **Text Book of Soil Science.** 2004. Mehara, R. K., ICAR, New Delhi.
2) **Fundamentals of Soil Science.** 2007. Patil, V. D. and Mali C. V., Aman Publication, Meerut.
3) **Text Book of Soil Science.** 2017. T. Biswas and S. Mukherjee, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4) **Fundamendals of Soil Science.** 2nd Edn., 2012. Indian Society of Soil Science (ISSS).

2.	**Course :**	SSAC-242	**Credit:** 3 (2+1)	**Semester-IV**
	Course title:	Soil Fertility Management		

Syllabus

Theory

Importance and classification of organic manures. Properties and methods of preparation of bulky manures. Green/leaf manuring – Types, Importance. Transformation reactions of organic manures in soils and importance of C:N ratio in rate of decomposition of manures. Chemical fertilizers: classification. Composition and properties of major nitrogenous fertilizer. Compositional properties of Phosphatic, potassic fertilizers, secondary & micronutrient fertilizers. Complex fertilizers, nano-fertilizers, Soil amendments. History of soil fertility and plant nutrition. Criteria of essentiality. Role of essential Nutrients. Deficiency of essential Nutrients. Toxicity symptoms of essential plant nutrients. Mechanisms of nutrient transport to plants. Factors affecting nutrient availability to plants. Integrated Nutrient Management (INM). Chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients. Soil fertility evaluation. 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 of manures & fertilizers under rainfed and irrigated conditions.

Practical

Identification of different fertilizers used in Agriculture. Identification of different manures samples used in Agriculture. Organic matter content from manures samples. Estimation of N, P, K from manure sample. Determination of moisture from manures. Determination of N from urea fertilizers. Determination of P from phosphatic fertilizer. Determination of K from potassic fertilizer. Study of Indicator plants for Soil fertility management. Determination of available nitrogen from the soil by alkaline permanganate method. Determination of available phosphorus from the soil by Watanabe and Olsen (1965) method. Determination of available potassium from the soil (neutal N ammonium acetate method). Determination of micronutrient from the soil Lindsay and Norvell (1978) mehod.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	Importance and Classification of organic manures	4
2	Properties and methods of preparation of bulky manures	4
3	Green/leaf manuring – Types, Importance	4
4	Transformation reactions of organic manures in soils and importance of C:N ratio in rate of decomposition of manures	4
5	Chemical fertilizers: classification	4
6	Composition and properties of major nitrogenous fertilizer	4
7	Compositional properties of Phosphatic, potassic fertilizers, secondary & micronutrient fertilizers.	4
8	Complex fertilizers, nano-fertilizers, Soil amendments	4
9	History of soil fertility and plant nutrition	4
10	Criteria of essentiality	4
11	Role of essential Nutrients	4
12	Deficiency of essential Nutrients	4
13	Toxicity symptoms of essential plant nutrients	4
14	Mechanisms of nutrient transport to plants	4
15	Factors affecting nutrient availability to plants	4
16	Integrated Nutrient Management (INM)	4
17	Chemistry of soil nitrogen, Phosphorus, potassium	4
18	Chemistry of Calcium, magnesium, sulphur and micronutrients	4
19	Soil fertility evaluation	4
20	Forms of nutrients in soil	4
21	Plant analysis, rapid plant tissue tests	4
22	Indicator plants	4
23	Methods of fertilizer recommendations to crops	4
24	Factor influencing nutrient use efficiency (NUE)	4
25	Methods of application of manures & fertilizers under rainfed and irrigated conditions.	4
	Total	**100**

b) Practical

Practicals	Topic
1	Identification of different fertilizers used in Agriculture.
2	Identification of different manures samples used in Agriculture.
3 & 4	Organic matter content from manures samples
5	Estimation of N from manure sample
6	Estimation of P from manure sample
7	Estimation of K from manure sample
8	Determination of moisture from manures
9 & 10	Determination of N from urea fertilizers
11	Determination of P from phosphatic fertilizer
12	Determination of K from potassic fertilizer
13	Study of Indicator plants for Soil fertility management
14	Determination of available nitrogen from the soil by alkaline permanganate method.
15	Determination of available phosphorus from the soil by Watanabe and Olsen (1965) method.
16	Determination of available potassium from the soil (neutal N ammonium acetate method).
17	Determination of micronutrient from the soil Lindsay and Norvell (1978) mehod.

Suggested Readings

1) **Fundamentals of Soil Science.** 2nd Edn. 2012. ISSS. Indian Society of Soil Science, New Delhi- 110 012.
2) **Handbook of Manures and Fertilizers.** 1971. ICAR publication.
3) **Manures and Fertilizers.** 1967. Yawalkar, K. S. , Agarwal, J. P. and Bokde, S., Agri-Horticultural Publication.
4) **Text Book of Plant Nutrient Management.** 2014. Rajendra Prasad, S. Pathak, A. K. Patra and Yashbir Singh Shivay.
5) **Soil Fertility and Fertilizers.** 8th Edn., 2016. J. L. Havlin, S. L. Tisdale, W. L. Nelson and J. D. Beaton. Pearson Education, India.

3.	**Course :**	SSAC-363	**Credit:** 2 (1+1)	**Semester-VI**
	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	Topics	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
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

Practicals	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 Readings

1) **Diagnosis and Improvement of Saline and Alkali Soils.** Vol. No. 60. 1954. Richards, L. A. United State Department of Agriculture.
2) **Nature, Properties and Management of Saline and Alkali Soils.** 2010. Maliwal, G. L. and Somani, L. L. Agro-tech Publishing Academy, Udaipur.
3) **Soil Resource Inventory and Management of Problematic [i.e. Problematic] Soils**. 2012. Mahendran, *et al*. Agrotech Publishing Academy (ISBN 10: 818321097X / ISBN 13: 9788183210973).
4) **Salt-Affected Soils and their Management.** 1988. Abrol, I. P., Yadav, J. S. P and Massoud. F. I. FAO Soils Bulletin 39. Food & Agriculture Organization of the United Nations, Rome.
5) **Agricultural Salinity Management in India.** 1998. Tyagi, N.K. and P.S. Minhas. CSRI, Karnal.
6) **Chemical Changes and Nutrient Transformation in Sodic/ Poor Quality water Irrigated Soils** . 2008. Yaduvanshi, N. P. S. CSRI., Karnal.
7) **Diagnostics, Remediation and Management of Poor Quality Waters: Lectures for Summer School**. 2012. Dey, P. &, Gupta, S. K.
8) **Salinity Management for Sustainable Agriculture in Canal Commands.** 2011. R. L. Meena, S. K. Gupta, R. K. Yadav and D. K. Sharma,Published by CSRI., Kernal
9) **Twenty-five Years of Research on Management of Salt Affected Soils and Use of Saline Water in Agriculture.** 1998. CSRI, Karnal, Haryana.
10) **Fundamentals of Soil Science.** 2007. Patil, V. D. and Mali C. V., Aman Publication, Meerut
11) **Introductory Soil Science.** Das, D. K.
12) **The Nature and Properties of Soils.** 15th edn. 2016. Brady, N. C., Pearson Education, ISBN: 978-0133254488
13) **The Chemistry of Soil.** Firman Bear
14) **Text Book of Pedology Concepts and Applications.** J. Sehgal
15) **FAO United Nations Soil Portal**.

Agriculture Polytechnic

10) Agricultural Entomology

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

Agricultural Entomology

Sr. No.	Semester	Course No	Credit	Course Title
1	II	ENTO-121	2 (1 + 1)	Fundamentals of Entomology
2	III	ENTO-232	2 (1 + 1)	Integrated Pest Management in Field Crops
3	IV	ENTO-243	2 (1 + 1)	Integrated Pest Management in Horticultural Crops
4	V	ENTO-354(E)	6 (0 + 6)	Bio-pesticide/Bio-agent Production Technology
5	VI	ENTO-365 (E)	6 (0 + 6)	Sericulture Technology & Enterprise
Total Credit Load			**18 (3+15)**	

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

Syllabus

Theory

History of Entomology in India. Factors for insect's abundance. Major points related to dominance of Insecta in Animal kingdom. Classification of phylum Arthropoda up to order. Morphology: Structures and functions of insect cuticle. Moulting and body segmentation. Structure of Head. Structure of Thorax and abdomen. Circulatory system of cockroach.Excretory system of Insects.Respiratory system of Insects. Nervous system of Insects.Reproductive systems in insects (male and female). Types of reproduction in insects. Major sensory organs and functions. **Beneficial Insects:** Honeybees. **Beneficial Insects: S**ilkworm.**Beneficial Insects: L**ac insect.

Practical

Methods of collection and preservation of insects. Study of External features of Grasshopper/ Cockroach. Study of Types of insect antennae. Study of mouthparts (cockroach and red cotton bug). Study of insect legs. Types of insect wings. Metamorphosis and diapauses. Types of insect larvae and pupae. Study of characters of important insect orders – Orthoptera, Hemiptera, Thysanoptera, Lepidoptera, Diptera, Coleoptera, Hymenoptera. Dissection of Insects to study digestive system of insects. Dissection of Insects to study nervous system of insects. Dissection of Insects to study reproductive system of insects.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	History of Entomology in India	5
2	Major points related to dominance of Insecta in Animal kingdom	5
3	Classification of phylum Arthropoda up to order	5
4	Morphology: Structures and functions of insect cuticle	10
5	Structure of Head	6
6	Structure of Thorax and abdomen	8
7	Structure and functions of digestive system of Insect (Cockroach)	8
8	Nervous system of Insects	8
9,10	Reproductive systems in insects (male and female)	8
11,12	Types of reproduction in insects	8
13	Major sensory organs and functions	8
14	**Beneficial Insects:** Honeybees	7
15	**Beneficial Insects: S**ilkworm	7
16	**Beneficial Insects: L**ac insect	7
	Total	**100**

b) Practical

Practicals	Topic
1	Methods of collection and preservation of insects.
2	Study of External features of Grasshopper/Cockroach
3	Study of Types of insect antennae
4	Study of mouthparts (cockroach and red cotton bug)
5	Study of insect legs, Types of insect wings
6	Metamorphosis and diapause
7	Types of insect larvae and pupae
8	Study of characters of important insect order - Orthoptera
9	Study of characters of important insect order – Hemiptera, Thysanoptera
10	Study of characters of important insect order - Lepidoptera
11	Study of characters of important insect order - Diptera
12	Study of characters of important insect order - Coleoptera
13	Study of characters of important insect order - Hymenoptera
14	Dissection of Insects to study digestive system of insects.
15	Dissection of Insects to study nervous system of insects.
16	Dissection of Insects to study reproductive system of insects.

Suggested Readings

1) **The Insects: Structure and Functions.** 2016. Chapman, R. F., Cambridge University Press, Delhi.
2) **Insect Physiology and Anatomy.** 1981. Pant N.C. and Swaraj Ghai, ICAR, New Delhi.
3) **General Entomology.** 2006. Upadhyay K. D. & Mathur Y. K., Aman Publ. House, Meerut.
4) **Insects.** 2012. Rajagopal and Chakravarthy A. K., Aavishkar Publishers, Distributors, Jaipur.
5) **Introduction to General and Applied Entomology.** 2012. Awasthi V. B., Scientific Publishers, Jodhpur.

2.	**Course :**	ENTO-232	**Credit:** 2 (1+1)	**Semester-III**
	Course title:	Integrated Pest Management in Field Crops		

Syllabus

Theory

Economic importance, identification, biology, nature of damage, host and integrated management of insect pests of Crop. Cereals : Rice - Green leaf hopper, Brown plant hopper, Paddy grasshopper, Gundhi bug, Hispa, stem borer, leaf folder. Sorghum – Shoot fly, Stem borer, Aphids, Midge fly. Bajra – Blister beetle. Wheat – Stem borer, Aphids, Termites, rhodents. Maize – Stem borer, aphids, false armyworm. **Pulses –** Pigeon pea – Pod borer, Spotted pod borer, Leaf webber, Mites. Chickpea – Gram pod borer. Cowpea, Pea, Mung and Urdbean – Aphids, Leaf eating caterpillar, Semilooper–Blue butterfly, Pod borer. **Oilseeds -** Soybean – Stem fly, Tobacco leaf eating caterpillar, Girdle beetle, Semilooper, Gram pod borer. Groundnut – Leaf miner, Hairy caterpillar, Aphids, Thrips, White grub. Sunflower – Head borer, Capitulum borer, Hairy caterpillar, Jassids, Thrips, white fly. Safflower : Aphids. Mustard – Guzia weevil, Sawfly, Leaf webber. **Fiber crops –** Cotton – Aphids, Jassids, Thrips, Whitefly, Mite, Spotted bollworm, American bollworm, Pink bollworm, Red cotton bug, Dusky cotton bug. **Sugarcane crops :** Sugarcane – Early shoot borer, Internode borer, Top shoot borer, Root borer, Woolly aphid, Pyrilla, Mealy bug, Scale insect, White grub. Non-insect pests of above crops – Crabs, Snails and Slugs, Rats, Mites and Birds.

Practical

Pests of Rice. Pests of Sorghum. Pests of Wheat. Pests of Maize and Bajra. Pests of Pigeon pea. Pests of Chickpea. Pests of Groundnut. Pests of Sunflower, Safflower and Mustard. Pests of Soybean. Pests of Cotton. Pests of Sugarcane. Management of White grub. Management of rodent. Management of non-insect pest.

Teaching Schedule

a) Theory

Lecture	Topic	Weightage (%)
	Economic importance, identification, biology, nature of damage, host and integrated management of insect pests of	25
	Cereals	
1	Rice - Green leaf hopper, Brown plant hopper, Paddy grasshopper, Gundhi bug, Hispa, stem borer, leaf folder.	
2	Sorghum – Shoot fly, Stem borer, Aphids, Midge fly	
3	Bajra – Blister beetle	
	Wheat – Stem borer, Aphids, Termites, rhodents	
	Maize – Stem borer, aphids, false armyworm	
	Pulses –	15
4	Pigeon pea – Pod borer, Spotted pod borer, Leaf webber, Mites	
5	Chickpea – Gram pod borer	
	Cowpea, Pea, Mung and Urdbean – Aphids, Leaf eating caterpillar, Semilooper–Blue butterfly, Pod borer	
	Oilseeds -	25
6	Soybean – Stem fly, Tobacco leaf eating caterpillar, Girdle beetle, Semilooper, Gram pod borer.	
7	Groundnut – Leaf miner, Hairy caterpillar, Aphids, Thrips, White grub.	
8	Sunflower – Head borer, Capitulum borer, Hairy caterpillar, Jassids, Thrips, white fly Safflower : Aphids	
9	Mustard – Guzia weevil, Sawfly, Leaf webber	
	Fiber crops –	35
10-11	Cotton – Aphids, Jassids, Thrips, Whitefly, Mite, Spotted bollworm, American bollworm, Pink bollworm, Red cotton bug, Dusky cotton bug.	
	Sugarcane crops	
12	Sugarcane – Early shoot borer, Internode borer, Top shoot borer, Root borer, Woolly aphid, Pyrilla, Mealy bug, Scale insect, White grub.	
13	Non-insect pests of above crops – Crabs, Snails and Slugs, Rats, Mites and Birds.	
	Total	**100**

b) Practical

Practicals	Topic
1.	Pests of Rice
2.	Pests of Sorghum
3.	Pests of Wheat.
4.	Pests of Maize and Bajra
5.	Pests of Pigeon pea
6.	Pests of Chickpea.
7.	Pests of Groundnut
8.	Pests of Sunflower.
9.	Pests of Soybean.
10.	Pests of Cotton.
11	Pests of Sugarcane
12	Pests of Safflower and Mustard
13	Management of White grub.
14	Management of rodent
15 &16	Management of non-insect pest.

Suggested Readings

1) **Agricultural Pests of South Asia and their Management. 2013.** A. S. Atwal and G. S. Dhaliwal, Kalyani Publishers, Ludhiana.

2) Insect Pest Management. 2004. Venu Gopal Rao. Agrobios (India).

3) **The Applied Entomology, Vol. II.** 2007. Shrivastava, Kalyani Publishers.

4) **Principles of Insect Pest Management.** 2003. Dhaliwal G. S. and Ramesh Arora. Kalyani Publishers.

5) **Agricultural Insect Pests and Their Control.** 2007. V. B. Awasthi. Scientific Publishers, Jodhpur.

3.	**Course :**	ENTO-243	**Credit:** 2 (1+1)	**Semester-IV**
	Course title:	Integrated Pest Management in Horticultural Crops		

Syllabus

Theory

Economic Importance, identification, host, biology, nature of damage and integrated management of important insect pests. Citrus: Lemon butterfly, Leaf miner, Fruit sucking moth, Psylla, aphids. **Mango:** Mango stem borer, Shoot borer, Thrips, Leaf gall, mango stone weevil, fruit fly. **Grapevine:** Flea beetle /Udadya beetle, Thrips, Mealy bug. **Guava:** Fruit fly, mealy bugs, spirilling whitefly. **Banana:** Root stock weevil/Rhizome weevil, aphid. **Papaya:** Papaya mealy bugs, aphid, whitefly. **Sapota :** Chiku moth / Sapota Leaf Webber, Sapota seed borer, Bud borer. **Fig :** Jassids, Mites,stem borer. **Coconut and other palm trees :** Rhinoceros beetle, Red palm weevil, Eriophyid mite, Rat, black headed caterpillar. **Ber:** Ber fruit borer, fruit fly. **Aonla:** Bark Borer. **Apple :** Codling moth, San Jose scale. **Cashew nut :** Tea mosquito bug. **Pomogranate:** Fruit borer**,** Thrips, Shot hole borer, Mealy bug, Whitefly, Aphids, fruit sucking moth. **Brinjal:-** Brinjal shoot & fruit borer, White fly, aphid, mites. **Okra:** Shoot & fruit borer, Leafhoppers, Aphids, Leaf Roller, Red Spider Mite. **Tomato :** Fruit borer, Leaf miner. **Potato:** Potato tuber moth, Cut worm, aphid. **Cruciferous crops (Cauliflower, Cabbage, Broccoli and Knolkol):** Diamond back moth, Aphids, Cabbage butterfly, Leaf eating caterpillar. **Cucurbitaceous vegetables:** Pumpkin beetles, Fruit Fly, Aphids, Leaf miner, whitefly. **Turmeric and Ginger:** Rhizome fly. **Onion and Garlic:** Thrips. **Rose, Gerbera, Carnation:** Thrips, Mites, White Fly, Bud borer, Leaf miner, scales.

Practical

Identification observation of Damage symptoms and integrated management practices of pests of following crops. Pests of Citrus. Pests of Mango and Sapota. Pests of Grapevine. Pests of Guava and pomegranate. Pests of Banana and Papaya. Pests of Coconut, Arecanut. Pests of Apple, Fig, Ber, Aonla and Cashew nut. Pests of Brinjal, Okra. Pests of Tomato and potato. Pests of cruciferous vegetables. Pests of cucurbitaceous vegetables. Pests of Turmeric, Ginger, Onion, Garlic. Pests of Rose, Gerbera, Carnation.

Teaching Schedule

a) Theory

Lecture No.	Topic	Weightage %
	Economic Importance, identification, host, biology, nature of damage and integrated management of important insect pests	100
1.	**Citrus:-** Lemon butterfly, Leaf miner, Fruit sucking moth, Psylla, aphids	
2.	**Mango:-**Mango stem borer, Shoot borer, Thrips, Leaf gall, mango stone weevil, fruit fly.	
3.	**Grapevine:-**Flea beetle /Udadya beetle, Thrips, Mealy bug	
4	**Guava:-**Fruit fly, mealy bugs, spirilling whitefly	
5	**Banana:-**Root stock weevil/Rhizome weevil, aphid **Papaya:-**Papaya mealy bugs, aphid, whitefly	
6	**Sapota :-**Chiku moth / Sapota Leaf Webber, Sapota seed borer, Bud borer **Fig :-**Jassids, Mites, stem borer	
7	**Coconut and other palm trees :-**Rhinoceros beetle, Red palm weevil, Eriophyid mite, Rat, black headed caterpillar.	
8	**Ber:-** Ber fruit borer, fruit fly **Aonla:-** Bark Borer **Apple :** Codling moth, San Jose scale **Cashew nut :** Tea mosquito bug	
9	**Pomogranate:-** Fruit borer**,** Thrips, Shot hole borer, Mealy bug, Whitefly, Aphids, fruit sucking moth	
10	**Brinjal:-** Brinjal shoot & fruit borer, White fly, aphid, mites **Okra:-**Shoot & fruit borer, Leafhoppers, Aphids, Leaf Roller, Red Spider Mite	
11.	**Tomato :-**Fruit borer, Leaf miner	
12	**Potato:-** Potato tuber moth, Cut wom, aphid	
13	**Cruciferous crops (Cauliflower, Cabbage, Broccoli and Knolkol):-** Diamond back moth, Aphids, Cabbage butterfly, Leaf eating caterpillar.	
14	**Cucurbitaceous vegetables:-** Pumpkin beetles, Fruit Fly, Aphids, Leaf miner, whitefly	
15	**Turmeric and Ginger:-**Rhizome fly **Onion and Garlic:-**Thrips.	
16	**Rose, Gerbera, Carnation:-**Thrips, Mites, White Fly, Bud borer, Leaf Miner, scales	

b) Practical

Practicals	Topic
1	Identification observation of damage symptoms and integrated management practices of pests of following crops. Pests of Citrus.
2	Pests of Mango and Sapota
3	Pests of Grapevine
4	Pests of Guava
5	Pests of Pomegranate
6	Pests of Banana and Papaya
7	Pests of Coconut, Arecanut
8	Pests of Apple, Fig, Ber
9	Pests of Aonla and Cashew nut
10	Pests of Brinjal, Okra
11	Pests of Tomato
12	Pests of Potato
13	Pests of cruciferous vegetables
14	Pests of cucurbitaceous vegetables.
15	Pests of Turmeric, Ginger, Onion, Garlic
16	Pests of Rose, Gerbera, Carnation

Suggested Readings

1) **Agricultural Pests of South Asia and their Management.** 2013. A.S. Atwal and G.S. Dhaliwal. Kalyani Publishers, Ludhiana.

2) **Insects and Fruit.** 2016. Butani, D. C. Astral International Pvt. Ltd., New Delhi.

3) **Insect in Vegetables.** 2013. Butani, D. K. and Jotwani, M. G., Daya Publishing House.

Agriculture Polytechnic

11) Social Studies

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

Social Studies

Sr.No.	Semester	Course No	Credit	Course Title
1	I	LANG-111	2 (1 + 1)	English - I
2	III	LANG-232	2 (1 + 1)	English - II
3	V	LANG-353	2 (1 + 1)	Comprehension & Communication Skill in English
Total Credit Load			**6 (3+3)**	

1.	**Course :**	LANG-111	**Credit:** 2 (1+1)	**Semester-I**
	Course title:	English – I		

Syllabus

Theory

Application of Grammar : Articles - Appropriate use of definite and indefinite Articles. Prepositions - To use correct Prepositions as per context. Conjunctions - Co-ordinating and sub-ordinating Conjunctions. **Prose :** Climb Every Mountain, A Time to Buy Horses, Bike Ride, The Best Advice I Ever Had, Mommy Knows Best, Schooling On The Streets, The Jamun Tree, Mumbai Dabbawalas. **Poetry section :** Start Where you stand, Work, City, On Journeys Through The States. **Tense** : Correct usages of past, present and future tenses. Active and Passive voice : use of Active and Passive voice. **Direct and indirect sentences** : Conversion of direct into indirect sentence and vice versa. Shock And Calm, The Puppy, Traffic Problems, Indian Women's Income Doubles, Empower The Farmer, For Heaven's Sake, Gandhiji: A 21st Centaury Leader, Harry Potter Novels Go Digital, My Mother, Marching song, O Gentlemen, The Flower School.

Practicals

Writing & communication skill - Letter Writing - Formal Letters (Different types & Practice), Informal Letters (Different types & Practice). **Note Making :** Seen abstract (Changing verbal into non verbal.) - Diagram, Chart, Table, Pie chart, Maps, Graph, etc. **Summarizing :** (Writing a summary of unseen passage The help of main important points) Summarizing Skill, Need of summarizing. **Tourist Leaflet :** Design of Leaflet of Historical place, Hill station, Points to be include in tourist leaflet, Drafting of tourist leaflet with the help of given points. **Report Writing :** Any program, function, ceremony, workshop, event, project. **Developing a news item:** News concepts & drafting, Types of news, Agriculture news & its drafting. **Appeal Writing :** Drafting of appeal Writing. Appeal for magazine, pamphlet or handbill. **Speech Writing :** Concepts of speech. Drafting of speech with given or without given points. Actual speech. **Advertisement Writing :** Concepts of Advertisement. Drafting of Advertisement with given or without given points. Actual Advertisement. **Interview Questions :** Concepts of Interview. Drafting of Interview Questions. Actual Interview of Social, Political or ideal leader. Actual Interview of Scientist, farmer, sportsman. **View – Counterview :** Formation of table for information base on various topics, issues, facts. Collection of views, counterviews on given topic. **Essay Writing:** Essay on given topic. Types of Essay. Actual Essay writing. **Grammar :** Do as directed. Rewrite sentence as per instruction.

Teaching Schedule

a) Theory

Sr. No.		Name of the Topic	Weightage (%)
1.		**Part -I : Application of Grammar**	**15**
	1.1 1.2 1.3	Articles : Appropriate use of definite and indefinite Articles Prepositions : To use correct Prepositions as per context. Conjunctions : Co-ordinating and sub-ordinating Conjunctions	
2.		**PART – II : Prose**	**20**
	2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8	Climb Every Mountain A Time to Buy Horses Bike Ride The Best Advice I Ever Had Mommy Knows Best Schooling On The Streets The Jamun Tree Mumbai Dabbawalas	
3.		**PART III : Poetry section**	**15**
	3.1 3.2 3.3 3.4	Start Where you stand Work City On Journeys Through The States	
4	4.1 4.2 4.3	Tense : Correct usages of past, present and future tenses Active and Passive voice : use of Active and Passive voice. Direct and indirect sentences : Conversion of direct into indirect sentence and vice versa	**15**
5	5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8	Shock And Calm The Puppy Traffic Problems Indian Women's Income Doubles Empower The Farmer For Heaven's Sake Gandhiji: A 21st Centaury Leader Harry Potter Novels Go Digital	**20**
6	6.1 6.2 6.3 6.4	My Mother Marching song O Gentlemen The Flower School	**15**
		TOTAL	**100**

b) Practicals

Sr. No.		Name of the Topic	Weightage (%)
1.	1.1 1.2	**Writing & communication skill - Letter Writing** Formal Letters (Different types & Practice) Informal Letters (Different types & Practice)	**10**
2.	 2.1 2.2 2.3 2.4 2.5 2.6 2.7	**Note Making** Seen abstract (Changing verbal into non verbal.) Diagram Chart Table Pie chart Maps Graph Etc.	**10**
3.	 3.1 3.2 3.3	**Summarizing** (Writing a summary of unseen passage The help of main important points) Summarizing Skill Need of summarizing	**05**
4.	 4.1 4.2 4.3	**Tourist Leaflet** Design of Leaflet of Historical place, Hill station Points to be include in tourist leaflet Drafting of tourist leaflet with the help of given points	**10**
5.	 5.1	**Report Writing** Any program, function, ceremony, workshop, event, project.	**05**
6.	 6.1 6.2 6.3	**Developing a news item** News concepts & drafting Types of news Agriculture news & its drafting	**10**
7.	 7.1 7.2	**Appeal Writing** Drafting of appeal Writing Appeal for magazine, pamphlet or handbill	**05**
8.	 8.1 8.2 8.3	**Speech Writing** Concepts of speech Drafting of speech with given or without given points Actual speech	**10**
9.	 9.1 9.2 9.3	**Advertisement Writing** Concepts of Advertisement Drafting of Advertisement with given or without given points Actual Advertisement	**05**
10.	 10.1 10.2 10.3 10.4	**Interview Questions** Concepts of Interview Drafting of Interview Questions Actual Interview of Social, Political or ideal leader Actual Interview of Scientist, farmer, sportsman.	**05**
11.	 11.1	**View – Counterview** Formation of table for information base on various topics, issues, facts.	**05**

	11.2	Collection of views, counterviews on given topic	
12.	 12.1 12.2 12.3	**Essay Writing** Essay on given topic Types of Essay Actual Essay writing	**10**
13.	 13.1 13.2	**Grammar** Do as directed Rewrite sentence as per instruction	**10**
		Total	**100**

Suggested Readings

1) **YUVAKBHARATI**
   A Course book in English for XI standard
   Publisher - Maharashtra State Board of Secondary and Higher Secondary Education, Pune.

2) **Essential English Grammar.** 2003.
   Raymond & Murphy, Cambridge publication.

3) **High School English Grammar and Composition.** 2002.
   Wren and Martin, S. Chand & Co. Publication.

2.	**Course :**	LANG-232	**Credit:** 2 (1+1)	**Semester-III**
	Course title:	English – II		

Syllabus

Theory

Self : Don't Quit, David Hartman's Impossible Dream, You've Got to find What You Love, The Ambitious Violet. **Family :** A Frosty Night, Go, Kiss the World, Right, Girls…?, Father's Laughter. **Society :** Basketful of Moonlight, India 2nd in World Road Mishaps, Dancing in the Rain, He Made a Dream Come True. **Town/City :** Now All's Become History!, Deluge in Mumbai, Operation Cockroach, A Village Powered Sun, Wind and Cowdung. **State :** To see Tukaram Shakespeare came over, Fine Footprints, The Bigger Cypher. **Nation :** An Indian Forest, India on High, Dreaming of a New India. **World :** What Endures, Down to Earth, View – Counterview. **Globalisation :** Ageing in America, My Family and Globalisers, Is SMS Ruining the English Language. **Rapid Readings Section :** Let's Go Home, The Speckled Band, The Woman on Platform No. 8, The Trojan Horse, Love and How to Cure it.

Practicals

Writing & communication skill - Letter Writing : Formal Letters (Different types & Practice). Informal Letters (Different types & Practice). **Note Making :** Seen abstract (Changing verbal into non verbal.)- Diagram, Chart, Table, Pie chart, Maps, Graph, etc. **Summarizing :** (Writing a summary of unseen passage The help of main important points) - Summarizing Skill. Need of summarizing. **Tourist Leaflet :** Design of Leaflet of Historical place, Hill station. Points to be include in tourist leaflet. Drafting of tourist leaflet with the help of given points. **Report Writing:** Any program, function, ceremony, workshop, event, project. **Developing a news item:** News concepts & drafting, Types of news and Agriculture news & its drafting.**Appeal Writing :** Drafting of appeal writing, Appeal for magazine, pamphlet or handbill. **Speech Writing :** Concepts of speech. Drafting of speech with given or without given points. Actual speech. **Advertisement Writing :** Concepts of Advertisement. Drafting of Advertisement with given or without given points. Actual Advertisement. **Interview Questions :** Concepts of Interview. Drafting of Interview Questions. Actual Interview of Social, Political or ideal leader. Actual Interview of Scientist, farmer, sportsman. **View–Counterview :** Formation of table for information base on various topics, issues, facts. Collection of views, counterviews on given topic. **Essay Writing :** Essay on given topic. Types of Essay. Actual Essay writing. **Grammar :** Do as directed. Rewrite sentence as per instruction.

Teaching Schedule

a) Theory

Sr. No.	Unit No.	Name of the Topic	Weightage (%)
1	1	**Self :** Don't Quit, David Hartman's Impossible Dream, You've Got to find What You Love, The Ambitious Violet,	13
2	2	**Family :** A Frosty Night, Go, Kiss the World, Right, Girls…?, Father's Laughter.	12
3	3	**Society :** Basketful of Moonlight, India 2nd in World Road Mishaps, Dancing in the Rain, He Made a Dream Come True.	13
4	4	**Town/City :** Now All's Become History!, Deluge in Mumbai, Operation Cockroach, A Village Powered Sun, Wind and Cowdung.	12
5	5	**State :** To See Tukaram Shakespeare came over, Fine Footprints, The Bigger Cypher	13
6	6	**Nation :** An Indian Forest, India on High, Dreaming of a New India. **World :** What Endures, Down to Earth, View – Counterview.	12
7	7	**Globalisation :** Ageing in America, My Family and Globalisers, Is SMS Ruining the English Language	13
8	8	**Rapid Readings Section :** Let's Go Home, The Speckled Band, The Woman on Platform No. 8, The Trojan Horse, Love and How to Cure it.	12
		Total	**100**

b) Practicals

Sr. No.		Name of the Topic	Weightage (%)
1		**Writing & communication skill - Letter Writing**	**10**
	1.1	Formal Letters (Different types & Practice)	
	1.2	Informal Letters (Different types & Practice)	
2		**Note Making**	**10**
		Seen abstract (Changing verbal into non verbal.)	
	2.1	Diagram	
	2.2	Chart	
	2.3	Table	
	2.4	Pie chart	
	2.5	Maps	
	2.6	Graph	
	2.7	Etc.	

3		**Summarizing**	**05**
	3.1	(Writing a summary of unseen passage The help of main important points)	
	3.2	Summarizing Skill	
	3.3	Need of summarizing	
4		**Tourist Leaflet**	**10**
	4.1	Design of Leaflet of Historical place, Hill station	
	4.2	Points to be include in tourist leaflet	
	4.3	Drafting of tourist leaflet with the help of given points	
5		**Report Writing**	**05**
	5.1	Any program, function, ceremony, workshop, event, project	
6		**Developing a news item**	**10**
	6.1	News concepts & drafting	
	6.2	Types of news	
	6.3	Agriculture news & its drafting	
7		**Appeal Writing**	**05**
	7.1	Drafting of appeal Writing	
	7.2	Appeal for magazine, pamphlet or handbill	
8		**Speech Writing**	**10**
	8.1	Concepts of speech	
	8.2	Drafting of speech with given or without given points	
	8.3	Actual speech	
9		**Advertisement Writing**	**05**
	9.1	Concepts of Advertisement	
	9.2	Drafting of Advertisement with given or without given points	
	9.3	Actual Advertisement	
10		**Interview Questions**	**05**
	10.1	Concepts of Interview	
	10.2	Drafting of Interview Questions	
	10.3	Actual Interview of Social, Political or ideal leader	
	10.4	Actual Interview of Scientist, farmer, sportsman.	
11		**View – Counterview**	**05**
	11.1	Formation of table for information base on various topics, issues, facts.	
	11.2	Collection of views, counterviews on given topic	
12		**Essay Writing**	**10**
	12.1	Essay on given topic	
	12.2	Types of Essay	
	12.3	Actual Essay writing	
13		**Grammar**	**10**
	13.1	Do as directed	
	13.2	Rewrite sentence as per instruction	
		Total	**100**

Suggested Readings

1) **YUVAKBHARATI**
   A Course book in English for XII standard
   Publisher - Maharashtra State Board of Secondary and Higher Secondary Education, Pune.

2) **Essential English Grammar.** 2003.
   Raymond & Murphy, Cambridge publication.

3) **High School English Grammar and Composition.** 2002.
   Wren and Martin, S. Chand & Co. Publication.

3.	**Course :**	LANG-353	**Credit:** 2 (1+1)	**Semester-V**
	Course title:	Comprehension & Communication Skill in English		

Syllabus

Theory

The Golden Watch, By Mulk Raj Anand. **Gulamdin, The Tongawallah,** By Gulabdas Broker. **Jahnavi,** By Jintendra Kumar. **Enlightenment,** By Yashpal. **The Flood,** By Thakazhi Sivasankara Pillai. **Wet and Shine,** By Kusumavati Deshpande. **The Whirlwind,** By Sant Singh Sekhon. **Attar of Roses,** By Sripada Subrahmanya Sastri.

Practical

Readings Comprehension. Listening Skills. Letter writing. Summary Writing. Paragraph Writing. Spoken English. Conversations. Vocabulary Development. Antonyms, Synonyms, Homophones, Homonymes. Concord- Subject – Verb agreement. Articles- An/ A/ The. Review.

Teaching Schedule

a) Theory

Lectures	Theory	Weightage (%)
1 2	**The Golden Watch** By Mulk Raj Anand	**12.5%**
3 4	**Gulamdin, The Tongawallah** By Gulabdas Broker	**12.5%**
5 6	**Jahnavi** By Jintendra Kumar	**12.5%**
7 8	**Enlightenment** By Yashpal	**12.5%**
9 10	**The Flood** By Thakazhi Sivasankara Pillai	**12.5%**
11 12	**Wet and Shine** By Kusumavati Deshpande	**12.5%**
13 14	**The Whirlwind** By Sant Singh Sekhon	**12.5%**
15 16	**Attar of Roses** By Sripada Subrahmanya Sastri	**12.5%**
	Total	**100 %**

b) Practical

Practical	Practical	Weightage (%)
1 **2** **3**	**Readings Comprehension**	10%
4 **5** **6**	**Listening Skills**	15%
7	Letter writing	10%
8	Summary Writing	5%
9	Paragraph Writing	5%
10	Spoken English	10%
11	Conversations	10%
12	Vocabulary Development	5%
13	Antonyms, Synonyms, Homophones, Homonymes	10%
14	Concord- Subject – Verb agreement	10%
15	Articles- An/ A/ The	10%
16	Review	
		100

Suggested Readings

1) **Contemporary Indian Short Stories -** Series II. 2006. Edited by Bhabani Bhattacharya, Sahitya Akadami, New Delhi
2) **LANG-111 Practical Manual- Comprehension & Communication Skills,** MPKV: Education Publication No.169-2017.

Agriculture Polytechnic

12) Science

- **Syllabus**
- **Teaching Schedule**
- **Suggested Readingss**

Science

Sr. No.	Semester	Course No	Credit	Course Title
1	I	SCI-111	3 (2+1)	Physics - 1 & 2
2	I	SCI-112	3 (2+1)	Biology- 1 & 2
3	II	SCI-123	3 (2+1)	Chemistry- 1 & 2
Total Credit Load			9 (6+3)	

1.	**Course :**	SCI-111	**Credit:** 3 (2+1)	**Semester- I**
	Course title:	Physics - 1 & 2		

Syllabus

Theory

Units and measurements : Need for measurements, Units for measurements, System of units, Definition of Unit, Requirements for good unit, Fundamental and derived quantities and their units. Meaning and definitions of dimensions, Determination of dimension of area, volume, density, velocity, acceleration, momentum, force. **Scalars and Vectors:** Meaning, definition and examples of scalars and vectors. **Force:** Types of forces such as real, pseudo forces and their examples. General idea of gravitational force, Electromagnetic force, Nuclear force, (weak and strong), Momentum and law of conservation of linear momentum. **Friction in solids and liquids :** Origin of frictional forces, Type of frictions, Laws of static friction and its experimental verification, Laws of kinetic friction. Meaning and definition of viscosity, Streamline flow and turbulent flow, Viscous force and viscous drag. **Sound waves :** Definition of wave and wave motion, Types of waves depending upon the necessity of medium (Mechanical and non mechanical waves). Progressive waves and its types (Longitudinal and transverse waves) and their properties. **Thermal Expansion :** Expansion of solids, Types of expansion of solids (Linear, areal and volume expansions). **Current Electricity:** Ohms' law, Definition of one ohm, resistance, Specific resistance, Conductivity, conductors, insulators, semiconductors. **Optics :** Reflection of light by spherical mirrors (Concave and convex), Focal length of spherical mirrors, Microscope, Compound microscope and Telescope, Refraction of monochromatic light, Laws of refraction, Snells' law, Dispersion of light and prism formula.
Circular Motion : Definition, example, uniform circular motion, Radius vector, angular displacement, angular velocity, angular acceleration, Period of revolution, centripetal force, centrifugal force. **Gravitation :** Newton's law of gravitation, Universal Gravitational constant, Gravitational field, Relation between 'g' & 'G', critical, velocity & binding energy of satellite, communication satellite. **Oscillations :** Linear simple harmonic motion, Examples, Amplitude, frequency, period, simple pendulum its length & period. **Surface tension :** Surface tension, Cohesive force, Adhesive force, sphere of influence, Applications of surface tension, Angle of contact capillary action, capillarity. **Wave theory of light :** Huygens wave theory of light, Merits & Demerits (Drawbacks), wavefront, wave normal, Huygens principle , Reflection, Refraction of light, polarization, Diffraction of light. **Interference & Diffraction:** Concept of interference, types & conditions of steady & clear interference, Bandwidth, Diffraction & types, Resolving power. **Communication :** Earth's atmosphere - Troposphere, stratosphere, Mesosphere Ionosphere, Radio waves, Satellite communication, Remote sensing, Line communication, Cables.

Practical

To study the use of log table. To determine the volume of solid sphere by using vernier caliper. To determine the radius & area of cross section of wire and thickness of glass plate by Micrometer screw gauge. To find the coefficient of static friction between the solid block and glass surface. To determine the resistance and specific resistance of a given wire by using Ohms' law. To determine R.I. of glass by travelling microscope. Spring mass oscillator. Surface tension**.** Resonance Tube. Use of meter bridge. Use of Sonometer – I. Use of Sonometer – II. Use of Potentiometer.

Teaching Schedule

a) Theory

Sr. No.	Name of the Topic	Weightage (%)
1.	**Units and measurements** Need for measurements, Units for measurements, System of units, Definition of Unit, Requirements for good unit, Fundamental and derived quantities and their units. Meaning and definitions of dimensions, Determination of dimension of area, volume, density, velocity, acceleration, momentum, force.	9
2.	**Scalars and Vectors:** Meaning, definition and examples of scalars and vectors.	4
3.	**Force:** Types of forces such as real, pseudo forces and their examples. General idea of gravitational force, Electromagnetic force, Nuclear force, (weak and strong), Momentum and law of conservation of linear momentum.	8
4.	**Friction in solids and liquids :** Origin of frictional forces, Type of frictions, Laws of static friction and its experimental verification, Laws of kinetic friction. Meaning and definition of viscosity, Streamline flow and turbulent flow, Viscous force and viscous drag.	9
5.	**Sound waves :** Definition of wave and wave motion, Types of waves depending upon the necessity of medium (Mechanical and non mechanical waves). Progressive waves and its types (Longitudinal and transverse waves) and their properties.	8
6.	**Thermal Expansion :** Expansion of solids, Types of expansion of solids (Linear, areal and volume expansions),	4
7.	**Current Electricity:** Ohms' law, Definition of one ohm, resistance, Specific resistance, Conductivity, conductors, insulators, semiconductors.	5

8.	**Optics :** Reflection of light by spherical mirrors (Concave and convex), Focal length of spherical mirrors, Microscope, Compound microscope and Telescope. Refraction of monochromatic light, Laws of refraction, Snells' law, Dispersion of light and prism formula.	3
9.	**Circular Motion :** Definition, example, uniform circular motion, Radius vector, angular displacement, angular velocity, angular acceleration, Period of revolution, centripetal force, centrifugal force.	8
10.	**Gravitation :** Newton's law of gravitation, Universal Gravitational constant, Gravitational field, Relation between 'g' & 'G', critical, velocity & binding energy of satellite, communication satellite.	8
11.	**Oscillations :** Linear simple harmonic motion, Examples, Amplitude, frequency, period, simple pendulum its length & period.	4
12.	**Surface tension :** Surface tension, Cohesive force, Adhesive force, sphere of influence, Applications of surface tension, Angle of contact capillary action, capillarity.	6
13.	**Wave theory of light :** Huygens wave theory of light, Merits & Demerits (Drawbacks), wavefront, wave normal, Huygens principle , Reflection, Refraction of light, polarization, Diffraction of light.	8
14.	**Interference & Diffraction:** Concept of interference, types & conditions of steady & clear interference, Bandwidth, Diffraction & types, Resolving power.	7
15.	**Communication :** Earth's atmosphere - Troposphere, stratosphere, Mesosphere Ionosphere, Radio waves, Satellite communication, Remote sensing, Line communication, Cables.	9
	Total	**100**

b) Practical

Practical	Name of the Practical
1.	To study the use of log table
2.	To determine the volume of solid sphere by using vernier caliper
3.	To determine the radius & area of cross section of wire and thickness of glass plate by Micrometer screw gauge
4.	To find the coefficient of static friction between the solid block and glass surface
5.	To determine the resistance and specific resistance of a given wire by using Ohms' law.
6.	To determine R.I. of glass by travelling microscope.
7.	Spring mass oscillator
8.	Surface tension**,**
9.	Resonance Tube
10.	Use of meter bridge,
11.	Use of Sonometer – I.
12.	Use of Sonometer - II,
13.	Use of Potentiometer.

Suggested Readings

1) **Physics book for XI standard.** 2008. Mahta, V. K. and Mehta, R.
   Maharashtra State Board of Secondary & Higher Secondary Education, Pune- 411 004
2) **Physics for XI Standard.**
   By Dr. Gambhir, Narendra Prakashan, Pune
3) **Physics book for XII standard**
   Maharashtra State Board of Secondary & Higher Secondary Education, Pune- 411 004.
4) **Physics for XII Standard**
   By Dr. Gambhir, Narendra Prakashan, Pune

2.	**Course :**	SCI-112	**Credit:** 3 (2+1)	**Semester-I**
	Course title:	Biology - I & II		

Syllabus

Theory

Section I - Botany

Systematic and binomial system of nomenclature - meaning of the terms taxonomy, systematics, classification and nomenclature, Need of classification, Taxonomic hierarchy with examples. Binomial nomenclature explanation, significance and examples. **Classification of living organisms :** (five Kingdom classification) – Major groups and principles of classification for each Kingdom with examples. Lichens - Meaning, characters, examples and importance. Viruses and viroids - Definitions, characters, types with examples, Economic importance and list of viral diseases. **Diversity in living organisms:** Salient features of major plant groups - Algae, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms (Dicotyledons and Monocotyledons). Three to five salient features and two examples of each category. Botanical gardens and herbaria - Meaning, importance and list of gardens and herbaria in India. **Biochemistry of cell Basic chemical constituents of living bodies :** Structure and function of carbohydrates, proteins, lipids. **Cell cycle:** Mitosis, Meiosis. **Morphology of Plants** : Morphology, anatomy and functions of different parts. Plant tissues. Movement of water, food, nutrients and gases. Transpiration, structure of stomata. Mineral deficiency symptoms, Mineral toxicity, Elementary idea of Hydroponics. **Plant Growth and Development:** Seed dormancy. Germination - Hypogeal, epigeal and viviparous. Definition and characteristics of growth. Phases of growth, Conditions of growth, Differentiation, de- differentiation, redifferentiation. Sequence of developmental process in a plant cell. Growth regulators - auxins, gibberellins, cytokinines, ethylene and abscissic acid (role in brief).

Genetic basis of inheritance: Mendelian inheritance. Modern concept of gene. DNA : Structure of eukaryotic DNA. RNA : General structure. Types and functions. Application of biotechnology in agriculture – Bt crops. Plant breeding. Tissue culture. Microbes as biocontrol agents. Photosynthesis, Photosynthetic pigments and their role. Significance of photosynthesis. Factors affecting photosynthesis. Respiration. Mechanism of Aerobic and anaerobic respiration. Significance of respiration. Reproduction in plants. Modes of reproduction, Sexual reproduction. Pollination : types and agencies. Environmental issues : effect of agrochemicals. Solid waste management, greenhouse effect. Global warming, ozone depletion, deforestation.

Section II - Zoology

Diversity in Living World: Kingdom Animalia: Salient features of major phyla under kingdom Animalia. Classification of following phyla with three to five salient features and

examples of each category: Annelida, Arthropoda, Mollusca. **Structure and function of cell:** Organization of Cell: Cell theory - brief account Prokaryotic and eukaryotic cell - structure and examples. Plant cell and animal cell. **Cell organelles**: Plastids, Mitochondria, Endoplasmic reticulum, Vacuoles, Ribosome. Microbodies, cilia and flagella. **Study of Animal Type:** Morphology, anatomy and functions of digestive and reproductive systems of cockroach.

Sex determination in honey bees only. Genetic engineering. Animal Husbandry. Management of farms and farm animals. Dairy, Poultry, Animal breeding. Bee keeping, Fisheries. Sericulture, Lac culture. Organism and Environment – II. Population interaction – competition, mutualism, parasitism, predation.

Practical

Study of parts of compound microscope. Preparation of T. S. of dicot (sunflower) and monocot roots and stem to study different plant tissues. Study and describe three locally available flowering plants from the families-Solanaceae, Fabaceae and Liliaceae with respect to types of root-(tap and adventitious), stem (herbaceous and woody), leaf (arrangement, shape, venation, simple and compound) and floral characters. Study of different modifications of root (parasitic root) pneumatophores), Epiphytic root. Study of different modifications of stem and leaf. Comparative study of rates of transpiration in upper & lower surface of leaf. Xylem, phloem, through temporary or permanent slides. Study of specimens and their identification with reasons – *Hydra*, Earthworm, Prawn, Silkworm Honey bee , Snail, Phyla, Star-fish, Shark, Rohu, Frog, Lizard, Pigeon and Rat. Study of external morphology of earthworm, cockroach and frog through models.

Study of Mitosis by Preparation of temporary mount of onion root tip. For meiosis Tradescantia. Dissection of given flower to display different parts. Make a temporary preparation of pollen grain. Calculate The rate of respiration by floral buds/leaf tissue/germinating seeds. Study of plant population density. Comparison test for the soil samples for pH. Floral adaptations for pollination by wind / insect. Exercise on controlled pollination (Emasculation, Tagging and Bagging). Study of mendelian inheritance using pea seeds of different colour / size.

Teaching Schedule

a) Theory

Sr.No.	Name of Topic	Weightage (%)
	Section I - Botany	
1	**Systematic and binomial system of nomenclature** - meaning of the terms taxonomy, systematics, Classification and nomenclature, Need of classification, Taxonomic hierarchy with examples. Binomial nomenclature explanation, significance and examples.	6
2	**Classification of living organisms** (five Kingdom classification) – Major groups and principles of classification for each Kingdom with examples. Lichens - Meaning, characters, examples and importance. Viruses and viroids - Definitions, characters, types with examples, Economic importance and list of viral diseases.	7
3	**Diversity in living organisms** Salient features of major plant groups - Algae, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms (Dicotyledons and Monocotyledons). Three to five salient features and two examples of each category. Botanical gardens and herbaria - Meaning, importance and list of gardens and herbaria in India.	5
4	**Biochemistry of cell Basic chemical constituents of living bodies.** Structure and function of carbohydrates, proteins.	2
5	**Cell cycle** : Mitosis, Meiosis	2
6	**Morphology of Plants** Morphology, anatomy and functions of different parts, Plant tissues. Movement of water, food, nutrients and gases. Transpiration, structure of stomata. Mineral deficiency symptoms, Mineral toxicity, Elementary idea of Hydroponics.	10
7	**Plant Growth and Development:** Seed dormancy. Germination - Hypogeal, epigeal and viviparous. Definition and characteristics of growth. Phases of growth, Conditions of growth, Differentiation, de- differentiation, redifferentiation. Sequence of developmental process in a plant cell. Growth regulators - auxins, gibberellins, cytokinines, ethylene and abscissic acid (role in brief)	8
8	Genetic basis of inheritance: Mendelian inheritance, Modern concept of gene, DNA : Structure of eukaryotic DNA, RNA : General structure, Types and functions,	4
9	Application of biotechnology in agriculture – Bt crops, Plant breeding, Tissue culture.	4
10	Photosynthesis, Photosynthetic pigments and their role, Significance of photosynthesis, Factors affecting photosynthesis,	6
11	Respiration, Mechanism of Aerobic and anaerobic respiration, Significance of respiration,	6
12	Reproduction in plants, Modes of reproduction, Sexual reproduction, Pollination: types and agencies,	6
13	Environmental issues : effect of agrochemicals, solid waste management, greenhouse effect, global warming, ozone depletion, deforestation.	3
	Section II - Zoology	
14	**Diversity in Living World:** Kingdom Animalia: Salient features of major phyla under kingdom Animalia.	2

15	Classification of following phyla with three to five salient features and examples of each category: Annelida, Arthropoda, Mollusca.	2
16	**Structure and function of cell:** Organization of Cell: Cell theory - brief account Prokaryotic and eukaryotic cell - structure and examples. Plant cell and animal cell.	2
17	**Cell organelles**: Plastids, Mitochondria, Vacuoles, Ribosome, Microbodies, cilia and flagella.	2
18	**Study of Animal Type:** Morphology, anatomy and functions of digestive and reproductive systems of cockroach	2
19	Sex determination in honey bees only. Genetic engineering,	4
20	Animal Husbandry, Management of farms and farm animals, Dairy, Poultry, Animal breeding,	6
21	Bee keeping, Fisheries, Sericulture, Lac culture,	5
22	Organism and Environment – II, Population interaction – competition, mutualism, parasitism, predation	6
	Total	**100**

b) Practical

Practicals	Name of Practical
1.	Study of parts of compound microscope.
2.	Study and describe three locally available flowering plants from the families-Solanaceae, Fabaceae and Liliaceae with respect to types of root-(tap and adventitious), stem (herbaceous and woody), leaf (arrangement, shape, venation, simple and compound) and floral characters.
3.	Preparation of T. S. of dicot (sunflower) and monocot roots and stem to study different plant tissues.
4.	Study of different modifications of root (parasitic root) pneumatophores), Epiphytic root.
5.	Study of different modifications of stem and leaf
6.	Comparative study of rates of transpiration in upper & lower surface of leaf
7.	Xylem, phloem, through temporary or permanent slides.
8.	Study of specimens and their identification with reasons – *Hydra*, Earthworm, Prawn, Silkworm Honey bee , Snail, Phyla, Star-fish, Shark, Rohu, Frog, Lizard, Pigeon and Rat.
9.	Study of external morphology of earthworm, cockroach and frog through models.
10.	Study of Mitosis by Preparation of temporary mount of onion root tip. For meiosis Tradescantia.
11.	Dissection of given flower to display different parts.
12.	Make a temporary preparation of pollen grain.
13.	Calculate The rate of respiration by floral buds/leaf tissue/germinating seeds
14.	Study of plant population density
15.	Comparison test for the soil samples for pH
16.	Floral adaptations for pollination by wind / insect,
17.	Exercise on controlled pollination (Emasculation, Tagging and Bagging),
18.	Study of mendelian inheritance using pea seeds of different colour / size,

Suggested Readings

1. **Biology book for XI standard**
   Maharashtra State Board of Secondary and Higher Secondary Education, Pune-411 004.
2. **Biology for XI Standard**
   Narendra Prakashan, Pune
3. **Biology book for XII standard.** Sharma J. P. and Garge, P. K.
   Maharashtra State Board of Secondary and Higher Secondary Education, Pune- 411 004
4. **Biology for XII Standard**
   Uttam Prakashan, Mumbai

3.	**Course :**	SCI -123	**Credit:** 3 (2+1)	**Semester-II**
	Course title:	**Chemistry – I & II**		

Syllabus

Theory

Physical and inorganic chemistry : Basic concept of chemistry- Importance, Role, Definition. Branches of chemistry, Mole concept. **Fundamental and derived units and their SI units -** Systems of units Fundamental basic units, Avogadro's law, Avogadro's number, Molecular weight. **State of matter** - Introduction, States of matter, Ideal gas equation. Liquid state. Qualitative description of vapour pressure, surface tension Viscosity, Classification of solid and their types. **Atomic structure –** Introduction. sub shells and orbitals Electronic configuration of elements. Fluf- Bau principle and Hund's rule. **Redox Reaction** – Introduction, Classical concept of oxidation and reduction, Electron transfer concept Oxidizing agent and reduction agent, Difference between oxidation and redaction. **Chemical equilibrium** – Introduction, Types of chemical reaction, difference between reversible and irreversible reaction, Chemical equilibrium, Law of mass action, Mass law equation. **Study of Periodic table** : **Nature of chemical bond -** Introduction, Electronic theory of valency, Postulates.Octate rule. Limitation, Types of bond, Valence bond theory, Hybridization. **Organic and inorganic chemistry : Chemistry of carbon compounds** – Introduction, impotence of organic chemistry. General characteristics of organic compound, Classification of organic compounds. Homologous series,. Empirical and molecular formula. **Alkanes** – Introduction, Structure of methane and ethane, Classification of alkanes isomerism in alkanes. Nomenclature Physical properties of alkanes chemical properties, Uses. **Alkenes** – Introduction, Structure of ethane, Isomerism, Nomenclature, Classification, Physical and chemical properties, Uses. **Alkynes** – Introduction, Structure of acetylene, Nomenclature, Physical and chemical properties (Only enlist), Uses. **Aromatic compounds** – Introduction, Characteristics difference between aliphatic and aromatic compounds, Benzene structure, Physical and chemical properties.

Solid State : Types of crystal and solid, Types of Semiconductors, Magnetic Properties of Solid. **Solutions and Collugative properties :** Ways of expression of concentration of solutions, Osmotic pressure. **Chemical thermodynamics :** Pressure Volume Type work in Isothermal irreversible process, Maximum work in Isothermal reversible process, First law of thermodynamics, Introduction of enthalpy, entropy and Gibbs energy, IInd, IIIrd Law of thermodynamics. **Electrochemistry :** Molar conductivity of solution, Electrolysis, Drycell and lead accumulator. **Chemical kinetics :** Order and molecularity of reaction. **General principals isolation and elements :** P Block element, p, d & f Blocks elements. **Halogen derivatives of alkanes :** Preparation methods and properties, uses. **Alcohols phenols & ethers :** Preparation methods and properties. **Chemistry in every day life :** Chemicals in medicines i.e. Analgesics, antibiotics, antiseptic, antioxidants, Chemicals in food preservatives and artificial sweetening agent, cleansing agents, soaps and detergents, cleaning action.

b) Practicals

Acid base titrations – Volumetric analysis. Detection of elements. Detection of acidic and basic radicles (qualitative analysis). Determination of pH of aqueous solution of different types of salts. Identification of functional group in organic compounds : alcoholic – OH, phenotic – OH, aldehyde, ketone, acid. Determination of melting and boiling points. Chemical kinetics **:** Effect of concentration and temperature on the rate of reaction between sodium thiosulphate & hydrochloric acid. Chromatography (demonstration) : Separation of pigments from extracts of leaves and flowers by paper Chromatography and determination of Rf values. Characteristic tests of carbohydrates, fats and proteins in pure samples and their detection in given food stuffs. Determination of concentration molarity of $KMnO_4$ solution by titrating it against a standard solution, Volumetric analysis. Qualitative analysis : Determination of two cations from a given mixture of salts and Identification of two anions.

Teaching Schedule

Theory

Lecture No.	Topic to be covered	Weightage (%)
	Physical and inorganic chemistry	
1	**Basic concept of chemistry**- Importance, Role, Definition. Branches of chemistry, Mole concept	4
2 & 3	**Fundamental and derived units and their SI units -** Systems of units Fundamental basic units, Avogadro's law, Avogadro's number, Molecular weight	3
4 - 6	**State of matter** - Introduction, States of matter, Ideal gas equation. Liquid state. Qualitative description of vapour pressure, surface tension Viscosity, Classification of solid and their types	4
7 -10	**Atomic structure –** Introduction. sub shells and orbitals Electronic configuration of elements. Fluf- Bau principle and Hund's rule.	3
13-14	**Redox Reaction** – Introduction, Classical concept of oxidation and reduction, Electron transfer concept Oxidizing agent and reduction agent, Difference between oxidation and redaction	4
15	**Chemical equilibrium** – Introduction, Types of chemical reaction, difference between reversible and irreversible reaction, Chemical equilibrium, Law of mass action, Mass law equation	5
16	**Study of Periodic table**	5
17-18	**Nature of chemical bond** - Introduction, Electronic theory of valency, Postulates.Octate rule. Limitation, Types of bond, Valence bond theory, Hybridization.	4
	Organic and inorganic chemistry	
19-21	**Chemistry of carbon compounds** – Introduction, impotence of organic chemistry. General characteristics of organic compound, Classification of organic compounds. Homologous series,. Empirical and molecular formula	5

22	**Alkanes** – Introduction, Structure of methane and ethane, Classification of alkanes isomerism in alkanes. Nomenclature Physical properties of alkanes chemical properties, Uses.	4
23	**Alkenes** – Introduction, Structure of ethane, Isomerism, Nomenclature, Classification, Physical and chemical properties, Uses.	3
24	**Alkynes** – Introduction, Structure of acetylene, Nomenclature, Physical and chemical properties (Only enlist), Uses	2
25	**Aromatic compounds** – Introduction, Characteristics difference between aliphatic and aromatic compounds, Benzene structure, Physical and chemical properties.	4
26	**Solid State :** Types of Crystal and solid, Types of Semiconductors, Magnetic Properties of Solid,	5
27	**Solutions and Collugative properties :** Ways of expression of concentration of solutions, Osmotic pressure,	6
28	**Chemical thermodynamics :** Pressure Volume Type work in Isothermal irreversible process, Maximum work in Isothermal reversible process, First law of thermodynamics, Introduction of enthalpy, entropy and Gibbs energy, IInd, IIIrd Law of thermodynamics.	8
29	**Electrochemistry :** Molar conductivity of solution, Electrolysis, Drycell and lead accumulator,	4
30	**Chemical kinetics :** Order and molecularity of reaction,	5
31	**General principals isolation and elements :** P Block element, p, d & f Blocks elements,	4
32	**Halogen derivatives of alkanes :** Preparation methods and properties, uses.	5
33	**Alcohols phenols & ethers :** Preparation methods and properties,	4
34	**Chemistry in every day life :** Chemicals in medicines i.e. Analgesics, antibiotics, antiseptic, antioxidants, Chemicals in food preservatives and artificial sweetening agent, cleansing agents, soaps and detergents, cleaning action	9
	Total	**100**

b) Practical

Practical No.	Name of the Practical
1	Acid base titrations – Volumetric analysis.
2	Detection of elements.
3	Detection of acidic and basic radicles (qualitative analysis).
4	Determination of pH of aqueous solution of different types of salts.
5	Identification of functional group in organic compounds : alcoholic – OH, phenotic – OH, aldehyde, ketone, acid.
6	Determination of melting and boiling points.
7	Chemical kinetics : Effect of concentration and temperature on the rate of reaction between sodium thiosulphate & hydrochloric acid
8	Chromatography (demonstration) : Separation of pigments from extracts of leaves and flowers by paper Chromatography and determination of Rf values,
9	Characteristic tests of carbohydrates, fats and proteins in pure samples and their detection in given food stuffs,

10	Determination of concentration molarity of $KMnO_4$ solution by titrating it against a standard solution, Volumetric analysis.
11	Qualitative analysis : Determination of two cations from a given mixture of salts and Identification of two anions.

Suggested Readings

1. **Chemistry book for XI standard.** 2010. Verma, N. K. and Khanna, S. K. Maharashtra State Board of Secondary and Higher Secondary Education, Pune-411 004
2. **Chemistry - practical Handbook for XI Standard** Narendra Prakashan, Pune
3. **Modern Inorganic Chemistry.** 1987. R.C. Agrrawal, S. Chand.
4. **Chemistry (XI) revised Ed. latur pattern notes** (2007), A. P. Narhare and V.R. Utake, Nikita publication, Latur
5. **Chemistry book for XII standard.** 2007. NCERT. Maharashtra State Board of Secondary and Higher Secondary Education, Pune-411 004.
6. **Chemistry for XII Standard.** Narendra Prakashan, Pune.

Agriculture Polytechnic

13) Mathematics

- **Syllabus**
- **Teaching Schedule**
- **Suggested Readingss**

Mathematics

Sr. No.	Semester	Course No	Credit	Course Title
1	I	MATH-111	2 (1+1)	Elementary Mathematics
2	II	MATH-122	2 (1+1)	Elementary Mathematics-II
Total Credit Load			4 (2+2)	

1.	**Course :**	MATH -111	**Credit:** 2 (1+1)	**Semester-I**
	Course title:	**Elementary Mathematics**		

Syllabus

Theory

Definition of matrices, Addition of matrices, Subtraction of matrices, Scalar Multiplication, product of Matrices, Types of Matrices. Definition of determinant as a function of square matrices, evaluation of determinant of second order only. Properties of determinants. Distance Formula, Section Formula, Section formula for internal division. Equation of co-ordinate axes, Equation lines parallel to axes, Slope -Intercept form of equation of line, Slope -Point form of equation of line, Two Point form of equation of line, Intercept form of equation of line. Definition of circle, various forms of equation of circle i.e. centre-radius form, standard form, three point form, diameter form and General form. Illustration of ordinates of curve and common distance between ordinates. Definition of function, types of function, Theorems on limits (statement only), Definition of continuity, Simple Problems on limit, Simple Problems on continuity. Definition of Derivatives. Differentiation of simple functions (Formulae's), Derivatives of Sum, difference, product & quotient of two functions(statement only). Definition, integrals of elementary functions (Formulae) Theorems, Integration of functions by decomposition method, Examples based on it. Definite integral **:** Definition of Definite Integral, Examples based on it, Area under simple well-known curves.(simple problem based on it).

Practical

Exercise on matrices. Exercise on determinants. Exercise on Section Formulae. Exercise on distance between two points, Slopes. Exercise on different forms of straight lines. Exercise on circles. Illustrations on ordinates of curve and Examples based on Simpson's rule. Exercise on functional limits. Exercise on derivatives and differentiation. Exercise on Integration.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1,2	Definition of matrices, Addition of matrices, Subtraction of matrices, Scalar Multiplication, product of Matrices, Types of Matrices.	11
3	Definition of determinant as a function of square matrices, evaluation of determinant of second order only. Properties of determinants.	06
4,5	Distance Formula, Section Formula, Section formula for internal division.	11
6,7	Equation of co-ordinate axes, Equation lines parallel to axes, Slope - Intercept form of equation of line, Slope -Point form of equation of line, Two Point form of equation of line, Intercept form of equation of line.	11
8,9	Definition of circle, various forms of equation of circle i.e. centre-radius form, standard form, three point form, diameter form and General form.	11
10,11	Illustration of ordinates of curve and common distance between ordinates	11
12,13	Definition of function, types of function, Theorems on limits (statement only), Definition of continuity, Simple Problems on limit, Simple Problems on continuity.	11
14,15,16	Definition of Derivatives, Differentiation of simple functions (Formulae's), Derivatives of Sum, difference, product & quotient of two functions(statement only)	16
17	Definition, integrals of elementary functions (Formulae) Theorems, Integration of functions by decomposition method, Examples based on it.	06
18	Definite integral **:** Definition of Definite Integral, Examples based on it, Area under simple well-known curves.(simple problem based on it.)	06
	Total	**100**

b) Practical

Practicals	Topic
1	Exercise on matrices.
2	Exercise on determinants.
3	Exercise on Section Formulae.
4	Exercise on distance between two points, Slopes.
5	Exercise on different forms of straight lines.
6	Exercise on circles.
7	Illustrations on ordinates of curve and Examples based on Simpson's rule.
8	Exercise on functional limits
9	Exercise on derivatives and differentiation
10	Exercise on Integration

Suggested Readings

1) A Text Book of Mathematics,
11^{th} Part-I and Part II, 12^{th} Part-I and Part-II- Maharashtra State Board of secondary and Higher secondary Education, Pune.

2) **Mensuration-I.** Pierpoint.

3) A text book Agricultural Mathematics
Ms. A. A. Chaudhari *et.al*.

2.	**Course :**	MATH -122	**Credit :** 2 (1+1)	**Semester**-II
	Course title :	Elementary Mathematics-II		

Syllabus

Theory

Matrics – Elementary transformation method, Inverse of a matrix, Application of matrics, method of reduction. Trigonometric functions - equations and solutions, solutions of triangle, sine-rule, cosine rule. Vectors – Collinearity and coplanarity of product, scaler triple product. Three dimensional geometry - Direction angles, direction cosines, relation between direction cosines of a line. Linear programming – Solution of LPP by graphical method, converting business problems in to a mathematical formation, terminologies related to the solution of LPP. Differentiation – Derivatives of composite function, derivatives of implicit function, higher order derivatives. Applications of derivatives – Rolle's theorum and L.M. V.T. theorem, increasing and decreasing function. Differential equations – Ordinary differential functions, order and degree differential equation, solution of a differential equation, formation of a differential equation.

Practical

Exercises on matrices. Exercises on trigonometric function. Exercises on vectors. Exercises on three dimentional geometry. Exercises on linear programming. Exercises on differentiation. Exercises on application of derivatives. Exercises on differential equation.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1 & 2	Matrics – Elementary transformation method, Inverse of a matrix, Application of matrics, method of reduction.	15
3 & 5	Trigonometric functions - equations and solutions, solution of triangle, sine-rule, cosine rule.	12
6 & 8	Vectors – Collinearity and coplanarity of product, scaler triple product.	8
9 & 11	Three dimensional geometry - Direction angles, direction cosines, relation between direction cosines of a line.	10
12 & 13	Linear programming – Solution of LPP by graphical method, converting business problems in to a mathematical formation, terminologies related to the solution of LPP.	10
14 & 16	Differentiation – Derivatives of composite function, derivatives of implicit function, higher order derivatives. Applications of derivatives – Rolle's theorum and L.M.V.T. theorem, increasing and decreasing function.	30
17 &18	Differential equations – Ordinary differential functions, order and degree differential equation, solution of a differential equation, formation of a differential equation.	15
	Total	**100**

b) Practical

Practicals	Topic
1 & 2	Exercises on matrices.
3 & 4	Exercises on trigonometric function.
5 & 6	Exercises on vectors.
7 & 8	Exercises on three dimentional geometry.
8 & 9	Exercises on linear programming.
10 & 11	Exercises on differentiation.
12 & 15	Exercises on application of derivatives.
16	Exercises on differential equation.

Suggested Readings

1) **A Text Book of Mathematics, XIIth Standard.**
Part-I and Part-II- Maharashtra State Board of secondary and Higher Secondary Education, Pune.

Agriculture Polytechnic

14) Computer & Agril. Statistics

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

Agricultural Statistics

Sr.No.	Semester	Course No	Credit	Course Title
1	II	COMP-121	3 (1 + 2)	Introduction to Computer Application and Statistics
Total Credit Load			**3 (1+2)**	

1.	**Course :**	COMP-121	**Credit :** 3 (1+2)	**Semester-**II
	Course title:	Introduction to Computer Application and Statistics		

Syllabus

Theory

Introduction to Computers, Definition: Hardware, Software &firmware. Types of software. Input Output devices, Memory - Primary, Secondary Memory,Units used for measurement of memory. Operating Systems - Introduction to different Operating Systems, definition and types. Data Representation, Number systems (Binary, Hexadecimal). Encoding schemes). File Management – Document, Folder, File & its process. Document Creation - Applications used for document creation & Editing, Data Presentation using slides. MS Word: Introduction of word- processing packages, Creating, editing, formatting and saving a document. MS Excel: Introduction, creating, editing, formatting, saving sheet. MS. Power point : Introduction , features of slide presentation package. Preparation of presentation. Import export operations, using Numerical tabular data/text/graph/slides within different applications using cut-paste. MS- Access : Introduction ,concept of data base. Internet : Introduction, world wide web (www), Concepts, web browsing etc. Smartphone apps in agriculture for farm advises, market price, post harvest management etc. Advance methods of communication – email, e-calendar, e-talk, e-video conferences & using its different softwares & Apps. Statistics – Introduction & its application in agriculture. Graphical representation of Data. Measures of central tendency & dispersion.

Practical

Introduction to computers & its types. Computer components & their functions. Study an anatomy of typical window. Working with windows – Desktop, icon, start button, Date & time. Working with windows – Shutdown, log off, restart, refresh. Working with MS- Words – Document create, font, font size, colour, bullet, alignment etc. Working with MS-Words – Print, Print preview, format, rename, save, save as, delete. Working with MS – Excel – Sheets, Workbooks, create, save, & data entry. Working with MS – Excel – Sheets, cell formulas, graphs, sum, average, sort, find & replace & other functions. Working with MS – Excel – Sample data analysis, exam- result sheet. Working with MS – Powerpoint – Preparation of presentation, different slides, save slides, format slides & data entry. Working with MS – Powerpoint – Using of animations, sounds, videos etc. Working with MS – Powerpoint – Actual presentation skills. Working with MS Access – Data base, create table, sort data query, record, analysis & report presentation. Working with internet – Search engines, Agricultural websites. Working with internet – Browsing, creating e-mail account & e-mail. Online transactions & its process. Working with internet - e - talk, video calling. Working with internet – Official video conference, virtual learning system. Creating graphs, reports on given topics. Practicals on measures of central tendency using MS Excel. Practicals on measure of dispersion using MS Excel.

Teaching Schedule

a) Theory

Lecture	Topics	Weightage (%)
1	**Introduction to Computers,** Definition: Hardware, Software &firmware. Types of software.	5
2	**Input Output devices,** Memory - Primary, Secondary Memory, Units used for measurement of memory	6
3	**Operating Systems** - Introduction to different Operating Systems, definition and types	5
4	**Data Representation,** Number systems (Binary, Hexadecimal). Encoding schemes)	5
5	**File Management** – Document, Folder, File & its process.	6
6	**Document Creation -** Applications used for document creation & Editing, Data Presentation using slides.	8
7	**MS Word:** Introduction of word- processing packages, Creating, editing, formatting and saving a document.	4
8	**MS Excel:** Introduction, creating, editing, formatting, saving sheet.	8
9	**MS. Power point** : Introduction , features of slide presentation package.	8
10	**Preparation of presentation.** Import export operations, using Numerical tabular data/text/graph /slides within different applications using cut-paste. **MS- Access** : Introduction ,concept of data base	8
11	**Internet :** Introduction, world wide web (www), Concepts, web browsing etc.	7
12	**Smartphone apps in agriculture** for farm advises, market price, post harvest management etc.	8
13	**Advance methods of communication** – email, e-calendar, e-talk, e-video conferences & using its different softwares & Apps.	5
14	**Statistics** – Introduction & its application in agriculture.	3
15	Graphical representation of Data.	4
16	Measures of central tendency & dispersion.	10
	Total	**100**

b) Practical

Exercise	Topics
1	Introduction to computers & its types.
2	Computer components & their functions.
3	Study an anatomy of typical window.
4	Working with windows – Desktop, icon, start button, Date & time.
5	Working with windows – Shutdown, log off, restart, refresh.
6	Working with MS- Words – Document create, font, font size, colour, bullet, alignment etc.
7	Working with MS-Words – Print, Print preview, format, rename, save, save as, delete.
8	Working with MS – Excel – Sheets, Workbooks, create, save, & data entry.
9	Working with MS – Excel – Sheets, cell formulas, graphs, sum, average, sort, find & replace & other functions.
10	Working with MS – Excel – Sample data analysis, exam- result sheet.
11	Working with MS – Powerpoint – Preparation of presentation, different slides, save slides, format slides & data entry.
12	Working with MS – Powerpoint – Using of animations, sounds, videos etc.
13	Working with MS – Powerpoint – Actual presentation skills.
14	Working with MS Access – Data base, create table, sort data query, record, analysis & report presentation.
15	Working with internet – Search engines, Agricultural websites.
16	Working with internet – Browsing, creating e-mail account & e-mail. Online transactions & its process.
17	Working with internet - e - talk, video calling.
18	Working with internet – Official video conference, virtual learning system.
19	Creating graphs, reports on given topics.
20	Practicals on measures of central tendency using MS Excel.
21	Practicals on measure of dispersion using MS Excel.

Suggested Readings

1) **Computer Fundamentals.** Pradeep K. Sinha and Priti Sinha, III edition, BPB Publications, B-14, Connaught Place, New Delhi – 110 001.
2) **http://www.nrsc.gov.in/Agriculture**
3) **http://iasri.res.in/**
4) **http://communicationtheory.org/berlos-smcr-model-of-communication/**
5) **Statistical Method**s. S. B. Gupta, S. Chand and Co., New Delhi
6) **A Textbook of Agricultural Statistics**. R. Rangaswamy, New Age International Pvt. Ltd.
7) **Fundamentals of Statistics**. Vol. Ist, Goon, A. M., Gupta M. K. and Dasgupta, B., A World Fresh Pvt. Ltd., Kolkata.

Agriculture Polytechnic

15) Non-gradial Courses

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

Non-gradial courses

Sr.No.	Semester	Course No	Credit	Course Title
1	I	PE- 111	1 (0 + 1)*	Physical Education & Yoga (Non Credit Course)
2	II	PE- 122	1 (0 + 1)*	Physical Education & Yoga (Non Credit Course)
3	VI	DEG-361	1 (1 + 0)*	Democracy, Elections, Good Governance
4	VI	HVE-361	1 (1 + 0)*	Human values and Ethics
Total Credit Load			**4 (2+2)**	

*** Non-gradial course.**

1 & 2	**Course :**	PE -111 & PE-122	**Credit:** 1(0+1)	**Semester- I, II**
	Course title:	Physical Education and Yoga		

Syllabus

Practical

Introduction to physical education definition, objectives, scope, and importance; physical culture; Warming up - Need and requirement of first aid. Meaning and importance of Physical Fitness and Wellness. Physical fitness components -speed, strength, endurance, power, flexibility, agility, coordination and balance. Methods of Training; aerobic and anaerobic exercises; weight training, circuit training, Interval training, Fartlek training. Skill of Volleyball, Rules & Regulation, Advance Skill of Volleyball, Specific Warming up. Skill of Kabaddi Rules& Regulations. Advance Skill of Kabaddi. Skill of Kho-Kho, Rules & Regulations. Advance Skill of Kho- Kho, & Specific Warming up. Skill of Basket ball Rules & Regulation, Advance skill of Basket ball & Specific warming up. Skill of Athletics, Long and Short Distance running, Skill of Athletics Jumping events, Throwing events.Yoga- History, Meaning and importance, Role of yoga in life. Omkar, Yogic kriya, Yogic Suksma vyayamas. Yogasana- in Standing posture (Tadasana, Vrikshasana, Padahastasana, Ardha-Chakrasana, Trikonasana). Yogasana- in Sitting postures (Asanas viz: Bhadrasana, Vjrasana, Ardha-Ustrasana, Ushtrasana, sasakasana and Vakrasana). Yogasana- in Prone postures (Makarasana, Bhujangasana and Salabhasana). Yogasana- in Supine posture (Setubandhasana, Uttanapadasana, Ardha-halasana, and Pavanamuktasana, Shavasana). Suryananskars, Yognidra. Kapalbhati, Pranayam, Meditation in different mudras.

Teaching Schedule

Practical

Practical	Topic
1	Introduction to physical education definition, objectives, scope, and importance; physical culture; Warming up - Need and requirement of first aid.
2	Meaning and importance of Physical Fitness and Wellness; Physical fitness components -speed, strength, endurance, power, flexibility, agility, coordination and balance; Methods of Training; aerobic and anaerobic exercises; weight training, circuit training, Interval training, Fartlek training
3	Skill of Volleyball, Rules & Regulation, Advance Skill of
	Volleyball, Specific Warming up
4	Skill of Kabaddi Rules& Regulations. Advance Skill of Kabaddi
5	Skill of Kho-Kho, Rules & Regulations. Advance Skill of Kho- Kho, & Specific Warming up
6	Skill of Basket ball Rules & Regulation, Advance skill of Basket ball & Specific warming up
7	Skill of Athletics, Long and Short Distance running, Sill of Athletics Jumping events, Throwing events
8	Yoga- History, Meaning and importance, Role of yoga in life
9	Omkar, Yogic kriya, Yogic Suksma vyayamas
10	Yogasana- in Standing posture (Tadasana, Vrikshasana, Padahastasana, Ardha-Chakrasana, Trikonasana)
11	Yogasana- in Sitting postures (Asanas viz: Bhadrasana, Vjrasana, Ardha-Ustrasana, Ushtrasana, sasakasana and Vakrasana)
12	Yogasana- in Prone postures (Makarasana, Bhujangasana and Salabhasana)
13	Yogasana- in Supine posture (Setubandhasana, Uttanapadasana, Ardha-halasana, and Pavanamuktasana, Shavasana)
14	Suryananskars, Yognidra
15	Kapalbhati,Pranayam, Meditation in different mudras

Suggested Readings

1) **Test, Measurement and Evaluation in Physical Education.** 2011. P. L. Karad.
2) **Foundations of Physical Education, Exercise Science, and Sport.** Deborah A., Wuest, Charles A. Bucher
3) **Light on Yoga.** Edn. 31st 1995. B. K. S. Iyangar. Schocken Publication.

3.	**Course :**	DEG-361*	**Credit :** 1 (1 + 0)	**Semester- VI**
	Course title:	Democracy, Elections, Good Governance		

Syllabus

Theory

Democracy – Introduction meaning, classification, Principles of Democracy, Dimensions of democracy, Democracy and Diversity Decentralization : concept, features, Fundamental Rights in the Indian Constitution, Outcomes of Democracy and Challenges of Democracy. Independent Election Commission in India powers of election commission in India, Elections to local self Government Bodies, National level, State level, Institutions at the local level Municipal Cooperation, Municipal Council Nagar Panchayat, Zilla Parishad, Panchayat Samiti, Gram Panchayat : powers duties, Constitutional Provision of 73 & 74 constitutional Amendment Act and Important features of 73 & 74 Constitutional Amendment Act. Good Governance : Concept, meaning, Government & Good Governance, Good Governance and India, Nature of G.G. in India, Attributes of Poor Goverance1 and Steps taken for Good Governance in India.

Teaching Schedule

Theory

Lectures	Topic	Weightages (%)
1	Democracy – Introduction meaning, classification	4
2	Principles of Democracy, Dimensions of democracy	6
3	Democracy and Diversity Decentralization : concept, features,	6
4	Fundamental Rights in the Indian Constitution	10
5	Outcomes of Democracy, Challenges of Democracy	6
6	Independent Election Commission in India powers of election commission in India	8
7	Elections to local self-Government Bodies, National level, State level	8
8	Institutions at the local level Municipal Cooperation, Municipal Council Nagar Panchayat	8
9 & 10	Zilla Parishad, Panchayat Samiti, Gram Panchayat : powers duties	10
11	Constitutional Provision of 73 & 74 constitutional Amendment Act	6
12	Important features of 73 & 74. Constitutional Amendment Act	4
13	Good Governance : Concept, meaning	4
14	Government & Good Governance, Good Governance and India, Nature of G.G. in India	6
15	Attributes of Poor Governance	4
16	Steps taken for Good Governance in India	10
	Total	**100**

Suggested Readings

1. **Development and Democracy in India.** 2002. Shailendra D Dharma, Lynne Rienner, Boulder.
2. **The Constitution of India**, Edn.: 14th, 2017. P. M. Bakshi. Publication:Universal Law Publishing.

4.	**Course :**	HVE-361*	**Credit :** 1 (1 + 0)	**Semester- VI**
	Course title:	Human values and Ethics		

Syllabus

Theory

Universal human aspirations: Happiness and prosperity; Human values and ethics: Concept, definition, significance and sources; Fundamental values: Right conduct, peace, truth, love and non-violence; Ethics: professional, environmental, ICT; Sensitization towards others particularly senior citizens, developmentally challenged and gender. Spirituality, positive attitude and scientific temper; Team work and volunteering; Rights and responsibilities; Road safety; Human relations and family harmony; Modern challenges and value conflict: Sensitization against drug abuse and other social evils; Developing personal code of conduct (SWOT Analysis); Management of anger and stress.

Teaching Schedule

Theory

Lectures	Topic	Weightages (%)
1	Universal human aspirations: Happiness and prosperity	6
2	Human values and ethics: Concept, definition	6
3	Human values and ethics: Significance and sources	6
4	Fundamental values: Right conduct, peace, truth, love and non-violence	8
5	Ethics: professional, environmental	6
6	Ethics: ICT	8
7	Sensitization towards others particularly senior citizens, developmentally challenged and gender	8
8	Spirituality, positive attitude and scientific temper	8
9	Team work and volunteering, Rights and responsibilities	8
10	Road safety; Human relations and family harmony	8
11	Modern challenges and value conflict, Sensitization against drug abuse and other social evils	6
12	Developing personal code of conduct (SWOT Analysis)	8
13	Management of anger	6
14	Stress Management	8
	Total	**100**

Suggested Readings

1. **A Foundation Course in Human Values and Professional Ethics.** 2011. Gaur RR, Sangal R & Bagaria GP. Excel Books.
2. **Professional Ethics and Human Values. Text book.** 2006. Nagrajan R. S. New Age International (P) Ltd. Publishers.
3. **Human Values and Education -Axiology, Inculcation and Research**. 2011. Sharma R. A. R., Lall Book Depot.
4. **Value Education and Professional Ethics.** 2011. Sharma RP & Sharma M., Kanishka Publishers.
5. **Human Values and Professional Ethics.** 2011. Srivastava S., S. K. Kataria & Sons.
6. **Environmental Science.** 2011. Srivastava S., S. K. Kataria & Sons.
7. **Human Values.** 2009. Tripathi A.N., New Age International (P) Ltd Publishers.
8. **Education for Values, Environment and Human Rights.** 2010. Mathur, S. S., RSA International.
9. **Encyclopedia of Ethics**, 2nd ed. D. H. Hill Ref. BJ63. E452001 3 vols.