

SYLLABUS
B.Sc. Agriculture (under CBCS)
Academic Session w.e.f. 2019-2023



University Department of Agriculture
RADHA GOVIND UNIVERSITY ,RAMGARH

RADHA GOVIND UNIVERSITY

B.Sc. (Agriculture) DEGREE PROGRAMME

(SEMESTER SYSTEM)

ACADEMIC RULES AND REGULATIONS

01. REGULATIONS

The Regulations provided herein shall apply to B.Sc. (Agriculture) Degree Programme offered by the Radha Govind University.

The system of instructions and education in the University shall be SEMESTER COURSE CREDIT SYSTEM

02. SHORT TITLE AND COMMENCEMENT

These regulations shall be called "*B.Sc. (Agriculture) Degree Programme Academic Rules and Regulations 2019.*"

03. DEFINITIONS

3.1 '**University**' means the Radha Govind University, Jharkhand

3.2 '**Academic Counsellor**' means a teacher of the Faculty who has been nominated by the Dean for counseling a group of students in academic matters.

3.3 '**Curriculum**' is a group of courses and other specified requirements for the fulfillment of the Degree Programme

3.4 '**Curricula and Syllabi**' are a list of approved courses for the Degree Programme wherein each course is identified with a three-letter code, a course number, outline of syllabus, credit assigned and schedule of classes.

3.5 '**Course**' is a teaching unit of a discipline to be covered within a semester as detailed in the Curricula and Syllabi issued by the University.

3.6 '**Experiential Learning Course**' means the list of specified courses offered by different departments from which the students can have the option of selecting the courses to complete the credit requirements for the degree programme. Experiential Learning

courses are offered in VIII semester (IV year).

3.7 RAWE: Rural Agricultural Work Experience (RAWE) means a programme in which the students will be placed in villages and attached with the Department of Agriculture, KVKs, NGOs, industries, etc for a fixed period of time to study the agro-eco and socioeconomic scenario of the villages and farmers and to study the functioning of various agricultural and allied institutions.

04. ELIGIBILITY FOR ADMISSION TO B.Sc. (Agriculture) DEGREE PROGRAMME

4.1 H.Sc./ Equivalent - Academic Stream

A pass in the Higher Secondary Course (10+2) or any other examination recognized as equivalent there to and fulfilling the following subject requirements.

I : Mathematics, Physics, Chemistry and Biology

II : Physics, Chemistry, Biology with any one of the following subjects as fourth (elective) subject (having marks and not grades) viz., Biochemistry or Biotechnology or Microbiology or Home Science or Computer Science

III : Physics, Chemistry, Botany and Zoology

4.2. Eligible Minimum Qualifying Marks (Academic Stream / Vocational Stream)

- 50 % aggregate of all the four subjects

Open Competition (OC)/General (GE)

- 40% aggregate of all the four subjects

Other Backward Class (OBC) / Backward Class Muslim (BCM) /

Most Backward Class (MBC) / Extreme Backward Class (EBC) /

Backward Tribe (BT)/Scheduled Caste (SC) / Scheduled Tribe (ST)

4.3. Age limit

A candidate should not have completed the age of 21 years on the first day of July of the admission year. However, for Scheduled Castes / Scheduled Tribes and NRI candidates the upper age limit is 25.

05. SYSTEM OF EDUCATION

5.1 The system of education followed for B.Sc. (Agriculture) degree programme is **Semester System** with a duration of four academic years (8 Semesters). The maximum duration permissible for a student shall be 14 consecutive semesters (7 years). The hostel facilities will be provided only for the actual duration of the academic programme.

5.2 **Course Teacher:** The Dean in consultation with respective Heads of Department will nominate the course teacher for each course at the beginning of the semester. The course teacher shall be responsible in all matters connected with the conduct of the course. The Dean/Head of the Department will monitor the progress of the course(s).

5.3 **Class Time Table:** At the beginning of each semester, the Dean will prepare the class time table with the help of Coordinator of the respective admission year (batch of students) and announce the same.

5.4 **Working days:** Except Sundays and other listed holidays, all other days of a week including Saturdays are working days for the students

5.5 **Inter-semester Break:** A break of about 15 (fifteen) days shall normally be allowed between any two consecutive semesters. A longer inter-semester break during summer (May and June) may be allowed every year, subject to a maximum of 30 days.

5.6 **Academic Calendar:** A common academic calendar shall be prepared by the Dean every semester indicating the date of registration, date of mid semester examinations, final practical and theory examinations, inter semester break and summer holidays. The Dean shall schedule the academic activities within the specified period without deviation.

06. REGISTRATION OF COURSES

6.1 A course shall be offered only once in an academic year during the semester as listed in the course curricula and syllabi.

07. ATTENDANCE REQUIREMENTS

7.1 Minimum Attendance requirement:

i. A minimum of 75 per cent attendance separately in theory and practical of the concerned course is a must, failing which the student shall not be permitted to appear for both final theory and final practical examinations in the course concerned and grade 'E' (incomplete) will be awarded.

a) THEORY:

- i. Number of classes conducted for a course from the first instructional day as per the time table to the last theory class of that semester is to be construed as the total number of theory classes conducted by the course teacher.
- ii. The mid-semester examinations are normally conducted during class hours.
- iii. The attendance for mid semester examination will be counted as a theory class for calculating attendance.

b) PRACTICAL:

- i. Number of practical classes conducted for a course from the first instructional day as per the time table to the last practical class of that semester is to be construed as the total number of practical classes conducted by the course teacher.
- ii. The final practical examination will be conducted after the completion of 96 working days as per the schedule.
- iii. The attendance for practical examination will not be counted for calculating the attendance for practical.
- iv. The student belonging to a batch will attend classes and earn attendance in the particular batch only as per the time table. No student shall be permitted to attend along with another batch to gain attendance either in theory or in practical.

**STUDY & EVALUATION
SCHEME
BACHELOR OF SCIENCE**

SUMMARY

Programme : B.Sc.(Agriculture)
 Duration : Four-year full time (Eight Semesters)
 Medium : English/Hindi
 Minimum Required Attendance : 75 %

Assessment :

Internal			External	Total	
40			60	100	
Class Test I	Class Test II	Class Test III	Assignment(s)	Attendance	Total
Best two out of three					
10 Marks	10 Marks	10 Marks	10 Marks	10 Marks	40 Marks

Evaluation of Practical :

Internal	External	Total
50	50	100

Evaluation of Seminar/Viva :

Internal	External	Total
50	50	100
External		Internal
3 hrs.		1 ¹ / ₂ hrs

AGRICULTURE

Defining UG & PG degree for general market needs & for specialized jobs and uniformity in UG & PG degree nomenclature

i) **UG Degree :** B.Sc. (Hons) Agriculture

ii) **PG Degree :** M.Sc. and Ph.D

Recommendations on the uniform nomenclature of PG degree in Agriculture

Agriculture subjects	Horticulture	Food Science
M. Sc. Ag. (Agricultural Economics)	M. Sc. Ag. Horticulture (Fruit Science)	M. Sc.(Food Science & Technology)
M. Sc. Ag. (Agricultural Extension & Communication)	M. Sc. Ag. Horticulture (Vegetable Science)	
M.Sc. Ag. (Agrometeorology)	M. Sc. Ag. Horticulture (Floriculture & Landscaping)	
M. Sc. Ag. (Agronomy)		
M. Sc. Ag (Entomology)		
M. Sc. Ag. (Genetics & Plant Breeding)		
M. Sc. Ag. (Seed Science & Technology)		
M. Sc. Ag. (Nematology)		
M. Sc. Ag (Plant Pathology)		
M.Sc. Ag. (Soil Science and Agriculture Chemistry)		

Ph.D. with suffix: (Agronomy, Agricultural Economics, Agricultural Extension & Communication, Entomology, Genetics and Plant Breeding, Horticulture (Fruit Science), Horticulture (Vegetable Science), Horticulture (Floriculture and Landscaping), Soil Science and Agriculture Chemistry, Agro-meteorology and Environmental Sciences, Plant Pathology, Agriculture Engineering, Agro-forestry, Seed Science and Technology, Agriculture Microbiology, Physiology and Biochemistry, Plant Biotechnology, Plant Virology, Plant Nematology and Sericulture)

Ph.D. Food Science and Technology

N.B.

Post graduate degree nomenclatures will be maintained by all the colleges/universities/ institutes. In case some nomenclature other than the listed above is to be adopted, a prior approval of the ICAR may be obtained.



**Restructuring of UG programmes for increased practical /
practice contents Discipline-wise Courses**

Discipline/Course title	Credit Hours
Agronomy	
Fundamentals of Agronomy	4(3+1)
Introductory Agro-meteorology & Climate Change	2(1+1)
Crop Production Technology – I (<i>Kharif</i> crops)	2(1+1)
Crop Production Technology – II (<i>Rabi</i> crops)	2(1+1)
Farming System & Sustainable Agriculture	1(1+0)
Practical Crop Production - I (<i>Kharif</i> crops)	2(0+2)
Practical Crop Production - II (<i>Rabi</i> crops)	2(0+2)
Principles of Organic Farming	2(1+1)
Geoinformatics and Nanotechnology and Precision Farming	2(1+1)
Rainfed Agriculture & Watershed Management	2(1+1)
Genetics & Plant Breeding	
Fundamentals of Genetics	3(2+1)
Principles of Seed Technology	3(1+2)
Fundamentals of Plant Breeding	3(2+1)
Crop Improvement-I (<i>Kharif</i> crops)	2(1+1)
Crop Improvement-II (<i>Rabi</i> crops)	2(1+1)
Soil Science & Agricultural Chemistry	
Fundamentals of Soil Science	3(2+1)
Manures, Fertilizers and Soil Fertility Management	3(2+1)
Problematic soils and their Management	2(2+0)
Entomology	
Fundamentals of Entomology	4(3+1)
Pests of Crops and Stored Grain and their Management	3(2+1)
Management of Beneficial Insects	2(1+1)

Discipline/Course title	Credit Hours
Agricultural Economics	
Fundamentals of Agricultural Economics	2(2+0)
Agricultural Finance and Co-Operation	3(2+1)
Agricultural Marketing Trade & Prices	3(2+1)
Farm Management, Production & Resource Economics	2(1+1)
Agricultural Engineering	
Soil and Water Conservation Engineering	2(1+1)
Farm Machinery and Power	2(1+1)
Renewable Energy and Green Technology	2(1+1)
Protected Cultivation and Secondary Agriculture	2(1+1)
Plant Pathology	
Fundamentals of Plant Pathology	4(3+1)
Diseases of Field and Horticultural Crops and their Management-I	3(2+1)
Diseases of Field and Horticultural Crops and their Management-II	3(2+1)
Principles of Integrated Pest and Disease Management	3(2+1)
Horticulture	
Fundamentals of Horticulture	2(1+1)
Production Technology for Fruit and Plantation Crops	2(1+1)
Production Technology for Vegetables and Spices	2(1+1)
Production Technology for Ornamental Crops, MAP and Landscaping	2(1+1)
Post-harvest Management and Value Addition of Fruits and Vegetables	2(1+1)
Food Science & Technology	
Principles of Food Science & Nutrition	2(2+0)
Agricultural Extension and Communication	
Fundamentals of Agricultural Extension Education	3(2+1)
Rural Sociology & Educational Psychology	2(2+0)
Entrepreneurship Development and Business Communication	2(1+1)
Communication Skills and Personality Development	2(1+1)
Biochemistry / Physiology / Microbiology/ Environmental Sciences	
Fundamentals of Plant Biochemistry and Biotechnology	3(2+1)
Fundamentals of Crop Physiology	2(1+1)
Agricultural Microbiology	2(1+1)
Environmental Studies & Disaster Management	3(2+1)
Introduction to Forestry	2(1+1)
Statistics, Computer Application and I.P.R.	
Statistical Methods	2(1+1)

Discipline/Course title	Credit Hours
Agri- Informatics	2(1+1)
Intellectual Property Rights	1(1+0)
Animal Production	
Livestock and poultry Management	4(3+1)
Language	
Comprehension & Communication Skills in English (Gradial course)	2(1+1)
Remedial Courses	
Agricultural Heritage	1(1+0)
Introductory Biology	2(1+1)
Elementary Mathematics	2(2+0)
Non-Gradial Courses	
NSS/NCC/Physical Education & Yoga Practices	2(0+2)
Human Values & Ethics	1(1+0)
Educational Tour	2(0+2)

Semester-wise distribution of courses

I Semester		
1	Fundamentals of Horticulture	2 (1+1)
2	Fundamentals of Plant Biochemistry and Biotechnology	3(2+1)
3	Fundamentals of Soil Science	3(2+1)
4	Comprehension & Communication Skills in English	2 (1+1)
5	Fundamentals of Agronomy	4(3+1)
6	Introductory Biology*/Elementary Mathematics*	2 (1+1)/ 2(2+0)*
7	Rural Sociology & Educational Psychology	2 (2+0)
8	Human Values & Ethics (non gradial)	1(1+0)**
9	NSS/NCC/Physical Education & Yoga Practices**	2 (0+2)**
TOTAL		
*R: Remedial course; **NC: Non-gradial courses		
II Semester		
1	Fundamentals of Genetics	3(2+1)
2	Agricultural Microbiology	2(1+1)
3	Soil and Water Conservation Engineering	2(1+1)
4	Fundamentals of Crop Physiology	2(1+1)
5	Fundamentals of Agricultural Economics	2(2+0)

6	Fundamentals of Plant Pathology	4(3+1)
7	Fundamentals of Entomology	4(3+1)
8	Fundamentals of Agricultural Extension Education	3(2+1)
9	Communication Skills and Personality Development	2(1+1)
Total		
III Semester		
1	Crop Production Technology – I (<i>Kharif Crops</i>)	2 (1+1)
2	Fundamentals of Plant Breeding	3 (2+1)
3	Agricultural Finance and Cooperation	3 (2+1)
4	Agri- Informatics	2(1+1)
5	Farm Machinery and Power	2 (1+1)
6	Production Technology for Vegetables and Spices	2 (1+1)
7	Environmental Studies and Disaster Management	3(2+1)
8	Statistical Methods	2(1+1)
9	Livestock and Poultry Management	4 (3+1)
Total		
IV Semester		
1	Crop Production Technology –II (<i>Rabi Crops</i>)	2(1+1)
2	Production Technology for Ornamental Crops, MAP and Landscaping	2(1+1)
3	Renewable Energy and Green Technology	2(1+1)
4	Problematic Soils and their Management	2(2+0)
5	Production Technology for Fruit and Plantation Crops	2(1+1)
6	Principles of Seed Technology	3(1+2)
7	Farming System & Sustainable Agriculture	1(1+0)
8	Agricultural Marketing Trade & Prices	3(2+1)
9	Introductory Agro-meteorology & Climate Change	2(1+1)
10	Elective Course	3 credit
Total		19(11+8) + 3
V Semester		
1	Principles of Integrated Pest and Disease Management	3(2+1)
2	Manures, Fertilizers and Soil Fertility Management	3 (2+1)
3	Pests of Crops and Stored Grain and their Management	3 (2+1)
4	Diseases of Field and Horticultural Crops and their Management -I	3 (2+1)
5	Crop Improvement-I (<i>Kharif Crops</i>)	2 (1+1)
6	Entrepreneurship Development and Business Communication	2 (1+1)
7	Geoinformatics and Nano-technology and Precision Farming	2 (1+1)
8	Practical Crop Production – I (<i>Kharif crops</i>)	2 (0+2)

9	Intellectual Property Rights	1(1+0)
10	Elective Course	3 credit
Total		21(12+09)+ 3
VI Semester		
1	Rainfed Agriculture & Watershed Management	2 (1+1)
2	Protected Cultivation and Secondary Agriculture	2 (1+1)
3	Diseases of Field and Horticultural Crops and their Management-II	3 (2+1)
4	Post-harvest Management and Value Addition of Fruits and Vegetables	2 (1+1)
5	Management of Beneficial Insects	2 (1+1)
6	Crop Improvement-II (<i>Rabi crops</i>)	2 (1+1)
7	Practical Crop Production –II (<i>Rabi crops</i>)	2 (0+2)
8	Principles of Organic Farming	2 (1+1)
9	Farm Management, Production & Resource Economics	2 (1+1)
10	Principles of Food Science and Nutrition	2(2+0)
11	Elective Course	3 credits
Total		21 (11 + 10)+ 3

VII Semester			
No.	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)		
	Activities	No. of weeks	Credit Hours
1	General orientation & On campus training by different faculties	1	14
2	Village attachment	8	
	Unitattachment in Univ./ College. KVK/ Research Station Attachment	5	
3	Plant clinic	2	02
	Agro-Industrial Attachment	3	04
4	Project Report Preparation, Presentation and Evaluation	1	
Total weeks for RAWE & AIA		20	20

- Agro-Industrial Attachment:** The students would be attached with the agro-industries for a period of 3 weeks to get an experience of the industrial environment and working.
- Educational tour will be conducted in break between IV & V Semester or VI & VII Semester

RAWE Component-I

Village Attachment Training Programme

Sl. No.	Activity	Duration
1	Orientation and Survey of Village	1 week



2

Agronomical Interventions

1 week



Sl. No.	Activity	Duration
3	Plant Protection Interventions	1 week
4	Soil Improvement Interventions (Soil sampling and testing)	1 week
5	Fruit and Vegetable production interventions	1 week
6	Food Processing and Storage interventions	
7	Animal Production Interventions	1 week
8	Extension and Transfer of Technology activities	1 week

RAWE Component –II

Agro Industrial Attachment

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

Activities and Tasks during Agro-Industrial Attachment Programme

- Acquaintance with industry and staff
- Study of structure, functioning, objective and mandates of the industry
- Study of various processing units and hands-on trainings under supervision of industry staff
- Ethics of industry
- Employment generated by the industry
- Contribution of the industry promoting environment
- Learning business network including outlets of the industry
- Skill development in all crucial tasks of the industry
- Documentation of the activities and task performed by the students
- Performance evaluation, appraisal and ranking of students

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

Sl. No.	Title of the module	Credits
1	Production Technology for Bioagents and Biofertilizer	0+10
2	Seed Production and Technology	0+10
3	Mushroom Cultivation Technology	0+10
4	Soil, Plant, Water and Seed Testing	0+10
5	Commercial Beekeeping	0+10
6	Poultry Production Technology	0+10
7	Commercial Horticulture	0+10
8	Floriculture and Landscaping	0+10

Sl. No.	Title of the module	Credits
9	Food Processing	0+10
10	Agriculture Waste Management	0+10
11	Organic Production Technology	0+10
12	Commercial Sericulture	0+10

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

Evaluation of Experiential Learning Programme/ HOT

S.No.	Parameters	Max. Marks
1.	Project Planning and Writing	10
2.	Presentation	10
3.	Regularity	10
4.	Monthly Assessment	10
5.	Output delivery	10
6.	Technical Skill Development	10
7.	Entrepreneurship Skills	10
8.	Business networking skills	10
9.	Report Writing Skills	10
10.	Final Presentation	10
	Total	100

Discipline-wise summary of credit hours

S.N.	Group	Credits
1	Agronomy	21(10+11)
2	Genetics & Plant Breeding	13(7+6)
3	Soil Science & Agricultural Chemistry	8(6+2)
4	Entomology	9(6+3)
5	Agricultural Economics	10(7+3)
6	Agricultural Engineering	8(4+4)
7	Plant Pathology	13(9+4)
8	Horticulture	10(5+5)
9	Food Science	2(2+0)
10	Agricultural Extension	9(6+3)
11	Biochemistry / Physiology / Microbiology/ Environmental Sciences	12(7+5)
12	Statistics, Computer Application and I.P.R.	5(3+2)
13	Animal Production	4(3+1)

S.N.	Group	Credits
14	English	2 (1+1)
15	Remedial Courses	03 (Biol/Math); 01 (Agriculture)
16	NSS/NCC/Physical Education & Yoga Practices	2(0+2)
17	Human Values and Ethics	1(1+0)
18	Educational Tour	2(0+2)
Total		126 + 3 (for Bio / Math)/ 01(Agri) + 5 NC 126+3+1+5+ 9 credits elective
RAWE ELP		20 +20
Grand Total		144+20+20=184
New Courses		24+4 (remedial)+1 (NC)

NEW COURSES

Sl. No.	Course Title	Credit Hours
1.	Geoinformatics, Nanotechnology and Precision Farming	2(1+1)
2.	Rainfed Agriculture and Watershed Management	2(1+1)
3.	Problematic Soils and their Management	2(2+0)
4.	Renewable Energy and Green Technology	2(1+1)
5.	Management of Beneficial Insects	2(1+1)
6.	Fundamentals of Horticulture	2(1+1)
7.	Introduction to Forestry	2(1+1)
8.	Agri- Informatics	2(1+1)
9.	Intellectual Property Rights	1(1+0)
10.	Principles of Food Science & Technology	2(2+0)
11.	Communication Skills and Personality Development	2(1+1)
12.	Principles of Integrated Pest & Diseases Management	3(2+1)
13.	Agricultural Heritage	1(1+0)*
14.	Introductory Biology	2(1+1)*
15.	Elementary Mathematics	2(2+0)*
16.	Human Values & Ethics (NG)	1(1+0)**

* Remedial courses

** Non-gradual courses

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

S.N.	Courses	Credit Hours
1	Agribusiness Management	3(2+1)
2	Agrochemicals	3(2+1)
3	Commercial Plant Breeding	3(1+2)
4	Landscaping	3(2+1)
5	Food Safety and Standards	3(2+1)
6	Biopesticides & Biofertilizers	3(2+1)
7	Protected Cultivation	3(2+1)
8	Micro propagation Technologies	3(1+2)
9	Hi-tech. Horticulture	3(2+1)
10	Weed Management	3(2+1)
11	System Simulation and Agro-advisory	3(2+1)
12	Agricultural Journalism	3(2+1)

SYLLABUS

I. AGRONOMY

1. Fundamentals of Agronomy

4(3+1) Theory

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

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

Practical

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

2. Introductory Agrometeorology & Climate Change

2(1+1) Theory

Meaning and scope of agricultural meteorology; Earth atmosphere- its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Energy balance of earth; Atmospheric humidity, concept of saturation, vapor pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking. Monsoon- mechanism and importance in Indian agriculture, Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave. Agriculture and weather relations; Modifications of crop microclimate, climatic normals for crop and livestock production. Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national Agriculture.

Practical

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

3. Crop Production Technology-I (*Kharif*)

Crops) 2(1+1) Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops. Cereals — rice, maize, sorghum, pearl millet and finger millet, pulses-pigeonpea, mungbean and urdbean; oilseeds- groundnut, and soybean; fibre crops- cotton & jute; forage crops-sorghum, cowpea, cluster bean and napier.

Practical

Rice nursery preparation, transplanting of rice, sowing of soybean, pigeonpea and mungbean. maize, groundnut and cotton, effect of seed size on germination and seedling vigour of *kharif* season crops, effect of sowing depth on germination of *kharif* crops, identification of weeds in *kharif* season crops, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of *kharif* season crops, study of crop varieties and important



agronomic experiments at experimental farm. study of forage experiments, morphological description of *kharif* season crops, visit to research centres of related crops.

4. Crop Production Technology-II (*Rabi* crops) 2(1+1) Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops; cereals –wheat and barley, pulses-chickpea, lentil, peas, oilseeds-rape seed, mustard and sunflower; sugar crops-sugarcane; medicinal and aromatic crops-mentha, lemon grass and citronella, Forage crops-berseem, lucerne and oat.

Practical

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

5. Farming System and Sustainable

Agriculture 1(1+0) Theory

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

6. Practical Crop Production-I (*Kharif*

Crops) 2(0+2) Practical

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



7. Practical Crop Production-II (*Rabi Crops*)

2(0+2) Practical

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

8. Principles of Organic Farming

2(1+1) Theory

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

Practical

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

9. Geoinformatics, Nano-technology and Precision

Farming 2(1+1) Theory

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

Practical

Introduction to GIS software, spatial data creation and editing. Introduction to image processing software. Visual and digital interpretation of remote sensing images. Generation of spectral



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

10. Rainfed Agriculture and Watershed Management–

(New)2(1+1) Theory

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

Practical

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

II. GENETICS AND PLANT BREEDING

1. Fundamentals of

Genetics3(2+1) Theory

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

Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanisms, chromosome mapping. Structural and numerical variations in chromosome and



their implications, Use of haploids, dihaploids and doubled haploids in Genetics. Mutation, classification, Methods of inducing mutations & CIB technique, mutagenic agents and induction of mutation. Qualitative & Quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance. Genetic disorders. Nature, structure & replication of genetic material. Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operons.

Practical

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

2. Principles of Seed Technology

3(1+2) Theory

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

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

Practical

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



3. Fundamentals of Plant Breeding

3(2+1) Theory

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male sterility- genetic consequences, cultivar options. Domestication, Acclimatization and Introduction; Centres of origin/diversity, components of Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self- pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept. Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross pollinated crops, modes of selection; Population improvement Schemes- Ear to row method, Modified Ear to Row, recurrent selection schemes; Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops, clonal selection and hybridization; Maintenance of breeding records and data collection; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding, mutation breeding-methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders and & Farmer's Rights.

Practical

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

4. Crop Improvement – I (*Kharif*)

2(1+1) Theory

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress



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

Practical

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

5. Crop Improvement – II

(Rabi)2(1+1) Theory

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

Practical

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

III. SOIL SCIENCE & AGRICULTURAL CHEMISTRY

1. Fundamentals of Soil Science

3(2+1) Theory

Soil as a natural body, Pedological and edaphological concepts of soil; Soil genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation; Soil Profile, components of soil; Soil physical properties: soil-texture, structure, density and porosity, soil colour, consistence and plasticity; Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; Soil air, composition, gaseous exchange, problem and plant



growth, Soil temperature; source, amount and flow of heat in soil; effect on plant growth, Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; soil colloids - inorganic and organic; silicate clays: constitution and properties; sources of charge; ion exchange, cation exchange capacity, base saturation; soil organic matter: composition, properties and its influence on soil properties; humic substances - nature and properties; soil organisms: macro and micro organisms, their beneficial and harmful effects; Soil pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

Practical

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

2. Manures, Fertilizers and Soil Fertility Management

3(2+1) Theory

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

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

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

Practical

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



3. Problematic Soils and their Management (New)

2(2+0) Theory

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

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

Multipurpose tree species, bio remediation through MPTs of soils, land capability and classification, land suitability classification. Problematic soils under different Agro-ecosystems.

IV. ENTOMOLOGY

1. Fundamentals of Entomology

4(3+1) Part – I

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

Part-II

Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors—temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors — food competition, natural and environmental resistance.

Part III

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

Part – IV

Systematics: Taxonomy—importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta upto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera:



Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturniidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae, Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

Practical

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

2. Pests of Crops and Stored Grains and their

Management 3(2+1) Theory

General account on nature and type of damage by different arthropods pests. Scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practice other important arthropod pests of various field crop, vegetable crop, fruit crop, plantation crops, ornamental crops, spices and condiments. Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain. Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management. Storage structure and methods of grain storage and fundamental principles of grain store management.

Practical

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



3. Management of Beneficial Insects

2(1+1) Theory

Importance of beneficial insects, Beekeeping and pollinators, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee. Role of pollinators in cross-pollinated plants.

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

Species of lac insect, morphology, biology, host plant, lac production — seed lac, button lac, shellac, lac-products. Identification of major parasitoids and predators commonly being used in biological control.

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

Practical

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

V. AGRICULTURAL ECONOMICS

1. Fundamentals of Agricultural Economics

2(2+0) Theory

Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macro economics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country. *Demand*: meaning, law of demand, schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Production: process, creation of utility, factors of production, input output relationship. *Laws of*



returns: Law of variable proportions and law of returns to scale. *Cost*: concepts, short run and long run cost curves. *Supply*: Stock v/s supply, law of supply, schedule, supply curve, determinants of supply, elasticity of supply. *Market structure*: meaning and types of market, basic features of perfectly competitive and imperfect markets. *Price determination* under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points. *Distribution theory*: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit. *National income*: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. *Population*: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control. *Money*: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, supply, general price index, inflation and deflation. *Banking*: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy. *Agricultural and public finance*: meaning, micro v/s macro finance, need for agricultural finance, public revenue and public expenditure. *Tax*: meaning, direct and indirect taxes, agricultural taxation, VAT. *Economic systems*: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.

2. Agricultural Finance and Co-Operation

3(2+1) Theory

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

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

Practicals

Determination of most profitable level of capital use. Optimum allocation of limited amount of capital among different enterprise. Analysis of progress and performance of cooperatives using published data. Analysis of progress and performance of commercial banks and RRBs using published data. Visit to a commercial bank, cooperative bank and cooperative society to acquire firsthand knowledge of their management, schemes and procedures. Estimation of credit requirement of farm business — A case study. Preparation and analysis of balance sheet — A case study. Preparation and analysis of income statement — A case study. Appraisal of a loan proposal





– A case study. Techno-economic parameters for preparation of projects. Preparation of Bankable projects for various agricultural products and its value added products. Seminar on selected topics.

3. Agricultural Marketing, Trade and Prices

3(2+1) Theory

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

Practical

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



4. Farm Management, Production and Resource

Economics 2(1+1) Theory

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

Practical

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

VI. AGRICULTURAL ENGINEERING

1. Introductory Soil and Water Conservation

Engineering 2(1+1) Theory

Introduction to Soil and Water Conservation, causes of soil erosion. Definition and agents of soil erosion, water erosion: Forms of water erosion. Gully classification and control measures. Soil loss estimation by universal Loss Soil Equation. Soil loss measurement techniques. Principles of erosion control: Introduction to contouring, strip cropping. Contour bund. Graded bund and bench terracing. Grassed water ways and their design. Water harvesting and its techniques. Wind

erosion: mechanics of wind erosion, types of soil movement. Principles of wind erosion control and its control measures.

Practical

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

Farm Machinery and Power 2(1+1)

Theory

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

Practicals

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

3. Renewable Energy and Green Technology

2(1+1) Theory

Classification of energy sources, contribution of these of sources in agricultural sector, Familiarization with biomass utilization for biofuel production and their application, Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and biooil production and their utilization as bioenergy resource, introduction of solar energy, collection and their application, Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application, introduction of wind energy and their application.

Practical

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

4. Protected Cultivation and Secondary

Agriculture 2(1+1) Theory

Green house technology: Introduction, Types of Green Houses; Plant response to Green house environment, Planning and design of greenhouses, Design criteria of green house for cooling and heating purposes. Green house equipments, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, typical applications, passive solar green house, hot air green house heating systems, green house drying. Cost estimation and economic analysis.

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

Practical

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

VII. PLANT PATHOLOGY

1. Fundamentals of Plant Pathology

4(3+1) Theory

Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Pathogenesis. Causes/factors affecting disease development: disease triangle and tetrahedron and classification of plant diseases. Important plant pathogenic organisms, different groups: fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them. Diseases and symptoms due to abiotic causes.

Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions, sub-divisions, orders and classes.

Bacteria and mollicutes: general morphological characters. Basic methods of classification and reproduction.

Viruses: nature, structure, replication and transmission. Study of phanerogamic plant parasites.

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

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

Practical

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

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

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

2. Diseases of Field & Horticultural Crops & their

Management-I 3(2+1) Theory

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

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

Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; Pigeonpea: Phytophthora blight, wilt and sterility mosaic; Finger millet: Blast and leaf spot; black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic; Castor: Phytophthora blight; Tobacco: black shank, black root rot and mosaic. Horticultural Crops: Guava: wilt and anthracnose; Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top; Papaya: foot rot, leaf curl and mosaic, Pomegranate: bacterial blight; Cruciferous vegetables: Alternaria leaf spot and



black rot; Brinjal: Phomopsis blight and fruit rot and Sclerotinia blight; Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic; Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot; Colocasia: Phytophthora blight; Coconut: wilt and bud rot; Tea: blister blight; Coffee: rust

Practical

Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems. Collection and preservation of plant diseased specimens for Herbarium; Note: Students should submit 50 pressed and well-mounted specimens.

3. Diseases of Field & Horticultural Crops & their Management-

II 3(2+1) Theory

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

Field Crops:

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

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

Sunflower: Sclerotinia stem rot and Alternaria blight; Mustard: Alternaria blight, white rust, downy mildew and Sclerotinia stem rot; Gram: wilt, grey mould and Ascochyta blight; Lentil: rust and wilt; Cotton: anthracnose, vascular wilt, and black arm; Pea: downy mildew, powdery mildew and rust.

Horticultural Crops:

Mango: anthracnose, malformation, bacterial blight and powdery mildew; Citrus: canker and gummosis; Grape vine: downy mildew, Powdery mildew and anthracnose; Apple: scab, powdery mildew, fire blight and crown gall; Peach: leaf curl.

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

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

Practical

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

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



4. Principles of Integrated Pest and Disease

Management 3(2+1) Theory

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

Practical

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

VIII. HORTICULTURE

1. Fundamentals of Horticulture (NEW)

2(1+1) Theory

Horticulture - Its definition and branches, importance and scope; horticultural and botanical classification; climate and soil for horticultural crops; Plant propagation-methods and propagating structures; Seed dormancy, Seed germination, principles of orchard establishment; Principles and methods of training and pruning, juvenility and flower bud differentiation; unfruitfulness; pollination, pollinizers and pollinators; fertilization and parthenocarpy; medicinal and aromatic plants; importance of plant bio-regulators in horticulture. Irrigation — methods, Fertilizer application in horticultural crops.

Practical

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

2. Production Technology for Fruit and Plantation

Crops 2(1+1) Theory

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

Practical

Seed propagation. Scarification and stratification of seeds. Propagation methods for fruit and plantation crops. Description and identification of fruit. Preparation of plant bio regulators and their uses, Important pests, diseases and physiological disorders of above fruit and plantation crops, Visit to commercial orchards.

3. Production Technology for Vegetable and

Spices 2(1+1) Theory

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

Practical

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

4. Production Technology for Ornamental Crops, MAPs and Landscaping 2 (1+1)

Theory

Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers. Production technology of important cut flowers like rose, gerbera, carnation, lily and orchids under protected conditions and gladiolus, tuberose, chrysanthemum under open conditions. Package of practices for loose flowers like marigold and jasmine under open conditions. Production technology of important medicinal plants like ashwagandha, asparagus, aloe, costus, Cinnamomum, periwinkle, isabgol and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver. Processing and value addition in ornamental crops and MAPs produce.

Practical

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

5. Post-harvest Management and Value Addition of Fruits and Vegetables 2(1+1) Theory

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

Practical

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

IX. FOOD SCIENCE & TECHNOLOGY

1. Principles of Food Science and Nutrition

2(2+0) Theory

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

X. AGRICULTURAL EXTENSION and COMMUNICATION

1. Fundamentals of Agricultural Extension

Education 3(2+1) Theory

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

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

Practical

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

2. Rural Sociology & Educational

Psychology 2(2+0) Theory

Sociology and Rural sociology: Definition and scope, its significance in agriculture extension, **Social Ecology, Rural society, Social Groups, Social Stratification, Culture concept, Social Institution, Social Change & Development. Educational psychology:** Meaning & its importance in

agriculture extension. Behavior: Cognitive, affective, psychomotor domain, Personality, Learning, Motivation, Theories of Motivation, Intelligence.

3. Entrepreneurship Development and Business

Communication 2 (1+1) Theory

Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs; SWOT Analysis & achievement motivation, Government policy and programs and institutions for entrepreneurship development, Impact of economic reforms on Agribusiness/ Agrienterprises, Entrepreneurial Development Process; Business Leadership Skills; Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation), Developing Managerial skills, Business Leadership Skills (Communication, direction and motivation Skills), Problem solving skill, Supply chain management and Total quality management, Project Planning Formulation and report preparation; Financing of enterprise, Opportunities for agri-entrepreneurship and rural enterprise.

Practical

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

4. Communication Skills and Personality

Development 2 (1+1) Theory

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

Practical

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

XI. BIOCHEMISTRY/ PHYSIOLOGY/ MICROBIOLOGY/ ENVIRONMENTAL SCIENCES

1. Fundamentals of Plant Biochemistry and

Biotechnology 3(2+1) Theory

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



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

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

Practical

Preparation of solution, pH & buffers, Qualitative tests of carbohydrates and amino acids. Quantitative estimation of glucose/ proteins. Titration methods for estimation of amino acids/lipids, Effect of pH, temperature and substrate concentration on enzyme action, Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides. Sterilization techniques. Composition of various tissue culture media and preparation of stock solutions for MS nutrient medium. Callus induction from various explants. Micro-propagation, hardening and acclimatization. Demonstration on isolation of DNA. Demonstration of gel electrophoresis techniques and DNA finger printing.

2. Fundamentals of Crop Physiology

2(1+1) Theory

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

Practical

Study of plant cells, structure and distribution of stomata, imbibitions, osmosis, plasmolysis, measurement of root pressure, rate of transpiration, Separation of photosynthetic pigments through paper chromatography, Rate of transpiration, photosynthesis, respiration, tissue test



for mineral nutrients, estimation of relative water content, Measurement of photosynthetic CO₂ assimilation by Infra Red Gas Analyser (IRGA).

3. Agricultural

Microbiology2(1+1) Theory

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

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

Practical

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

4. Environmental Studies and Disaster Management

3(2+1) Theory

Multidisciplinary nature of environmental studies Definition, scope and importance.

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

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



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

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

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

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

Disaster Management

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

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

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

Practical

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



5. Introduction to Forestry (New)

2(1+1) Theory

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

XII. STATISTICS, COMPUTER APPLICATION AND IPR

1. Statistical Methods

2(1+1) Theory

Introduction to Statistics and its Applications in Agriculture, Graphical Representation of Data, Measures of Central Tendency & Dispersion, Definition of Probability, Addition and Multiplication Theorem (without proof). Simple Problems Based on Probability. Binomial & Poisson Distributions, Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation. Linear Regression Equations. Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 × 2 Contingency Table. Introduction to Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.

Practical

Graphical Representation of Data. Measures of Central Tendency (Ungrouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Central Tendency (Grouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Dispersion (Ungrouped Data).



Measures of Dispersion (Grouped Data). Moments, Measures of Skewness & Kurtosis (Ungrouped Data). Moments, Measures of Skewness & Kurtosis (Grouped Data). Correlation & Regression Analysis. Application of One Sample t-test. Application of Two Sample Fisher's t-test. Chi-Square test of Goodness of Fit. Chi-Square test of Independence of Attributes for 2×2 contingency table. Analysis of Variance One Way Classification. Analysis of Variance Two Way Classification. Selection of random sample using Simple Random Sampling.

2. Agri-Informatics

2(1+1) Theory

Introduction to Computers, Operating Systems, definition and types, Applications of MS-Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, uses of DBMS in Agriculture, World Wide Web (WWW): Concepts and components. Introduction to computer programming languages, concepts and standard input/output operations.

e-Agriculture, concepts and applications, Use of ICT in Agriculture. Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc; Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc for supporting Farm decisions. Preparation of contingent crop-planning using IT tools.

Practical

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

XIII. Intellectual Property Rights 1(1+0)

Theory

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

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



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

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

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

XIV. ANIMAL PRODUCTION

1. Livestock & Poultry Management 4

(3+1) Theory

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

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

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

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

Practical

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

XV. LANGUAGE

1. Comprehension and Communication Skills in

English 2(1+1) Theory

War Minus Shooting- The sporting Spirit. A Dilemma- A layman looks at science Raymond B. Fosdick. You and Your English — Spoken English and broken English G.B. Shaw. Reading Comprehension, Vocabulary- Antonym, Synonym, Homophones, Homonyms, often confused words. Exercises to Help the students in the enrichment of vocabulary based on TOEFL and other competitive examinations. Functional grammar: Articles, Prepositions, Verb, Subject verb Agreement, Transformation, Synthesis, Direct and Indirect Narration. Written Skills: Paragraph writing, Precise writing, Report writing and Proposal writing. The Style: Importance of professional writing. Preparation of Curriculum Vitae and Job applications. Synopsis Writing. Interviews: kinds, Importance and process.

Practical

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

XVI. REMEDIAL COURSES

1. Agricultural Heritage (New Course)

1(1+0) 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.

2. Introductory Biology (New)

2(1+1) Theory

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

Practical

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

3. Elementary Mathematics (New)

2(2+0) Theory

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

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

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

XVII. NON-GRADUAL COURSES

1. NSS/NCC/Physical Education & Yoga Practices 2

(0+2) Theory

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

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

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

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

SYLLABUS

Semester I

Course Title: National Service Scheme I

Introduction and basic components of NSS:

Orientation: history, objectives, principles, symbol, badge; regular programmes under NSS,



organizational structure of NSS, code of conduct for NSS volunteers, points to be considered by NSS volunteers awareness about health

NSS programmes and activities

Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analysing guiding financial patterns of scheme, youth programme/ schemes of GOI, coordination with different agencies and maintenance of diary

Understanding youth

Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change

Community mobilisation

Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilisation involving youth-adult partnership

Social harmony and national integration

Indian history and culture, role of youth in nation building, conflict resolution and peace-building

Volunteerism and shramdan

Indian tradition of volunteerism, its need, importance, motivation and constraints; shramdan as part of volunteerism

Citizenship, constitution and human rights

Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information

Family and society

Concept of family, community (PRIs and other community based organisations) and society

Semester II

Course Title: National Service Scheme II

Importance and role of youth leadership

Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership

Life competencies

Definition and importance of life competencies, problem-solving and decision-making, inter personal communication

Youth development programmes

Development of youth programmes and policy at the national level, state level and voluntary sector; youth-focused and youth-led organisations





Health, hygiene and sanitation

Definition needs and scope of health education; role of food, nutrition, safe drinking water, water born diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programmes and reproductive health.

Youth health, lifestyle, HIV AIDS and first aid

Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid

Youth and yoga

History, philosophy, concept, myths and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method

Semester III

Course Title: National Service Scheme III

Vocational skill development

To enhance the employment potential and to set up small business enterprises skills of volunteers, a list of 12 to 15 vocational skills will be drawn up based on the local conditions and opportunities. Each volunteer will have the option to select two skill-areas out of this list

Issues related environment

Environmental conservation, enrichment and sustainability, climatic change, natural resource management (rain water harvesting, energy conservation, forestation, waste land development and soil conservations) and waste management

Disaster management

Introduction and classification of disaster, rehabilitation and management after disaster; role of NSS volunteers in disaster management.

Entrepreneurship development

Definition, meaning and quality of entrepreneur; steps in opening of an enterprise and role of financial and support service institution.

Formulation of production oriented project

Planning, implementation, management and impact assessment of project

Documentation and data reporting

Collection and analysis of data, documentation and dissemination of project reports

Semester IV

Course Title: National Service Scheme IV

Youth and crime

Sociological and psychological factors influencing youth crime, cyber crime, peer mentoring in preventing crime and awareness for juvenile justice



Civil/self defence

Civil defence services, aims and objectives of civil defence; needs and training of self defence

Resource mobilisation

Writing a project proposal of self fund units (SFUs) and its establishment

Additional life skills

Positive thinking, self confidence and esteem, setting life goals and working to achieve them, management of stress including time management.

National Cadet Corps Credit hours: 2(0+2)

Semester I: National Cadet Corps

1. Aims, objectives, organization of NCC and NCC song. DG's cardinals of discipline.
2. Drill- aim, general words of command, attention, stands at ease, stand easy and turning.
3. Sizing, numbering, forming in three ranks, open and close order march and dressing.
4. Saluting at the halt, getting on parade, dismissing and falling out.
5. Marching, length of pace, and time of marching in quick/slow time and halt. Side pace, pace forward and to therear.
6. Turning on the march and wheeling. Saluting on the march.
7. Marking time, forward march and halt.
8. Changing step, formation of squad and squad drill.
9. Command and control, organization, badges of rank, honours and awards
10. Nation Building- cultural heritage, religions, traditions and customs of India. National integration.
11. Values and ethics, perception, communication, motivation, decision making, discipline and duties of goodcitizen.
12. Leadership traits, types of leadership. Character/personality development.
13. Civil defense organization, types of emergencies, fire fighting, protection,
14. Maintenance of essential services, disaster management, aid during development projects.
15. Basics of social service, weaker sections of society and their needs, NGO's and their contribution, contribution of youth towards social welfare and family planning.
16. Structure and function of human body, diet and exercise, hygiene and sanitation.
17. Preventable diseases including AIDS, safe blood donation, first aid, physical and mental health.
18. Adventure activities
19. Basic principles of ecology, environmental conservation, pollution and its control.
20. Precaution and general behaviour of girl cadets, prevention of untoward incidents, vulnerable parts of the body, self defense.

Semester II: National Cadet Corps

1. Arms Drill- Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out. Ground/take up arms, examine arms.

- 
2. Shoulder from the order and vice-versa, present from the order and vice-versa.
 3. Saluting at the shoulder at the halt and on the march. Short/long trail from the order and vice-versa.
 4. Guard mounting, guard of honour, Platoon/Coy Drill.
 5. Characteristics of rifle (.22/.303/SLR), ammunition, fire power, stripping, assembling, care, cleaning and sight setting.
 6. Loading, cocking and unloading. The lying position and holding.
 7. Trigger control and firing a shot. Range Procedure and safety precautions. Aiming and alteration of sight.
 8. Theory of groups and snap shooting. Firing at moving targets. Miniature range firing.
 9. Characteristics of Carbine and LMG.
 10. Introduction to map, scales and conventional signs. Topographical forms and technical terms.
 11. The grid system. Relief, contours and gradients. Cardinal points and finding north. Types of bearings and use of service protractor.
 12. Prismatic compass and its use. Setting a map, finding north and own position. Map to ground and ground to map.
 13. Knots and lashings, Camouflage and concealment, Explosives and IEDs.
 14. Field defenses obstacles, mines and mine lying. Bridging, waterman ship
 15. Field water supplies, tracks and their construction.
 16. Nuclear, Chemical and Biological Warfare (NCBW)
 17. Judging distance. Description of ground and indication of landmarks.
 18. Recognition and description of target. Observation and concealment. Field signals. Section formations.
 19. Fire control orders. Fire and movement. Movement with/without arms. Section battle drill.
 20. Types of communication, media, latest trends and developments.

Physical Education and Yoga Practices Credit hours: 2(0+2)

(0+2) Semester I: Physical Education and Yoga Practices

1. Teaching of skills of Football — demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit)
 2. Teaching of different skills of Football — demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit)
 3. Teaching of advance skills of Football — involvement of all the skills in game situation with teaching of rules of the game
 4. Teaching of skills of Basketball — demonstration, practice of the skills, correction of skills, involvement in game situation
 5. Teaching of skills of Basketball — demonstration, practice of the skills, involvement in game situation
 6. Teaching of skills of Basketball — involvement of all the skills in game situation with teaching of rule of the game
- 

- 
7. Teaching of skills of Kabaddi — demonstration, practice of the skills, correction of skills, involvement in game situation
 8. Teaching of skills of Kabaddi — demonstration, practice of the skills, correction of skills, involvement in game situation
 9. Teaching of advance skills of Kabaddi — involvement of all the skills in game situation with teaching of rule of the game
 10. Teaching of skills of Ball Badminton — demonstration, practice of the skills, correction of skills, involvement in game situation
 11. Teaching of skills of Ball Badminton — involvement of all the skills in game situation with teaching of rule of the game
 12. Teaching of some of Asanas — demonstration, practice, correction and practice
 13. Teaching of some more of Asanas — demonstration, practice, correction and practice
 14. Teaching of skills of Table Tennis — demonstration, practice of skills, correction and practice and involvement in game situation
 15. Teaching of skills of Table Tennis — demonstration, practice of skills, correction and practice and involvement in game situation
 16. Teaching of skills of Table Tennis — involvement of all the skills in game situation with teaching of rule of the game
 17. Teaching — Meaning, Scope and importance of Physical Education
 18. Teaching — Definition, Type of Tournaments
 19. Teaching — Physical Fitness and Health Education
 20. Construction and laying out of the track and field (*The girls will have Tennis and Throw Ball).

Semester II: Physical Education and Yoga Practices

1. Teaching of skills of Hockey — demonstration practice of the skills and correction.
 2. Teaching of skills of Hockey — demonstration practice of the skills and correction. And involvement of skills in games situation
 3. Teaching of advance skills of Hockey — demonstration practice of the skills and correction. Involvement of all the skills in games situation with teaching of rules of the game
 4. Teaching of skills of Kho-Kho — demonstration practice of the skills and correction.
 5. Teaching of skills of Kho-Kho — demonstration practice of the skills and correction. Involvement of the skills in games situation
 6. Teaching of advance skills of Kho-Kho — demonstration practice of the skills and correction. Involvement of all the skills in games situation with teaching of rules of the game
 7. Teaching of different track events — demonstration practice of the skills and correction.
 8. Teaching of different track events — demonstration practice of the skills and correction.
 9. Teaching of different track events — demonstration practice of the skills and correction with competition among them.
 10. Teaching of different field events — demonstration practice of the skills and correction.
 11. Teaching of different field events — demonstration practice of the skills and correction.
 12. Teaching of different field events — demonstration practice of the skills and correction.
- 

- 
13. Teaching of different field events — demonstration practice of the skills and correction with competition among them.
 14. Teaching of different asanas — demonstration practice and correction.
 15. Teaching of different asanas — demonstration practice and correction.
 16. Teaching of different asanas — demonstration practice and correction.
 17. Teaching of different asanas — demonstration practice and correction.
 18. Teaching of weight training — demonstration practice and correction.
 19. Teaching of circuit training — demonstration practice and correction.
 20. Teaching of calisthenics — demonstration practice and correction.

Note: 1) Compulsory Uniform: Half pants, Tee Shirts, Shoes and socks all white (Girls will have white Tee Shirt and Track pants) **2)** The games mentioned in the practical may be inter changed depending on the season and facilities.

Course title: Human Value and Ethics 1(1+0)

Theory

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

Course Title: Educational Tour 2 (0+2)

ELECTIVE COURSES

Agri-business Management 3 (2+1)

Theory

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



Practical

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

2. Agrochemicals 3

(2+1) Theory

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

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

Fungicides - Classification — Inorganic fungicides - characteristics, preparation and use of sulfur and copper, Mode of action-Bordeaux mixture and copper oxychloride.

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

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

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

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

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

Practical

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



watersoluble P_2O_5 and citrate soluble P_2O_5 in single superphosphate. Estimation of potassium in Muriate of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide. Determination of thiram. Determination of ziram content.

3. Commercial Plant Breeding

3(1+2) Theory

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

Practical

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

4. Landscaping

3(2+1) Theory

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



Practical

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

5. Food Safety and Standards

3(2+1) Theory

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

Practical

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

6. Biopesticides & Biofertilizers

3(2+1) Theory

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

Biofertilizers - Introduction, status and scope. Structure and characteristic features of bacterial biofertilizers- *Azospirillum*, *Azotobacter*, *Bacillus*, *Pseudomonas*, *Rhizobium* and *Frankia*; Cyanobacterial biofertilizers- *Anabaena*, *Nostoc*, *Hapalosiphon* and fungal biofertilizers- AM mycorrhiza and ectomycorrhiza. Nitrogen fixation -Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilization and phosphate mobilization, K solubilization. Production



technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertilizers. FCO specifications and quality control of biofertilizers. Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers -Storage, shelf life, quality control and marketing. Factors influencing the efficacy of biofertilizers.

Practical

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

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

7. Protected

Cultivation3(2+1) Theory

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

Practical

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

8. Micro propagation Technologies

3(1+2) Theory

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

Practical

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



explants, Preparation of stocks and working solution, Preparation of working medium, Culturing of explants: Seeds, shoot tip and single node, Callus induction, Induction of somatic embryos regeneration of whole plants from different explants, Hardening procedures.

9. Hi-tech. Horticulture

3(2+1) Theory

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

Practical

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

10. Weed Management

3(2+1) Theory

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

Practical

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

11. System Simulation and Agroadvisory

3(2+1) Theory

System Approach for representing soil-plant-atmospheric continuum, system boundaries, Cropmodels, concepts & techniques, types of crop models, data requirements, relational diagrams.



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

Practical

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

12. Agricultural Journalism

3(2+1) Theory

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

Practical

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



Minimum Standards for Establishing a College of Agriculture

1. **Degree Nomenclature:** B.Sc. (Hons.) Agriculture
2. **Eligibility Criteria :** 10+2 or intermediate with PCMB, PCB, PCM or Agriculture (P - Physics, C - Chemistry, M - Mathematics, B — Biology) from a recognised Board/university.
3. **Medium of Instruction :** English
4. **Minimum Intake :** 60 students per year
5. **Divisions/Departments/Sections**
 1. Agronomy
 2. Agricultural Economics
 3. Agricultural Extension & Communication
 4. Entomology
 5. Genetics and Plant Breeding
 6. Horticulture
 7. Food Science and Technology
 8. Soil Science and Agricultural Chemistry
 9. Plant Pathology
 10. Animal Sciences
 11. Fisheries
 12. Biochemistry
 13. Crop Physiology
 14. Agricultural Engineering
 15. Agro-forestry
 16. Seed Science and Technology
 17. Agro-meteorology
 18. Environmental Sciences
 19. Microbiology
 20. Basic Sciences and Humanities
 - a) Basic Economics
 - b) Sociology and Psychology
 - c) English
 - d) Mathematics
 - e) Computer Sciences
 - f) Statistics

Note: To reduce the number, the subjects which have only one or two courses may be merged with major Division/Department. Colleges/Universities have liberty to do this at their level. However, for practical purposes following model has been proposed giving minimum teaching staff required for each Division/Department taking into account the merger of related subjects.

6. Divisions/Departments/Sections proposed alongwith Cadre-wiseteachingstaffrequired.

S. No.	Divisions/Departments/Sections including mergers shown in bracket	Minimum Requirement Professor	Teaching Staff required			
			Professor	Assoc Prof.	Asstt. Prof.	Total
A. Divisions/Departments						
1.	Agronomy + (Agro-forestry)	5	1	1	4+1	7
2.	Agricultural Economics + (Basic Economics, Maths & Computer Science and Statistics)	5	0	1	2+3	6
3.	Agriculture Extension & Communication +(Sociology and Psychology, English)	3	0	1	1+2	4
4.	Entomology	2	0	1	2+0	3
5.	Genetics & Plant Breeding + (Seed Science & Technology)	3	1	1	2+1	5
6.	Horticulture + (Food Science & Technology)	4	1	1	2+1	5
7.	Soil Science and Agricultural Chemistry + (Microbiology, Agro-meteorology, Environmental Sciences)	4	0	1	2+3	6
8.	Plant Pathology	2	0	1	2+0	3
	Total	28	3	8	17+11	39
B. Sections						
9.	Animal Sciences including Fisheries, Dairy Sciences & poultry units	1	0	0	1+1	2
10.	Agriculture Engineering +(Farm Management)	1	0	0	1+1	2
11.	Biochemistry and Crop Physiology	1	0	0	1+1	2
	Total	31	3	8	20+14	45

Note: Total strength after four years should have 45 teachers as faculty. However, in extreme cases, it can be 31 and few courses viz. Basic Sciences, and Humanities, Maths, and Computer Sciences, etc. can be completed by hiring the teachers.

7. Administrative Staff requirement for Divisions/Departments/Sections

S. No.	Divisions/Departments/Sections	Assistant *	Lab Asstt.	Field Asstt.	Attendant/Messenger	Total
1.	Agronomy + (Agro-forestry)	1	2	3	- **	6
2.	Agricultural Economics + (Basic Economics, Maths & Computer Science and Statistics)	1	3	-	-	4
3.	Agriculture Extension & Communication + (Sociology and Psychology, English)	1	1	-	-	2
4.	Entomology	1	1	1	-	3
5.	Genetics & Plant Breeding + (Seed Science & Technology)	1	2	2		5
6.	Horticulture + (Food Science & Technology)	1	2	2		5
7.	Soil Science and Agricultural Chemistry + (Microbiology, Agro-meteorology, Environmental Sciences)	1	3	1		5
8.	Plant Pathology	1	2	1		4
9.	Animal Sciences including Fisheries, Dairy Science&Poultry units)	1	1	1		3
10.	Agriculture Engineering + (Farm Management)	1	1	2		4
11.	Biochemistry and Crop Physiology	1	1	-		2
	Total	11	19	13		43

*Assistant should have computer literacy, accounts and store handling training

**Attendant/Messenger/Janitor/Security/watch and ward to be outsourced.

8. Manpower Requirement of Dean's Office

Sl. No.	Name of the Post	No. of Posts
1.	Dean	01
A. Establishment		
1.	P.A./P.S. to Dean	01
2.	Asstt. Administrative Officer	01
3.	Asstt. Academic Officer	01
4.	Assistant Accounts Officer	01
5.	Assistants (one for each AAO)	03
6.	Steno/Computer Operators	01

Sl. No.	Name of the Post	No. of Posts
7.	Driver	01
8.	Farm Manager (Asstt. Prof.)	01*
9.	Store Keeper	01

*Will be with Engineering/Agronomy. Utility services like Wireman/Plumber/Janitors/ Attendants/Messengers, Landscaping, and Mechanic, etc. to be outsourced.

B. Central Instrumentation Laboratory		
1.	Instrumentation Asstt. Engineer	01
2.	Instrumentation Technician/Lab Asstt.	01
C. Library Staff		
1.	Asstt. Librarian(Asstt. Prof. cadre)	01
2.	Library Asstt./Clerk	01
3.	Shelf Asstt.	01
D. Students Welfare		
1.	Physical Education (Asstt. Prof.)	01
2.	Attendant	01
E. Hostel Staff		
1.	Warden	01+01
2.	Care taker/Asstt.	01+01
F. Estate Branch		
1.	Junior Engineer	01
2.	Security Asstt.	01

9. Land Required

- (A) 1) Plain Regions : 30 ha
 2) Hill, islands and coastal regions : 16 ha

(B) Land Utilization Pattern

		(hectares)	
		Plain	Hill/Coastal Region
1.	Main Building/Hostels/Residential Quarters (Including roads)	6.8	3.2
2.	Playground & other amenities	3.2	2.0
3.	Farm Area, including godown/ stores	20.0	10.8

Note: If land is not in one stretch, it should be at least within a radius of 5 kms

(C) Division/Department/Section-wise land allocations (hectares)

1.	Agronomy & Farm Forestry	6.0	3.2
2.	Entomology	0.4	0.2
3.	Genetics & Plant Breeding + (Seed Science & Technology)	3.2	1.6
4.	Horticulture	6.0	3.6
5.	Soil Science and Associated Departments	0.8	0.2
6.	Plant Pathology	0.4	0.2
7.	Animal Sciences	2.0	1.2
8.	Biochemistry and Physiology	0.4	0.2
9.	Agricultural Engineering	0.8	0.4
10.	Total	20.0	10.8

10. Infrastructure facilities (Floor space required)**A. Central Facilities**

S. No.	Details	No. of Rooms	Dimensions (ft)
1.	Dean Office	1	20x24
2.	P.A. Room	1	10x12
3.	Committee Room with video conferencing facility	1	20x30
4.	Assistant Administrative Officer including staff	1	20x12
5.	Assistant Accounts Officer including staff	1	20x12
6.	Assistant Academic Officer including staff	1	20x12
7.	Exam Cell (300 capacity)	1	20x12
8.	Evaluation Room	1	20x36
9.	Faculty Room (Ladies)	1	10x12
10.	Faculty Room (Gents)	1	20x12
11.	Placement Cell	1	20x12
12.	Smart Lecture Halls	5	40x30 (60 capacity)
13.	Exam Hall Cum Auditorium	1	100x50
14.	Library/Book Bank	1	30x72
15.	Common Utility Room	1	20x36
16.	Central Laboratory	1	50x36
17.	Hostels including Mess, Gym/Indoor, Reading Room, Warden Room, Store etc.	1 (boys)	150
		1 (girls)	150

S. No.	Details	No. of Rooms	Dimensions (ft)
18.	Canteen	1	20x12 (kitchen with store)
			20x36 Seating
19.	Wash room (with toilet & urinary facilities)	10	20x12 (keeping ladies requirements)
20.	Parking space		As per requirement
21.	Farm stores, threshing yards including implements and tractor sheds	One core complex	
22.	Vehicles		
	Car	1	
	Jeep/Car staff	2	
	Bus	1	
	Pickup van	1	
	Motor Bikes	2	
	Minibus (30 capacity)	1	
	Tractors	2	
23.	Drinking water and irrigation facilities		As per requirements
24.	Vehicles shed	1	10x80

B. Divisions/Departments/Sections – Requirements

No.	Details	No. of Rooms	Dimensions(ft)
1.	Office of Head	11	24x12 with wash room facility
2.	Faculty Rooms 1+1	12	12x10 + 18x12 24x10 depending on the strength of each deptt.
3.	Clerical/technical staff	12	12x10 to 24x10 depending on the strength of each deptt.
5.	Laboratories	12	30x 60 Larger deptt. will have two
6.	Field/Lab Stores	5	1. Agronomy 2. Gen. & Pl. Breeding 3. Soil Sci. 4. Horticulture 5. Pests & Chemicals
7.	Green house/poly house/ Nursery facilities (Hort. Deptt.)	0.02 ha	

Requirements of Lab/field equipment for each Division/Department/Section)

1. Agronomy + Agroforestry

1.	Crop Cafeteria	½ acre land small implements like spade, hoe, khurpi, darati etc.
2.	Museum for identification of seeds, fertilizer, weeds, commonly used agro-chemical and medicinal and aromatic plants etc.	Storage bottle Herbarium posting material
3.	Field of sowing method, fertilizer application, irrigation and soil productivity and yield estimation	Small equipment/ implement
4.	Irrigation water measurement, bulk density etc.	
	Equipment	Number
	i. Hot air oven	02
	ii Moisture box	30
	iii Moisture meter	05
	iv Tube Auger	10
	v Bucket auger	10
	vi Weighing Balance	01
	vii Seed Germinator	02
	viii Conductivity Meter	01
	ix pH Meter	02
	x Water Bath	01
	xi Shaker	01
	xii Chlorophyll Meter	01
	xiii Drip and Sprinkler System	03
	xiv Sprayer	03
	xv Spring Balance 50 Kg	05
	xvi Spring Balance 10 Kg	05
	xvii Top Pan Balance 1 kg capacity	05
	xviii Top Pan Balance 2 kg capacity	05
	xix Meter Scale	10
	xx Tape	05
	xxi Brix meter	02

2. Agricultural Economics + (Basic Economics, Maths & Computer Science and Statistics)

No.	Items	Nos.
1.	Computers	15
2.	Camera	01
3.	Software	As per requirement

3. Agriculture Extension & Communication + (Sociology and Psychology, English)

Audio-visual Lab

No.	Items	Nos.
1.	LCD projector	1
2.	Camera (SLR) with zoom, wide-angle, tele-photo lens	1
3.	Video camera with tripod, lighting accessories and editing facility	1
4.	Computers (workstation) with editing softwares	1
5.	Digital voice recorders	5
6.	Audio recording-mixing consoles	1
7.	Computation softwares for statistics	

4. Entomology

No.	Items	Nos.
1.	Binocular Microscope	20
2.	Insect Box	60
3.	Insect Collection Nets	60
4.	Collection Bottles	60
5.	Insect Collection Big Boxes for Museum (1 for each order)	29
6.	Insecticides for showing students/Representative for each group	As per requirement
7.	Stereomicroscope	01
8.	Electronic Balance	01
9.	Soxhlet Extraction Apparatus	01
10.	Bee keeping equipment	01 Set
11.	Oven	01
12.	PattersTower	01
13.	Sprayers	01 of each type
14.	Light traps	01 set
15.	Fumigation Chamber	01

No.	Items	Nos.
16.	Sides/cover slips	as per requirement
17.	pH meter	01
18.	Computer with printer	01 set

5. Genetics & Plant Breeding + (Seed Science & Technology)

Genetics

No.	Items	Nos.
1.	Microscope	10
2.	Binocular microscope	10
3.	Electronic Moisture Meter	02
4.	Electronic Balance	02
5.	Seed Germinator	02
6.	Automatic seed/grain counter	01

Biotechnology

No.	Items	Nos.
10.	Hot Air Oven	01
11.	BOD Incubator	01
12.	Fluorescence microscope	01
11.	Centrifuge	01
12.	Growth Chamber	01
13.	Distillation Assembly	01

6. Horticulture + (Food Science & Technology)

a. Labs (Post Harvest)

No.	Items	Nos.
1	Hand Refractometer	05
2	Digital Refractometer	02
3	Oven	01
4	Refrigerator	01
5	Electronic Weighing Balance	02
6	Pan Balance (1 kg & 10 kg. capacity each)	02
7	Deep Freezer	01
8	pH Meter	01

No.	Items	Nos.
9	Fruit crusher	01
10	Grinding and Mixing Machine	01
11	Distillation Assembly	01

b. Lab (UG Lab)

No.	Items	Nos.
1.	Seed Germinator	02
2.	Grafting and budding knife	60
3.	Secateur	60
4.	Saw	05
5.	Loppers	05
6.	Mist Chamber	01
7.	Poly house with drip irrigation system	02
8.	Microscope	

c. Food Science & Technology

No.	Items	Nos.
1.	Refrigerator	1
2.	Muffle furnace	1
3.	Weighing balance	2
4.	Water bath	2
5.	Hot air oven	2
6.	Fruit penetrometer	2
7.	Pulper	1
8.	Juice extractor	1
9.	Crown corking machine	1
10.	Spectrophotometer	1
12.	Microwave oven	1
13.	Baking oven	1
14.	Sieve shaker	1
15.	Poly pouch sealer	1
16.	Crusher	1

No.	Items	Nos.
17.	Masala grinder	1
18.	Dehydrator	1
19.	Cold room	1
20.	Vacuum pump	

7. Soil Science and Agricultural Chemistry + (Microbiology, Agro-meteorology, Environmental Sciences)

No.	Items	Nos.
1.	Electronic Top pan balance (0.1 g capacity)	02
2.	Electronic Top pan balance (1 mg capacity)	02
3.	Hot air oven	02
4.	pH Meter	05
5.	EC Meter	05
6.	Flame Photometer	01
7.	Visible spectrophotometer	01
8.	Hot Plate	02
9.	Distilled water unit	02
10.	Water Bath	01
11.	Rotary Shaker	02
12.	Binocular Microscope	20
13.	BOD Incubator	02
14.	Autoclave	02
15.	Laminar Air Flow	01
16.	Microwave oven	01
17.	Digestion block	02
18.	Hydrometer	05
19.	Infiltrometer	02
20.	Hydraulic conductivity meter	01
21.	Atterberg's limitsmeter	05
22.	Nitrogen Analyser	02

8. Agrometeorology

No.	Items	Nos.
1.	Thermometer Max	05
2.	Thermometer Min	05
3.	Digital Anemometer	02
4.	Cup Anemometer	02
5.	Pan Evaporimeter	01
6.	Soil thermometer 05 cm. 10 cm. 15 cm.	05 05 05
7.	Rain gauge	01
8.	Self-recording Rain gauge	01
9.	Sunshine Recorder	01
10.	Stevenson's Screen	01
11.	Thermograph	01
12.	Hygrograph	01
13.	Soil Heat Flux Plate	01
14.	GPS	10
15.	AWS (optional)	01
16.	Lysimeter (optional)	01
17.	Luxmeter	02
18.	Solar Pyranometer	01

9. Plant Pathology

No.	Items	Nos.
1.	Microscope compound with photodisplay arrangement	03
2.	Sterobinocular	05
3.	Sample processing Board (Dry preservation of samples)	04
4.	Wet preservation Jars	50
5.	Autoclave	02
6.	Oven	01
7.	Deep Freeze	01
8.	Centrifuge (3000 rpm)	01

No.	Items	Nos.
9.	Refrigerator	01
10.	Water bath	02
11.	Electronic balance	02
12.	Weighing machine	01
13.	Incubator	02
14.	Ocular meter	05
15.	Stage Micrometer	05
16.	Camera Lucida	05

10. Animal Sciences including Fisheries

No.	Items	Nos.
1.	5000/6500 Feed and Forage Analyzer	01
2.	Hand and electric centrifuge	01
3.	Analytical balance	01
4.	Hot air oven	01
5.	Micro kjeldahl N digestion & distillation apparatus	01
6.	Soxhlet unit for fat estimation	01
7.	Hot plate, Fiber Tech.	01
8.	Vacuum pump	01
9.	Willy mill grinder	01
10.	Platform balance (100 kg cap)	01
11.	Gerber centrifuge unit (for milk fat testing)	01
12.	Milk analyzer (automatic)	01
13.	Crude fiber estimation unit	01
14.	Distilled water unit	01

11. Dairy & Poultry

No.	Items	Nos.
1.	Incubator cum hatcher	01
2.	Brooder machine	01
3.	Feeder	01
4.	Waterer	01
5.	Egg candling machine	01

No.	Items	Nos.
6.	Debeaker	01
7.	Vaccinator	01
8.	Milking machine	As per requirements
9.	Milking bucket	As per requirement
10.	Milking can	As per requirements
11.	Animal and bird identification tools	As per requirement
12.	Chaff cutter	01
13.	Lactometer	01
14.	Castrator	01
15.	Shearer	01
16.	Electric dehorner	01
17.	Artificial vagina	01
18.	Common medication device	01
19.	Cattle crate	01

12. Agriculture Engineering + Farm Management

No.	Items	Nos.
1.	Working models of MB plough, Disk plough and indigenous plough	2 sets each
2.	Working model of different harrows	Actual
3.	Seed drill	01
4.	Different types of threshing drums	As per requirement
5.	Working models of reaper and mowers	02
6.	Different types of sprayers and dusters	As per requirement
7.	Cut model of CI & SI engine	01
8.	Cut model of Tractor	01

13. Central Library and Information System

No.	Items	Nos.
1.	Internet Server	01
2.	Intranet Server	01
3.	Computers for Reading Hall	20
4.	Heavy Duty Photocopiers	02



No.	Items	Nos.
5.	Computerized Issue and Catalogue Systems	02
6.	Wi-Fi facility in college/library/hostels	As per requirement
7.	CCTV monitoring system for library	01
8.	RFID and Access Control System (Optional)	01
9.	Broadband Internet Connectivity with minimum speed of 1Gbps	

