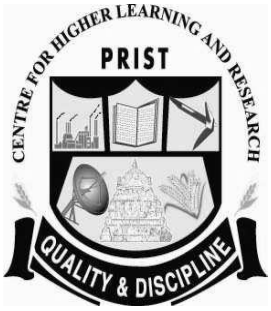

Ponnaiyah Ramajayam Institute of Science & Technology [PRIST]
(Institution Deemed to be University – U/s 3 of the UGC Act, 1956)
Vallam, Thanjavur – 613 403, TAMIL NADU

B.Sc. Hons. (Agriculture)

Syllabus

2018 Regulation

Programme educational objectives

The educational objectives are intended to impart high quality education so as to produce not just agricultural graduates but agro technocrats with practical and conceptual skills. With precise and deliberate course modules, which provides education, research and training along with first hand field experiences, the students would sure be transformed as skilled human resources.

During the programme of four year duration, the students will undergo 66 courses in the domain of agriculture, horticulture, agricultural engineering, and information technology including linguistics. The students would gain in depth expertise in scientific farm management and post harvest technologies. The students are also taught with elective courses on mushroom cultivation, sericulture, tissue culture crops and bio fertilizer production, which could explore the graduates' entrepreneurial skills and also add students 'competitive values' in job market.

Programme outcome

At the end of the programme, the graduate should be able to:

1. Recognize the importance of agriculture in providing food, fibre and income as well as nation building.
2. Understand scientific methods of cultivation of field crops and horticultural crops along with animal production.
3. Establish agro based start-ups for the upliftment of rural community
4. Initiate rural enterprises there by providing jobs for the jobless.
5. Carry out basic and applied research geared towards augmentation of crop and animal production
6. Transfer of agro technologies to the farming community via public and private sector stakeholders.
7. Pursue advanced courses and trainings in International and National institutions

CREDIT DISTRIBUTION
2018 Regulation

Semester	CORE COURSES		EXPERIENTIAL LEARNING COURSES		ELECTIVE COURSES		RESEARCH		Total Credits for OGPA
	No.	Credits	No.	Credits	No.	Credits	No.	Credits	
I	11	23	-	-	-	-	-	-	23
II	9	22	-	-	-	-	-	-	22
III	11	23	-	-	-	-	-	-	23
IV	9	21	-	-	1	3	-	-	24
V	9	20	-	-	1	3	-	-	23
VI	10	20	-	-	1	3	-	-	23
VII	-	-	1	20	-	-	1	2	22
VIII	-	-	2	20	-	-	-	-	20
Total	**59**	**129**	**3**	**40**	**3**	**9**	**1**	**2**	**180**

Semester – wise distribution of courses

I Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 AGR 101	Fundamentals of Agronomy	3(2+1)
2	18 AGR 102	Agricultural Heritage*	1(1+0)
3	18 AGR 103	Introduction to Forestry	2(1+1)
4	18 AEX 101	Rural Sociology & Educational Psychology	2(2+0)
5	18 AEX 102	Human Values & Ethics (non gradial)	1(1+0)
6	18 GPB 101	Introductory Biology	2(1+1)
7	18 HOR 101	Fundamentals of Horticultre	2(1+1)
8	18 SAC 101	Fundamentals of Soil Science	3(2+1)
9	18 BIC 101	Fundamentals of Plant Biochemistry and Biotechnology	3(2+1)
10	18 ENG 101	Comprehension & Communication Skills in English	2(1+1)
11	18 NSS / NCC 101	NSS/NCC/Physical Education & Yoga Practices	2(0+2)
Total			**23(14+9)**

II Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 AGR 104	Introductory Agro-meteorology & Climate Change	2(1+1)
2	18 AEC 101	Fundamentals of Agricultural Economics	2(2+0)
3	18 AEN 101	Fundamentals of Entomology	3(2+1)
4	18 AEX 103	Fundamentals of Agricultural Extension Education	3(2+1)
5	18 AGM 101	Agricultural Microbiology	2(1+1)
6	18 GPB 102	Fundamentals of Genetics	3(2+1)
7	18 CRP 101	Fundamentals of Crop Physiology	2(1+1)
8	18 PAT 101	Fundamentals of Plant Pathology	3(2+1)
9	18 SWE 101	Soil and Water Conservation Engineering	2(1+1)
Total			**22(14+8)**

III Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 AGR 201	Crop Production Technology - I (Kharif Crops)	2(1+1)
2	18 AGR 202	Education of Tour	1(0+1)
3	18 AEC 201	Agricultural Finance and Co-operation	2(1+1)
4	18 AMP 201	Livestock and Poultry Management	3(2+1)
5	18 ENS 201	Environmental Studies and Disaster Management	3(2+1)
6	18 FMP 201	Farm Machinery and Power	2(1+1)
7	18 GPB 201	Fundamentals of Plant Breeding	3(2+1)
8	18 HOR 201	Production Technology for Vegetables and Spices	2(1+1)
9	18 COM 201	Agro-Informatics	2(1+1)
10	18 MAT 201	Statistical Methods	2(1+1)
11	18 AGR 203	Farming System & Sustainable Agriculture	1(1+0)
Total			**23(13+10)**

IV Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 AGR 204	Crop Production Technology - II (Rabi Crops)	2(1+1)
2	18 AGR 205	Irrigation Water Management	2(1+1)
3	18 AEC 202	Agricultural Marketing Trade & Prices	3(2+1)
4	18 AEX 201	Communication Skills and Personality Development	2(1+1)
5	18 ERG 211	Renewable Energy and Green Technology	2(1+1)
6	18 HOR 202	Production Technology for Fruit and Plantation Crops	2(1+1)
7	18 PAT 201	Principles of Integrated Pest and Disease Management	2(1+1)
8	18 SAC 201	Problematic Soils and their Management	2(1+1)
9	18 SST 201	Principles of Seed Technology	3(2+1)
10	18 OPT 201	Elective Course	3(2+1)
Total			**23(13+10)**

V Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 GPB 301	Crop Improvement - I (Kharif Crops)	2(1+1)
2	18 AGR 301	Rainfed Agriculture & Watershed Management	2(1+1)
3	18 AGR 302	Practical Crop Production - I (Kharif Crops)	2(1+1)
4	18 AEN 301	Pests of Crops and Stored Grain and their Management - I	3(2+1)
5	18 AEX 301	Entrepreneurship Development and Business Communication	2(1+1)
6	18 HOR 301	Production Technology for Ornamental Crops, MAP and Landscaping	2(1+1)
7	18 PAT 302	Diseases of Field and Horticultural Crops and their Management - I	3(2+1)
8	18 SAC 301	Manures, Fertilizers and Soil Fertility Management	3(2+1)
9	18 IPR 301	Intellectual Property Rights	1(1+0)
10	18 OPT301	Elective Course	3(2+1)
Total			**23(14+9)**

VI Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 AGR 303	Geoinformatics and Nano-technology and Precision Farming	2(1+1)
2	18 GPB 302	Crop Improvement - II (Rabi Crops)	2(1+1)
3	18 AGR 304	Practical Crop Production - II (Rabi Crops)	2(1+1)
4	18 AGR 305	Principles of Organic Farming	2(1+1)
5	18 AEC 301	Farm Management, Production & Resource Economics	2(1+1)
6	18 AEN 302	Pest of Horticulture Crops and Management of Beneficial Insects	2(1+1)
7	18 FSN 301	Principles of Food Science and Nutrition	2(2+0)
8	18 HOR 302	Post-Harvest Management and Value Addition of Fruits and Vegetable	2(1+1)
9	18 PAT 302	Diseases of Field and Horticultural Crops and their Management - II	2(1+1)
10	18 PCA 301	Protected Cultivation and Secondary Agriculture	2(1+1)
11	18 OPT 302	Elective Course	3(2+1)
Total			**23(13+10)**

VII Semester

VII Semester				
No.	**Course Code**	**Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)**		
		Activites	**No. of weeks**	**Credit Hours**
1	18 AEX 401	General orientation & On campus training by different faculties	1	14
		Village attachment	8	
		Unit attachment in Univ./ College. KVK/ Research Station Attachment	5	
		Plant clinic	2	02
		Agro-Industrial Attachment	3	04
	18 PRJ 401	Project Report Preparation, Presentation and Evaluation	1	02
		Total weeks for RAWE & AIA	**22**	**22**

- **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
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, Post harvest-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.**

VIII Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 EXP 401	Experiential Learning - Module I	0+10
2	18 EXP 402	Experiential Learning - Module II	0+10

Experiential Learning: A student can select two experiential learning out of the following and offer during 8th semester.

S. No.	Title of the module	Credits
1	Production Technology for Bioagents and Biofertilizer	0+10
2	Seed Production and Technology	0+10
3	Mushroom Cultivatiuon 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
9	Food Processing	0+10
10	Agriculture Waste Management	0+10
11	Organic Production Technology	0+10
12	Commercial Sericulture	0+10

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

S. No.	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 Issues	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)

I Semester

18 AGR 101 Fundamentals of Agronomy (2+1)

Course Objectives

- To know the basic concept of agriculture and agronomy.
- To know the relationship and interaction between crops and climate.

Course Outcome

- The students will get acquainted with basic concepts in sowing, tillage, crop density, inter cultural operations etc… of agronomy
- They will understand soil- plant- water relationship, water use efficiency and scheduling irrigation.

18 AGR 102- Agricultural Heritage 1(1+0)

Course Objectives

- To identify and provide institutional support to nature friendly agricultural practices of local and tribal population around the world
- To reduce vulnerability of climate change and enhance sustainable agriculture and rural development.
- To study ancient culture of agriculture and make it use in modern agriculture to sustain ability.

Course Outcome

- The students will learn about the capacity building at local farming communities to conserve and manage revenue based farming in sustainable fashion.
- They know how to mitigate risk of erosion bio diversity and traditional knowledge about land degradation and threats.
- They learn to strengthen and conserve the sustainable use of bio diversity agricultural and rural development
- They study the ancient culture of agriculture and make it use in modern agriculture for sustainability.

18 AGR 103 - Introduction to Forestry 2 (1+1)

Course Objectives

- To create environmental awareness among all sectors of people
- To gain better knowledge about forest and forest trees and its utilisation

- To learn how the forest products is been used for day to day activities and to know about some of the cultivation practices of tree species.

Course Outcome

- The students will learn about production and protection of species of economic value(Propagation of more valuable and useful species) to meet the multiplying requirements of the people
- They learn how to produce large volume per unit area to increase the productivity and profitability of forest trees.
- They learn about classification of forest in which they may know about the types of forest which is under humane intervention which in turn helps to know the facts to conserve it.

18 BIC Fundamentals of Plant Biochemistry and Biotechnology 3(2+1)

Course Objectives

- To specified a brief understanding of the fundamentals of plant biochemistry with a view to provide the learners with an understanding of plant growth and requirements of plant.
- To acquaint the students with basic concepts of plant bio chemistry like Classification and Nomenclature of bio chemical compounds.
- To study the new technology about the biological science.

Course Outcome

- The students will learn the fundamental of plant biochemistry and briefly learn about biological techniques.
- The students will get the knowledge about the classification and nomenclatures of plant growth and easily understand techniques about the bio technology.
- The students will increase awareness about the concept of applications of plant biotechnology.
- On completion of the course, students are able to understand the basic component or bio molecules of plant substances.

18 AEX 101 Rural Sociology & Educational Psychology 2(2+0)

Course Objectives

- To acquire knowledge of the students on basics concepts related to rural sociology and educational psychology. Improving the agricultural practices as well as the well-being of the farmers in the rural areas.

Course Outcome

- The students will learn the sociological and psychological concepts in rural areas
- The students will understand investigates the social, cultural, political and religious problems of rural society.

18 AEX 102 Human Values & Ethics (non gradial) 1(1+0)

Course Objectives

- Values are the guiding principles of our lives. They are essential for positive human behavior and actions in our daily lives.

Course Outcome

- The students will gain knowledge about the concept human values, basis interests, choices, needs, desires and preferences of human.

18 HOR 101 – Fundamentals of Horticulture 2(1+1)

Course Objectives

- To learn the basic knowledge of horticulture and its importance at the National and International perspective.

Course Outcome

- Students will acquire knowledge on basic techniques in horticulture
- Students will realize the importance of Horticulture and its impact in the human health, economic development of farmers and National economy.

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

Course Objectives

- To impart knowledge about soils, their formation, pedological and edaphological approaches of soil.
- Students will acquire knowledge on physical, chemical and biological properties of soils.

Course Outcome

- The course will provide the over view of fundamental concepts in soil science genesis, classification and morphology, soil physics, soil chemistry, fertility and land use pattern.

18 GPB 101 – Introductory Biology 2(1 + 1)

Course Objectives

To expose the students to the basic features of botanical description, economic parts and economic importance of different field and horticultural crops

Course Outcomes

Botanical features and economic importance of different field and horticulture crops will be exposed

18 ENG 101 – Comprehension & Communication Skills in English 2(1 + 1)

Course Objectives

18 NSS / NCC 101 - NSS/NCC/Physical Education & Yoga Practices 2(0+2)

Course Objectives

To impart basic knowledge on various functions of NSS programmes and activities

Course Outcome

Students will come to know basic knowledge on NSS,NCC programmes, youth development programme, yoga, health, hygiene and sanitation

II Semester

18 AGR- 104 Introductory Agro-Meteorology and Climate Change 2(1+1)

Course Objectives

- To introduce agro-meteorology (definition, aim, scope and importance).
- To understand the role of agro meteorology in agriculture and its relation to other areas of agriculture.

Course Outcome

- The students will get acquainted with recent development in agro –meteorology with historical development of climate change.
- The students will study the important characterization of agricultural climate change.
- They study crop planning for prevailing climate for sustainable agriculture
- They study about crop management to various climate change and ways to mitigate it.
- They study about various instruments used in agro- meteorology.

18 AEX 103 Fundamentals of Agricultural Extension Education 3(2+1)

Course Objectives

- The dissemination of useful and practical information relating to agriculture, including improved seeds, fertilizers, implements, pesticides, improved cultural practices, dairying, poultry nutrition etc.

Course Outcome

- To create an environment for rural people so that they can show their talent, leadership and efficiency, provide appropriate solution of the farmer's problems.
- The students will gain knowledge about various schemes, community development programmes, and rural development projects.

18 AEN 101 Fundamentals of Entomology 3(2+1)

Course Objectives

- To gain knowledge about the insects morphology, physiology.

Course Outcome

- Facilitate the students to acquire knowledge in insect orders

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

Course Objectives

- This course aims to introduce the basic principles of economics including the problem of economic decision-making, laws of economics and macroeconomic concepts.

Course Outcomes:

- The students will gain the knowledge on basic principles of economics including the problem of economic decision-making, laws of economics and macroeconomic concepts.

18 SWE 101 – Soil and Water Conservation Engineering 2(1+1)

Course Objectives

- To introduce basic knowledge on soil erosion and surveying instruments.

Course Outcome

- Students gain practical knowledge on the surveying instruments and erosion control measures.

18 AGM 101 – Agricultural Microbiology 2(1+1)

Course Objectives:

- To understand the diverse group of microorganisms present in the microbial world, their morphological features and cell metabolism

- To acquaint knowledge about bacterial cell growth and genetic recombination techniques
- Perceive the knowledge about the role of microbes in soil fertility and agriculture production
- Finally this course will help students to view the importance of plant growth promoting rhizobacteria and biofertilizer production technology

Course Outcomes:

- Gain hands on skill development in safe handling, culturing and staining of microorganisms
- Get an complete understanding on historical events, diversity and scope of microbes
- Understanding the structural characters, cell growth, recombination techniques and metabolic features of microorganisms
- Gather theoretical background of microbes in soil fertility, crop production, biofertilizers, biopesticides and biofuel production
- Finally students will able to perform various aseptic techniques ; gain instrumentation and equipment based knowledge

18 PAT 101 – Fundamentals of Plant Pathology 3(2+1)

Course Objectives:

- To study the fundamentals of plant pathology
- To study the living entities that cause diseases in plants
- to know the non-living entities and the environmental conditions that cause disorders in plants
- to study the mechanisms by which the disease causing agents produce diseases
- To study the interactions between the disease causing agents and host plant in relation to overall environment

Course Outcomes:

- Learning about the plant pathogens, and their basic host – parasite relationship
- Learning about the pathogens, plant pathology history & their impacts in the environment
- Acquiring knowledge about the plant and host relationship and their management

18 GPB 102 – Fundamentals of Genetics 3(2+1)

Objectives

- The fundamental concepts of Genetics will be exposed to the students quoting classical examples

Outcomes

- Basic Principles of inheritance and modern consepts of genetics will be exposed to students

18 CRP 101 – Fundamentals of Crop Physiology 2(1+1)

III Semester

18 AGR 201- Crop production technology I (Kharif crops) 2(1+1)

Course Objectives

- To develop environmentally compatible strategies for efficient management of crops.
- To play a strong and a key role in technology transfer to agriculture and food technology.
- To study the advancement and innovations in improvement of crop development.

Course Outcome

- Students learn about developing a crop that have high water use efficiency (Drought tolerant) high yielding, early maturing and high consumer acceptability
- They will learn about developing crop system for food and value added products which are compatible with environment.
- To develop cropping system for food and value added products which are compatable with environment and application of advancement in science and technology leading to improved production of safe and nutritious food
- Students learn to identify the development and application of advances in sciences which leads to the production of healthy food.

18 AGR 202 - Education tour 1(0+1)

Course Objectives

- To make the students learn about the important practices followed around tamilnadu.
- To make them know about various research stations and works carrying out there.

Course Outcome

- Students learn about the various practices of agriculture followed in many places of tamilnadu
- They exposed themselves into many question and answer session in research stations through which they can mould themselves for their better subject knowledge.

18 ENS 201 Environmental Studies and Disaster Management 3(2+1)

Course Objectives

- To acquire knowledge of the students on basics concepts environmental science.
- To study the natural resources.
- To study the concept of an ecosystem and also study the structure and function of an ecosystem.
- To study the principles and methods of Biodiversity and its conservation.

Course Outcome

- On completion of the courses the students able to understand
- The students get complete knowledge in definition, cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution and thermal pollution.
- The students gain the knowledge about definition, genetic, species & ecosystem diversity and biogeographically classification of India
- The students learn the definition, classification, biological function of natural resources.
- The students will gain the knowledge of the ecosystems, Food chains, food webs and ecological pyramids.

18 HOR 201 – Production Technology for Vegetables and Spices 2(1+1)

Course Objectives

- Students would learn the modern production systems of vegetable and spice crops and problems in the production of these crops.

Course Outcome

- The students will have a complete knowledge on the production procedures of vegetables and spices crops at different locations.

18 AEC 201 – Agricultural Finance, Banking and Co-operation (1+1)

Course Objectives

- This course aims at imparting knowledge on principles of finance, Banking and Co-operation, and farm financial analyses.
- This course will also help the Under Graduate students in understanding the functions of various institutions involved in farm financing and different cropping insurance products implemented in India.

Course Outcomes

- The students will gain the knowledge on principles of finance, Banking and Co-operation, and farm financial analyses.

18 FMP 201 - Farm Machinery and Power 2(1+1)

Course Objective:

- To equip the students with sufficient theoretical knowledge and practical skills about farm power and tractor power sources.
- Implements resources used in agriculture, their cost of operation and selection.
- Handling and operation of tractor and agriculture machinery.

Course Outcomes:

- Students will be equipped with sufficient theoretical knowledge with practical skills on farm power sources, the availability of tractors and handling of tractors, power tillers and various implement used in land preparation, sowing, inter cultivation, plant protection and harvesting operations.
- Students will be able to hitch the implements with tractor.

18 AGR 203 – Farming System and Sustainable Agriculture 1(1+0)

Course Objective:

- To study about different types of farming and cropping systems.
- To study the practices which bring sustainability in crop production

Course Outcomes:

- Students learn about the connection between agriculture, farming system and cropping systems.
- Students know about the sustainable ways to produce crops and its management.

18 GPB 201 – Fundamentals of Plant Breeding 3(2+1)

Course Objectives

To expose the students to the basic and applied principle of plant breeding

Course Outcomes

The plant breeding methodologies and application employed for self, cross and vegetatively propagated crops will be exposed

18 COM 201 – Agro - Informatics 2(1+1)

Course outcomes

Learn the basic concept of Computer and Internet
Create document in MS Word

Do the Statistical Calculations and draw the chart using MS Excel
Design Presentation using MS Powerpoint

18 MAT 201 – Statistical Methods 2(1+1)

Course outcomes

Be familiar with basic concepts and terms
Solve problems using appropriate statistical measures
Create and interpret visual representation of statistical data.

18 AMP 201 – Livestock and Poultry Management 3(2+1)

Course outcomes

The students have learned about basic knowledge on how to manage and operate livestock and poultry farms

The students will get acquainted on selection and breeding of livestock and their management aspects

The students will gain knowledge and skills required to run broiler and layer chicken farm successfully

IV Semester

18 AGR 204- Crop production technology II (Rabi crops) 2(1+1)

Course Objectives

- To develop environmentally compatible strategies for efficient management of crops.
- To play a strong and a key role in technology transfer to agriculture and food technology.
- To study the advancement of a bio technological innovations in improvement of crop development.

Course Outcome

- Students learn about developing a crop that have high water use efficiency (Drought tolerant) high yielding, early maturing and high consumer acceptability
- They will learn about developing crop system for food and value added products which are compatible with environment.
- To develop cropping system for food and value added products which are compatable with environment and application of advancement in science and technology leading to improved production of safe and nutritious food
- Students learn to identify the development and application of advances in sciences which leads to the production of healthy food.

18 AGR 205 - Irrigation Water Management 2(1+1)

Course Objectives

- To describe the benefits of irrigation
- To learn the methods of irrigation and about application methods

- To know the progress of agriculture by means of efficient water management

Course Outcome

- Students identified the ways to determine the need for irrigation.
- They learn about irrigation concepts like Irrigation scheduling, water use efficiency, crop water requirement etc…
- They learn the importance of water management in agriculture which leads to better development of agricultural sustainability.

18 AEX 201 Communication Skills and Personality Development 2(1+1)

Course Objectives

- The students should improve the personality, communication skills and their self-confidence.

Course Outcome

- The students will gain knowledge about 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

18 AEC 202 – Agricultural Marketing, Trade and Prices (1+1)

Course Objectives

- The aim of the course is to give exposure to the Under Graduate students on market concepts, marketing of agricultural commodities, intermediaries involved, domestic and export trade, risk in agricultural marketing, marketing institutions involved, price dynamics and the role of Government in regulation of markets.

Course Outcomes:

- The students will gain the knowledge of market concepts marketing of agricultural commodities, intermediaries involved, domestic and export trade, risk in agricultural marketing.

18 SAC 201 – Problematic Soils and their Management 2(1+1)

Course Objective

- To impart knowledge on types of problematic soils and their management, soil water quality parameters, remote sensing, land suitability and pollution control.

Course Outcome:

- Students will learn type of problematic soils and their management practices, soil water

quality parameters, application of remote sensing technology in agriculture and to mitigate pollutions.

18 HOR 202 – Production Technology for Fruits and Plantation Crops (1+1)

Course Objectives

- Students would learn cultivation practices of fruits and plantation crops as perennial crops.

Course Outcome

- The students will have through information on the production practices for fruits and plantation crops.

18 ERG 211- Renewable Energy and Green Technology (1+1)

Course Objective

- To impart the knowledge of various sources of renewable energy
- To know the renewable energy used in agriculture.

Course Outcomes

- The students will understand the renewable sources like solar energy, wind energy and biochemical energy
- Students gain practical knowledge about solar PV system, solar cooker, solar water heater and solar dryer
- Students know the construction of biogas plant and their performance evaluation

18 PAT 201 - Principles of Integrated Pest and Disease Management 3(2+1)

Course Objective

- To study the different methods of Plant disease and pest controls like cultural, physical, chemical, biological and use of quarantine laws
- To expose the students on various integrated Plant Diseases and pest management including Avoidance, exclusion, Eradication, Protection and Immunization

Course Outcomes

- Learning about the diseases , their impacts and their management
- Acquiring knowledge about the plant and host relationship and their management
- To get knowledge about the integrated management of plant diseases and pest.

18 SST 201 – Principles of seed technology

Objectives

To make the students understand the importance of seed quality and principles involved in seed production

Outcomes

The students will gain knowledge about the various techniques of quality seed production, processing and seed quality enhancement

V Semester

18 AGR 301- Rainfed Agriculture and Water Shed Management 2(1+1)

Course Objectives

- To know about transforming location specific technology and recommendations for a particular rainfed area
- To know about rainfed agriculture
- To create specific awareness among the farmers to achieve sustainable agriculture production even in unfavourable conditions.

Course Outcome

- Students learn to motivate the farmers for the adaption of improved agricultural practices for enhancement of crop production and productivity under rainfed areas.
- They learn to adapt new irrigation systems by using less water under adverse climatic conditions.

18 IPR 301 Intellectual Property Rights 1 (1+0)

Course Objectives

- To acquire knowledge of the students on Introduction and meaning of intellectual property.
- To study brief introduction to GATT, WTO, TRIPs and WIPO.
- To study the concept of an patent system in india.
- To study the principles and methods of International treaty on plant genetic resources for food and agriculture.

Course Outcome

- On completion of the courses the students able to understand
- The students get complete knowledge in definition, Introduction and meaning of intellectual property.
- The students gain the knowledge about GATT, WTO, TRIPs and WIPO; Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc.;
- The student will learn the types of Intellectual Property and legislations covering IPR in India: Patents, Copyrights, Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets.
- The students will gain the knowledge of the 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.

18 AEX 301 Entrepreneurship Development and Business Communication 2(1+1)

Course Objectives

- To explain entrepreneurship development programme, government policies, schemes and incentives for promotion of entrepreneurship and social responsibility of business.

Course Outcome

- The students will gain knowledge about analyze the selected enterprises in terms of their management process and functions through study visits develop the skills of an effective manager through simulated exercises on communication skills.

18 AEN 301 – Pests of crops and stored grain and their management 3(2+1)

Course Objectives

- To know about the damage symptoms caused by the agriculturally important pest, biology and management

Course Outcome

- Learn about the nature of damages caused by the insect pest

18 HOR 301 – Production Technology for Ornamental Crops, MAP and Landscaping 2(1+1)

Course Objectives

- Students will be having the cultural practices for flower crops, medicinal and aromatic plants, landscaping for different location will also be taught.

Course Outcome

- The students will be able to undertake commercial cultivation of flower crop, medicinal and aromatic plants.
- Students will gain knowledge to establish different types garden in various locations.

18 SAC 301 - Manures, Fertilizers and Soil Fertility 3(2+1)

Course Objective

- To impart knowledge on essential nutrients, soil fertility, nutrient transformations in soil, manures, fertilizers and soil fertility management through various approaches.

Course Outcome

- To acquire knowledge on the aspects of soil fertility management and to diagnose tailor made fertilizer recommendations for crops.

18 PAT 302 - Diseases of Field and Horticultural Crops and their Management – I

Course Objective

- To study the living entities that cause diseases in plants;
- To know the non-living entities and the environmental conditions that cause disorders in plants
- To study the mechanisms by which the disease causing agents produce diseases
- To study the interactions between the disease causing agents and host plant in relation to overall environment
- To know the method of preventing or management the diseases and reducing the losses/damages caused by diseases in field and horticultural crops

Course Outcome

- Learning about the diseases and their impacts in plants
- Acquiring knowledge about the pathogens and diseases in both field and horticultural crops
- To get knowledge about the management of the disesase by various methods

18 AGR 302 – Practical crop production I (Kharif crops) 2(1+1)

Course Objective

- To learn the cultivation practice of kharif crops
- To understand the basics of field preparation
- To acquire knowledge about field practices and other farm activities.

Course Outcome

- Each student will be allotted a small crop cafeteria and he / she will do all field operations in the allotted land from field preparation to harvest and processing.
- To gain better knowledge about kharif crops.
- Learning all farm activities field management and to gain maximum knowledge about crops of a particular season

18 GPB 301 – Crop improvement – I (Kharif crops) 2(1+1)

Course Objectives

- To make the students to understand the origin of different field crops, emasculation and crossing techniques in cereals, pulses and oilseeds

Course Outcomes

- The students will gain knowledge on floral biology of different field crops and their crossing hybridization techniques

VI Semester

18 FSN 301 Principles of Food Science and Nutrition 2(2+0)

Course Objectives

- To acquire knowledge of the students on basics concepts related to food science and nutrition.
- To study the physicochemical characteristics food.
- To study the major and micro nutrients presence in the food samples.
- To study the principles and methods of food processing and preservation.
- To study the food microbiology applications.

Course Outcome

- On completion of the courses the students able to understand

- The students get complete knowledge in food science, processing, product development and preservation.
- The students gain the knowledge about the nutrition, nutritional education and nutrition awareness.
- The students learn the definition, classification, biological function and chemical and physical properties of major and micro nutrients.
- The students will gain the knowledge of the fundamentals food microbiology and also learn the food safety and standards.

18 AEC 301 – Farm Management, Production and Resource Economics 2(1+1)

Course Objectives

- This course aims at imparting knowledge on principles of farm management.
- This course also would help the Under Graduate students in using different methods and tools for decision making in farm management, which would facilitate profit maximization through optimizing farm resource use.

Course Outcomes

- The students will gain the knowledge on principles of farm management.

18 HOR 302 – Post Harvest Management and Value Addition of Fruit and Vegetables 2(1+1)

Course Objectives

- Students would be able realize the difficulties in handling the perishable and to learn the handling systems of fruit and vegetables.

Course Outcome

- The students will have complete knowledge on the post harvest handling, processing and packing systems of fruits and vegetables.

18 AGR 303 - Geo informatics, Nano technology and Precision farming 2(1+1)

Course Objectives

- To study and moniter the change of natural environment and choosing data from a wide variety of high resolution satellite and apply them for industrial purpose
- To study a range of science and engineering discipline.
- To increase the accuracy and efficiency of agricultural input application.

Course Outcome

- Students learn about the connection between agriculture with nanotechnology and geo informatics.
- Students know about the economic and environmental feasibility of the precision farming technology.

18 PAT 302 -Diseases of Field and Horticultural Crops and their Management – II 2(1+1)

Course Objectives

- To study the living entities that cause diseases in plants;
- to know the non-living entities and the environmental conditions that cause disorders in plants
- to study the mechanisms by which the disease causing agents produce diseases
- To study the interactions between the disease causing agents and host plant in relation to overall environment
- To know the method of preventing or management the diseases and reducing the losses/damages caused by diseases in field and horticultural crops

Course Outcome

- Learning about the diseases and their impacts in field and horticultural crop plants
- Acquiring knowledge about the pathogens and diseases in both field and horticultural crops
- To get knowledge about the management of the disease by various methods

18 PCA 301 – Protected Cultivation and Secondary Agriculture 2(1+1)

Course Objectives

- To study about protected cultivation and its applications.
- To study the practices which create facilities for primary processing in agriculture.

Course Outcome

- Students learn about the technique wherein the micro climate around the plant is controlled.
- Students know about the sustainable ways to protect the crops from adverse weather using protected cultivation.

18 AGR 304 – Practical crop production I (Rabi crops)

Objective

- To learn the cultivation practice of rabi crops
- To understand the basics of field preparation
- To acquire knowledge about field practices and other farm activities.

Outcome

- Each student will be allotted a small crop cafeteria and he / she will do all field operations in the allotted land from field preparation to harvest and processing.

- To gain better knowledge about rabi crops.

- Learning all farm activities field management and to gain maximum knowledge about crops of a particular season

18 AGR 305- Principles of organic farming

Objective

- To know the importance of organic farming
- To know the practices and methods which is followed in organic farming
- To know the methods which can be replaced by organic farming to maintain healthy and residue free crops.

Outcome

- Students learn about promoting the usage of natural products
- They learn to use the locally available natural farm resources which is effectively recyclable.
- They know to control the pest and disease and also weeds in organic manner.

18 GPB 302 – Crop improvement – II (Rabi Crops) 2(1+1)

Course Objectives

- To make the students to understand the origin and floral biology of different field crops like fiber, sugarcane, vegetables, fruit crops and to familirise the crossing, emasculation techniques

Course Outcomes

- The students will gain knowledge on origin, floral biology, emasculation and crossing techniques of different field crops and horticulture crops.

VII Semester

18 AEX 401 RAWE (Rural Agricultural Work Experience) 20(0+20)

Course Objectives

- To understanding rural life by students, preparation and production plan suitable for local situation.

Course Outcome

- The students identified the agricultural problems & farmers problems

- Visit to various agricultural research centers, local institution, interaction with research scientist, conducting different type of experiment, demonstrations etc..

VIII Semester

18 EXP 401 & 18 EXP 402 – Experiential Learning – Module I & II (0+20)

1. Production Technology for Bioagents and biofertilizers

Course Objectives

- To promote skill based knowledge on types of Bioagents and biofertilizer
- Acquaint knowledge on structure and characteristics features of bacterial and fungal biofertilizers; their production technology, growth and fermentation techniques; mass production and liquid biofertilizers
- To gather knowledge on their formulation methodology and their specificity
- To acquire skills on low cost media preparation and cultural practices in biopesticides and biofertilizer production
- Understanding the application strategies, quality control and marketing

Course Outcome

- Gain experimental knowledge on Bioagents and biofertilizer production methodologies, formulations and application strategies
- At the end of this course students will themselves be a entrepreneur with the knowledge on starting biofertilizer unit and low low cost technologies in biofertilizer and Bioagents production

3. Mushroom Cultivation Technology

Course Objectives

- To study in detail about the mushroom cultivation
- To know the details about the edible mushroom cultivation
- To study and overcome the constrains in mushroom cultivation
- To study the advantages and disadvantages in mushroom cultivation
- To know different method and different substrate to cultivate mushroom
- To know the marketing techniques of mushroom in local markets

Course Outcome

- Learning about the details of edible mushroom
- Acquiring knowledge about the edible mushroom and their cultivation technology

- Acquired knowledge about the various disease and pests that affect mushroom during cultivation process
- To get knowledge about the management of the mushroom diseases and various cultivation techniques.

Seed production and technology(0+10)

Objectives

- To make the students to understand seed production and its process

Outcomes

- The students will gain knowledge about the various techniques of quality seed production, pre and post harvest operation, processing and seed quality enhancement

Commercial Horticulture

Objectives

- To gain knowledge and hands on experience in different aspects of commercial (fruits, vegetables, flowers, ornamentals and medicinal plants) nursery, soil media preparation and care, maintenance & handling of seedling of fruit crops.

Student's attitude in leadership, managerial skill and professionalism will be enriched

Outcome:

- The students who are undergoing this experiential learning will have independent skill to manage commercial nursery. They know to prepare a nursery and it will create a self enterprising activity for them.

Floriculture and Landscaping

Objectives

- To gain knowledge and hands on experience in different aspects of flower production, green wall, layout of garden and post harvest handlings. It also includes production of planting material through seeds, cutting, budding, grafting, etc, up to marketing of the flower and flower produce.

Outcome:

- The students who are undergoing this experiential learning about identification and study important commercial varieties of the flowering crops. Preparation of ground and beds for planting specific flower crops. Layout of plots and gardens, planning for home gardens, landscape gardens. Preparation and execution of landscape plants maintenance

of gardens and lawns. Accessories and containers for flower arrangements. Floral arrangement preparation of floral ornaments bouquets etc. Preparation of bottle gardens, terrarium etc.

18 OPT 301, 18 OPT 301, 18 OPT 302 – Elective course 3 (2+1)

Commercial plant breeding 3(1+2)

Objectives

- To make the students to understand techniques of self pollinated ,cross pollinated crops, multiplication and purification of various crops for hybrid seed production

Outcomes

- The students will gain knowledge about role of pollinators, analytical procedure for hybrid seed production

Landscaping

Objectives

- To gain knowledge and hands on layout of gardening, characteristics of plants, care and maintenance of planting materials.

Outcome:

- The student will gain the knowledge about layout of gardening, characteristics of plants, care and maintenance of planting materials

I Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 AGR 101	Fundamentals of Agronomy	3(2+1)
2	18 AGR 102	Agricultural Heritage*	1(1+0)
3	18 AGR 103	Introduction to Forestry	2(1+1)
4	18 AEX 101	Rural Sociology & Educational Psychology	2(2+0)
5	18 AEX 102	Human Values & Ethics (non gradial)	1(1+0)
6	18 GPB 101	Introductory Biology	2(1+1)
7	18 HOR 101	Fundamentals of Horticultre	2(1+1)
8	18 SAC 101	Fundamentals of Soil Science	3(2+1)
9	18 BIC 101	Fundamentals of Plant Biochemistry and Biotechnology	3(2+1)
10	18 ENG 101	Comprehension & Communication Skills in English	2(1+1)
11	18 NSS/NCC 101	NSS/NCC/Physical Education & Yoga Practices	2(0+2)
Total			**23(14+9)**
***Non – gradial Course**			

18 HOR 101 FUNDAMENTALS OF HORTICULTURE 2 (1+1)

Course outlines

Theory

Horticulture-Its definition and branches, Importance and scope of horticulture, Horticultural and botanical classification, Climate and soil for horticultural crops, Plantpropagation-methods (sexual & asexual), propagating structures; separation, division, grafting, budding, layering), High density planting; Use of rootstocks; Orchard establishment; (Principles & Layout) Principles and methods of training and pruning, Juvenility and flower bud differentiation; Unfruitfulness; pollination, pollinizers andpollinators; fertilization and parthenocarpy; Vegetable gardens & ornamental garden types and parts; Lawn making, Use of plant bio-regulators in horticulture, Irrigation methods in horticulture crops, Fertilizers application-methods.

Practical

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

Lecture outlines

Theory

1. Horticulture – Definition - Divisions of horticulture with suitable examples.
2. Scope and importance of horticulture - Importance of horticulture in terms of income, employment generation, industry, religious, aesthetic, food & nutritive value and export.
3. Horticultural classification based on soil, climate and botanical classification.
4. Climate and soil for horticultural crops - Influence of environmental factors on horticultural crop production – Temperature, humidity, wind, rainfall and solar radiation – Influence of soil factors – Soil type, pH, EC.
5. Propagating structures- Plant propagation- Methods - Sexual and asexual – Propagation by cuttings – Definition of cutting – Stem cuttings – Leaf cuttings – Root cuttings.
6. Propagation by Layering - Types of layering (tip, simple, compound, mound, trench, air layering) - Natural modifications of layering (runners, suckers, stolon, offset)- Propagation by separation - Bulbs, corms; division (rhizome, stem tuber, tuberous roots).
7. Grafting, budding -Rootstock and scion selection – Grafting methods – Attached scion methods of grafting, simple or approach grafting, detached scion methods of grafting (side grafting - Veneer grafting, apical grafting- epicotyl grafting, double, soft wood grafting, cleft grafting, tongue grafting, whip grafting) – Graft incompatibility – Types – Translocated and localized incompatibility; Budding – Methods of budding – T-budding, inverted T-budding, patch budding and ring budding - Top working.
8. Principles of orchard establishment – Points to be kept in mind while selecting site for the establishment of orchards - Principles and steps in orchard establishment - Layout of orchards – Systems of planting - Square, rectangle, quincunx, hexagonal and contour systems of planting- their merits and demerits.

9. Principles and methods of training and pruning - Definition of training, objectives and training, principles and methods of training of fruit crops - Open centre, closed centre and modified leader systems their merits and demerits - Definition of pruning, objectives of pruning, principles and methods of pruning of fruit crops.
10. Juvenility and flower bud differentiation – Methods for shortening juvenility - Application of growth regulators (Gibberellins, Auxins, cytokinins, Abscissic acid, Ethylene), environmental methods (photoperiod, temperature) – Cultivation techniques (grafting, pruning, girdling, irrigation, nutrition) - Bearing habits of fruit trees.
11. Unfruitfulness, factors (physiological, phylogenical, management, parasitical, climatological) pollination - Self and Cross pollination, pollinizers and pollinators - Fertilization and parthenocarpy – Types.
12. Types of vegetables Gardens – Kitchen Garden, market garden, truck garden, vegetable forcing, garden for processing, seed production garden and floating garden. Ornamental garden types – Formal – Informal – Wild Garden – Parts/ features of an ornamental garden.
13. Lawn making – Selection of Grass – Bermuda grass – Korean grass – Poa grass – Fescue grass – Kentucky blue grass - Grasses for shady areas – Site Selection – Soil - Preparation of soil – Drainage – Digging – Manuring and grading – Methods of planting – Sowing of seeds – Dibbling – Turfing – Maintenance of lawn – Mowing – Rolling – Sweeping –Scraping – Raking – Weeding – Irrigation – Top dressing with compost and fertilizers - Diseases and other problems – Fairy ring – Pale Yellow Laws.
14. Use of plant bio-regulators (PBR) in horticulture – Introduction – Applications of PBR in fruit crops.
15. Irrigation methods in horticulture crops - Different methods followed in horticultural crops (check basin, furrow, ring basin, basin, flood, pitcher, funnel, drip and sprinkler).
16. Fertilizer application- Different methods of application to horticultural crops- Broad casting, top dressing, localized placement, contact placement Band placement, row placement, pellet, foliar application, starter solution, fertigation.

Practical

1. Identification of garden tools.
2. Identification of horticultural crops.
3. Layout of different planting systems.
4. Layout of kitchen garden.
5. Preparation of nursery bed (raised and flat beds) and sowing of seeds.
6. Practice of different asexual methods by divisions.
7. Practice of different asexual methods by cuttings.
8. Practice of different asexual methods by grafting.
9. Practice of different asexual methods by budding.
10. Practice of different asexual methods by layering.
11. Training and pruning of fruit trees.
12. Transplanting and care of vegetable seedlings.
13. Making of herbaceous and shrubbery borders.
14. Preparation of potting mixture, potting and repotting.
15. Fertilizer application in different crops.
16. Visits to commercial nurseries/orchard.

References

1. Chadha, K.L. 2001. *Handbook of Horticulture.* ICAR, New Delhi.

2. Jitendra Singh, 2012. *Basic Horticulture.* Kalyani Publishers. New Delhi.

3. Randhawa, G.S. and Mukhopadhyaya, A. 1994. *Floriculture in India*. Allied Publishers Pvt. Ltd., New Delhi

4. Kumar, N. 1997. *Introduction to Horticulture*. Rajyalakshmi Publications, Nagorcoil, Tamilnadu.

18 BIC 101 FUNDAMENTALS OF PLANT BIOCHEMISTRY AND BIOTECHNOLOGY 3 (2+1)

Course outlines

Theory

Importance of Biochemistry - Properties of Water, pH and Buffer – Carbohydrate, Importance and classification - Structures of Monosaccharides - Reducing and oxidizing properties of Monosaccharides -Mutarotation, Structure of Disaccharides and Polysaccharides – Lipid, Importance and classification -Structures and properties of fatty acids - Storage lipids and membrane lipids – Proteins, Importance of proteins and classification, Structures - titration and zwitterions nature of amino acids – Structural organization of proteins – Enzymes, General properties and 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.

Lecture outlines

1 Introduction – Historical aspects of Biochemistry– Scope, impact and importance of Biochemistry in plant sciences -Properties of water – PH – Buffers.

2 Carbohydrates– Classification - Structures – Monosacharides – Structural aspects – mutarotation - Reducing and oxidizing properties.

3 Oligosaccharides and polysaccharides-Funtions of carbohydrates

4 Lipids – Fatty acids – Structures and properties – Functions of lipids

5 Lipids - Classification – Storage lipids and membrane lipids – Saponification, hydrogenation, Iodine number and Acid value.
6 Amino acids – Structures - Classification – Zwitterions – Titration
7 Peptides – Oligopeptides – Cyclic and acyclic peptides – Malformin, Glutathione, Gramicidin – Functions of peptides.
8 Proteins –Importance - Classification - Properties of proteins –Isoelectric PH – Denaturation - Protein sequencing – Edman degradation method
9 Proteins – Structural organization – Primary, secondary, tertiary and quaternary structures and forces involved in stabilizing proteins
10 Enzymes – Characteristics of enzymes – Chemical nature, speed, specificity, active site - activation energy – Mechanism of enzyme action.
11 Classification of enzymes - Isoenzymes – Multienzyme complex – Allosteric enzymes and coenzymes.
12 Measurement of enzyme activity – Factors effecting enzyme activity – Enzyme Inhibition – MM & LB plots
13 Nucleic acids – Functions – Structures of nitrogen bases – Nucleosides – Nucleotides in RNA and DNA.
14 Various types of DNA and RNA – Secondary structure of B-DNA and t-RNA.
15 Metabolism – Anabolism and Catabolism – Stages of respiration – Overall metabolic view of carbohydrates, proteins and lipids.
16 Metabolism of carbohydrates – Glycolysis – Aerobic and anaerobic.
17 Tricarboxylic Acid (TCA) cycle— Glyoxalate cycle – Electron transport chain
18 Metabolism of lipids –Biosynthesis of fatty acids and tri acyl glycerol
19 Catabolism of lipids _ α, β & γ oxidation of fatty acids in brief and α oxidation in detail.
20 Protein Biosynthesis and post translational modifications
21 Secondary metabolites – Terpenoids – Alkaloids - Phenolics – Importance
22 Biotechnology – Major – Concepts and importance – Applications of plant biotechnology.
23 Introduction to plant tissue culture – History – Scientists - Terminology – Steps in general tissue culture – Types of sterilization and nutrient media – Types of cultures – Organ cultures, cell suspension culture, callus culture, pollen culture and their applications.
24 Micropropagation – Procedure techniques – Organogenesis and embryogenesis – Problems – Advantages – Limitations.
25 Anther culture – embryo culture – Ovule culture – Somatic embryogenesis - Synthetic seeds and its applications.
26 Protoplast isolation and fusion – Somatic hybridization – Cybrids – Somaclonal variations and applications in crop improvement – Cryo preservation
27 Recombinant DNA methods - Introduction to genetic engineering – Definitions – Gene cloning - Vectors.
28 & 29Gene transfer methods – Indirect methods (Agrobacterium) and direct methods (physical-gene gun method; chemical-PEG mediated and other methods) with case studies / examples.
30 Transgenic plants – Present status - Applications in crop improvement – Limitations – biotechnology regulations.
31 Polymerase chain reaction (PCR) – Procedure and applications.

32 Markers - Morphological, biochemical and molecular markers – RFLP, RAPD and SSR – Marker assisted selection for crop improvement.

Practical

1 Preparation of solutions, pH and buffers.
2 Qualitative tests for carbohydrates.
3 Qualitative tests amino acids.
4 Estimation of amylose in rice.
5 Estimation of reducing sugar/Total soluble sugars.
6 Estimation of proteins by Lowrys method.
7 Extraction of oil from oil seeds by soxhlet apparatus.
8 Effect of PH, temperature and substrate concentration on enzyme action.
9 Paper chromatography / TLC demonstration for seperation of amino acids.
10 Sterilization techniques.
11 Composition of various tissues culture media and preparation of stock solutions for MS nutrient medium.
12 Callus induction from various explants.
13 Micropropagation – Hardening and acclimatization.
14 Demonstration of isolation of DNA and of gel electrophoresis technique.
15 Demonstration of PCR Technique.
16 Demonstration of DNA finger printing –RAPD and Restriction digestion.

References:

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

18 SS&AC 101 FUNDAMENTALS OF SOIL SCIENCE 3(2+1)

Course outlines

Theory

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

Practical

Study of soil profile in field. Study of soil sampling tools, collection of representative soil sample, its processing and storage. 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, Infiltration rate. 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.

Lecture outlines

Theory

1. Introduction - Spheres of the earth atmosphere, hydrosphere and lithosphere – Their characteristics – Origin of soil – Soil and soil components – Mineral matter, organic matter, water and air – Definition of soil and various concepts of soil – Branches of soil science.
2. Rocks – Classification of rocks based on mode of origin –Iigneous rocks, sedimentary rocks and metamorphic rocks – Classification of rocks based on silica content – Weatherability of rocks.
3. Minerals – Primary, secondary, essential and accessory minerals – Primary minerals – Quartz, feldspar, micas, pyroxenes, amphiboles and olivines – Weatherability of primary minerals.
4. Non-silicate minerals – P, Ca, Mg, S and micronutrient containing minerals –Secondary silicate minerals – Basic structural units.
5. Weathering – Types of weathering – Physical weathering of rocks – Agents of physical weathering and their role- Biological weathering – Role of flora and fauna in weathering process.
6. Chemical weathering – Solution, hydration, hydrolysis, carbonation, oxidation and reduction.

7. Parent material – Classification of parent materials based on their mode of transport by different agents - Soil formation – Soil forming factors – Classification and their role in soil formation – Catena – Definition.

8. Pedogenic processes – Eluviation, illuviation, humification, calcification, laterization, podzolisation, melanisation, salinization and alkalization.

9. Soil profile –Detailed description of a theoretical soil profile – Differences between surface soil and sub soil.

10. Soil physical properties – Soil texture – Definition – Various inorganic components in soil and their properties – Various textural classes in soil and their properties.

11. Particle size analysis –Stoke's Law – Assumptions and limitations – significance of soil texture.

12. Soil consistence – Consistence of wet and dry soils – Soil crusting – Soil plasticity – Atterberg's plastic limits – Factors affecting plastic limits – Significance of soil consistence.

13. Soil structure – Classification – Types, classes and grades of soil structure – Importance of soil structure and its management.

14. Soil density – Bulk density and particle density – Factors affecting density parameters – Importance of bulk density of soil – Soil compaction –Iits importance – Calculation of porosity.

15. Soil strength and its importance – Soil colour – Components – Significance of soil colour.

16. Soil water – Forces of soil water retention – pF concept – Soil moisture characteristic curves – Importance of soil water.

17. Soil water potential – Components of water potentials – Soil moisture constants – Field capacity, wilting coefficient, hygroscopic water and saturation – Available water and methods for determining soil moisture constants – Pressure plate and pressure membrane apparatus.

18. Soil water content – Soil water movement – Darcy's Law – Saturated, unsaturated and vapour flows – Infiltration, percolation and permeability – Distribution of water in profile in different soils – Soil drainage and its importance.

19. Soil temperature – Sources of heat – Heat capacity and conductivity –factors influencing soil temperature – Modification of soil thermal regimes – Measurement of soil temperature – Importance of soil temperature on crop growth –Management of soil temperature and importance.

20. Soil air – Compositions of atmospheric air and soil air – Gaseous exchange –Influence of soil air on plant growth, soil properties and nutrient availability – Measurement of oxygen diffusion rate – Measures to improve soil aeration.

21. Soil reaction, pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability.

22. Soil colloids – Definition – General properties – Shape, surface area, electrical charge, adsorption, flocculation, deflocculation, plasticity, cohesion, swelling, shrinkage, Tyndall effect and Brownian movement.

23. Secondary silicate clay minerals of different types – Kaolinite, illite, montmorillonite and chlorite – Properties – Allophones.

24. Origin of charge in organic and inorganic colloids – Negative and positive charges – Differences between organic and inorganic soil colloids.

25. Adsorption of ions – Types of ion exchange – Cation and anion exchange – Cation and anion exchange capacities of soil – Base saturation – Factors affecting ion

exchange capacity of soils – Importance of Cation Exchange Capacity (CEC) of soils – Calculation of base exchange capacity and exchangeable acidity.

26. Soil biology – Biomass – Flora and fauna – Their important characteristics – Role of beneficial organisms – Organic matter decomposition, mineralization and immobilization.

27. Nitrogen fixation, denitrification , solubilization of phosphorus and biological control of plant diseases – Promotion of plant growth promoting substances –Harmful activities of soil organisms.

28. Soil organic matter – Various sources – Composition – Compounds in plant residues – Their decomposability – Humus – Definition – Synthesis of humus.

29. Soil organic matter and humus – Importance - Fractionation of soil humus – Carbon cycle – Carbon : nitrogen (C:N) ratio of commonly available organic residues – Significance of C:N ratio in soil fertility.

30. Soil classification – Early system of soil classification – Diagnostic horizons.

31. Soil taxonomy – Order, sub order, great group and family series – Nomenclature according to soil taxonomy.

32. Soil groups of India – Alluvial soils, black soils, red soils, laterite soils and coastal sands.

Practicals

1. Methods of chemical analysis, principles, techniques and calculations
2. Study of soil sampling tools, collection of representative soil sample, its Processing and storage.
3. Description of soil profile in the field.
4. Studies of capillary rise phenomenon of water in soil column and water movement in soil.
5. Determination of texture by feel method.
6. Determination of mechanical composition of soil using Bouyoucos Hydrometer.
7. Determination of bulk density and particle density of soil and porosity.
8. Determination of soil moisture content by gravimetric method.
9. Determination of infiltration rate.
10. Determination of soil strength by cone penetrometer.
11. Aggregate analysis by wet sieving method.
12. Determination of soil pH & EC of soil.
13. Determination of cation exchange capacity of soil.
14. Determination of soil colour & study of soil map.
15. Estimation of organic matter content in soil.
16. Determination of heat transfer in soils.

References

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

18 AGR 103 INTRODUCTION TO FORESTRY 2(1+1)

Course outlines

Theory

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

Practical

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

Lecture outlines

Theory

1. Introduction – definitions of basic terms related to forestry, Indian forest, target area, productivity
2. Influence of forest on climate, soil, floods, erosion, human health and recreation.
3. Objectives of silviculture, forest classification, salient features of Indian forest policies.
4. Forest regeneration, Naturals regeneration - natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers.
5. Artificial regeneration – objectives, choice between natural and artificial regeneration, planting methods, essential preliminary considerations. Crown classification.
6. Tending operations – weeding, cleaning, thinning – mechanical, ordinary, crown and advance thinning.
7. Principles and practices of social forestry nurseries- types of nurseries - success in nursery production.
8. Afforestation in different sites - shifting sand dunes, saline soils, ravine lands, wet lands, lateritic soils, dry rocky soils, canal banks, road sides and watershed areas.
9. Village wood lots, selection of species - measures for shortage of fuel wood- Properties of fuel wood- management and advantages of energy plantations- Suitable tree species

10. Forest mensuration – objectives, diameter measurement, instruments used in diameter measurement; Non instrumental methods of height measurement - shadow and single pole method;
11. Instrumental methods of height measurement - geometric and trigonometric principles, instruments used in height measurement;
12. Tree stem form, form factor, form quotient, measurement of volume of felled and standing trees, age determination of trees.
13. Major and minor forest products
14. Agroforestry – definitions, importance, criteria of selection of trees in agroforestry
15. Different agroforestry systems prevalent in the country, shifting cultivation, taungya, alley cropping, wind breaks and shelter belts, home gardens.
16. Cultivation practices of Subabul, Eucalyptus and Casuarina tree species.

Practical

1. Identification of tree-species.
2. Diameter measurements using calipers and tape, diameter measurements of forked, buttressed, fluted and leaning trees.
3. Height measurement of standing trees by shadow method, single pole method and hypsometer.
4. Volume measurement of logs using various formulae.
5. Biomass estimation in energy plantations
6. Nursery lay out, seed sowing,
7. Application of pre-sowing seed treatments
8. Vegetative propagation techniques.
9. Field planting techniques
10. Forest plantations and their management.
11. Identification of important major and minor forest products
12. Visits of nearby forest based industries.
13. Visit to social nurseries of forest department
14. Visit to energy plantations and forest research centres.
15. Visits to nearby forest based industries.
16. Collection and maintenance of forest products and herbarium

References

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

18 ENG 101 COMPREHENSION AND COMMUNICATION SKILLS IN ENGLISH
2 (1 + 1)

Lecture outlines

Theory

1. War minus shooting – A lesson from the text book "The Sporting Spirit"` by George Orwell - Comprehension pertaining to the textual grammar - Fill in the blanks, matching and vocabulary.
2. War Minus Shooting – A lesson from the text book, "The Sporting Spirit" by George Orwell - Comprehension pertaining to the textual grammar - Fill in the blanks, matching and vocabulary.
3. Synonyms- List of synonyms - Choose the synonyms - Exercises - Practice and implementation.
4. Antonyms – Fill in the blanks - Choose the correct antonyms - Exercises Practice and implementation.
5. Verbal ability – A list of words often confused and misused - Practice and implementation.
6. A Dilemma – A lesson from the text book, "Layman looks at Science" by Raymond - B. Fosdick - Comprehension pertaining to the textual Grammar - Fill in the blanks, matching, vocabulary and reading comprehension.
7. A Dilemma – A Layman looks at Science - Reading comprehension and answering the questions.
8. Homonynms - Homonyms are distinct words with quite different meanings using the words in two ways - More words at a glance and exercises related to GRE and TO EFL.
9. Homophones – A list of homophones - Fill in the blanks, underline the correct word and exercises related to GRE and TOEFL.
10. You and Your English – A lesson from the text book," A Spoken English and Broken English" by G. B. Shaw – Answering the questions related to the text - Fill in the blanks, matching and vocabulary and reading comprehension.
11. You and Your English – Reading comprehension and answering the questions.
12. Functional Grammar – Tenses - Active voice and passive voice - Degrees of comparison and types of sentences - Direct and indirect speech and agreement of verb with subject functional grammar – Articles – Prepositions - Parts of speech and agreement verb with subject - Glossary.
13 Business correspondence - Principles of letter – Writing - Courtesy and consideration - Directness and conciseness, avoid – Verbosity and participial endings - Clarity and precision - Negative and roundabout - Structure and layout of letters - Planning a letter quotations, orders, tenders, sales letters, claim and adjustment letters, job application letters - Social correspondence – Personal correspondence and *curriculum vitae*.
14 The style - Importance of professional writing - Choice of words and phrases, clichés - Jargons - Foreign words and phrases.
15. Precise writing- Summarizing – The essential features of a good precise – Important points while making a precise - Some don'ts - Make a precise of the following paragraph and suggest suitable title - Figurative language – Figurative language associated with literature and with poetry - The figures of speech usually used in writing and conversation.

16. Interviews – The screening interview- The informational interview- The directive style - The meandering style - The stress interview - The behavioural interview - The audition - The tag team interview - The meal time interview - The follow–up interview - Fermi interview - Preparing for the interview - Body language and interview - Types of interview questions - Idiomatic language.

Practical

1. Effective listening – Developing listening skills – Honing listening skills.
2. Listening to short talks and lectures from the cassettes of EFL University.
3. Spoken english – Vowels – Consonants - Monophthongs, diphthongs, triphthongs.
4. Stress – Intonation - Phonetic transcription.
5. Seminars – Conferences - Preparation and demonstration.
6. Oral presentation by students - Articulation and delivery – Evaluation sheet for oral presentation.
7. Communication skills – Verbal communication - Written communication.
8. Telephonic conversation.
9. Reading skills - Skimming, scanning - Extensive reading - Intensive reading and examples.
10. Meeting - Purpose, procedure, participation, physical arrangements.
11. Presentation of reports by using power point and L.C.D.
12. Interviews – Mock interviews .
13. Debate and Group discussion.
14. Using a dictionary effectively.
15. Vocabulary.
16. Pronunciation practice.

References

1. Balasubramanian, T. 1989. *A Text Book of Phonetics for Indian Student*, Orient Longman, New Delhi.
2. Balasubramanyam, M. 1985. *Business Communication.* Vani Education Books, New Delhi.
3. Jean Naterop, B. and Rod Revell. 1977. *Telephoning in English*. Cambridge University Press, Cambridge.
4. Krishna Mohan and Meera Banerjee. 1990. *Developing Communication Skills*. Mc Millan India Ltd. New Delhi.
5. Krishanswamy, N and Sriraman, T. 1985. *Current English for Colleges*. Mc Millan India Ltd., Madras.
6. Narayanaswamy V R. 1979. *Strengthen Your Writing.* Orient Longman, New Delhi.
7. Sharma R C and Krishna Mohan. 1978. *Business Correspondence.* Tata Mc Graw Hill Publishing Company, New Delhi.

18 AGR 101 FUNDAMENTALS OF AGRONOMY 3(2+1)

Course outlines

Theory

Agronomy and its scope; Seeds and sowing, tillage and tilth, 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, methods, quality of irrigation water and water logging. Weeds, importance, classification, crop weed competition, concepts of weed management, principles and methods; Herbicides, classification, selectivity, resistance , allelopathy; Growth and development of crops, factors affecting growth and development, plant ideotypes; Crop rotation and its principles; Adaptation and distribution of crops, crop management technologies in problematic areas; Harvesting and threshing of crops.

Practical

Identification of crops, seeds, fertilizers, pesticides and tillage implements; Effect of sowing depth on germination and seedling vigour; Identification of weeds in crops, methods of herbicide and fertilizer application; Study of yield contributing characters, 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 and seed drill; Study of soil moisture measuring devices, measurement of field capacity, bulk density and infiltration rate and measurement of irrigation water.

Lecture outlines

Theory

1 Agriculture - Agronomy and its scope- Role of Agronomists in resource management for crop production

2 Tillage and tilth - Objectives of tillage- Characteristics of ideal seed bed- Effect of tillage on soil properties

3 Types of tillage- Factors affecting tillage and seed bed preparation - After cultivation- Puddling.

4 Concepts of tillage – Minimum tillage, zero tillage, strip tillage, conservation tillage and their advantages and limitations.

5 Seeds and sowing- Characteristics of good quality of seed, seed treatment, agronomic significance of seed purity and quality - Methods of sowing, importance of time and depth of sowing.

6 Crop density and geometry - Crop stand establishment, factors affecting optimum stand establishment.

7 Plant population – Competition, types of competition, intra and inter plant competition - Effect of plant population on growth and yield,optimum plant density and planting pattern.

8 Soil fertility and soil productivity – Soil organic matter and its importance - Loss of soil fertility and its maintenance.

9 Crop nutrition – Essential plant nutrients- Primary, secondary and micro nutrients – Nutrient uptake – Nutrient use efficiency

10 Manures and fertilizers- Types of manures and fertilizers - Factors influencing methods and time of fertilizer application - Bio-fertilizers..

11 Irrigation - Importance of Irrigation - Objectives of irrigation - Methods of irrigation and water use efficiency

12 Crop growth and development - Factors affecting growth and development - Agronomic manipulation of crop growth and development.

13 Plant ideotypes – Concept, definition-Morphological and physiological characteristics of new plant types.

14 Cropping pattern, Cropping system (navadhanya concept) - Crop rotation – Principles of crop rotation - Mono cropping and its disadvantages – Types of cropping systems-Mixed, multiple, intercropping, relay and multistoried cropping

15 Crop adaptation and distribution in India and Andhra Pradesh - Factors influencing crop adaptation and distribution.

16 Common problems in crop production related to climate, soil, pest and disease incidence - Crop management technologies to overcome the problems identified.

17 Dryfarming, dryland farming and rainfed farming – Classification of climate – Problems of crop production in dry areas.

18 Soil moisture conservation and water harvesting measures – Watershed: Objectives and components – Watershed management

19 Weed –Definition – Importance- Harmful and beneficial effects of weeds – Aquatic weeds

20 Classification of weeds - Based on morphology, life cycle, habitat, origin, association and special features with examples

21 Propagation of weeds – Sexual – Asexual- Vegetative (Rhizomes, root stocks, runners, stolons, suckers, offsets, tubers, bulbs, bulbils, stems and roots)

22 Weed biology- Characteristic features of weeds, weed ecology – Persistence of weeds, climatic, edaphic and biotic factors.

23 Crop weed association – Factors affecting crop weed competition- Common weeds associated with major crops like rice, maize, wheat, sorghum, pulses, groundnut, sugarcane, cotton, and tobacco

24 Crop-weed-competition - Critical period of crop weed competition – Allelopathy.

25 Methods of weed management - Prevention, control and eradication – Physical, mechanical and cultural methods - Chemical and biological methods of weed control – Integrated weed management

26 Herbicides- Definition, advantages and limitations of herbicide usage in India.- Bioherbicides

27 Classification of herbicides based on chemical nature, time and method of application

28 Herbicidal formulations – active ingredient- Acid equivalent- Nomenclature of herbicides.

29 Adjuvants and their use in herbicide application –Types of adjuvants with examples.

30 Mode of action of herbicides - Important biochemical modes of action of herbicides (especially interfering with photosynthesis and respiration).

31 Selectivity and resistance- Selectivity of herbicides - Fundamental principles of selectivity- Differences in morphology and growth habit of plants – Differential absorption and translocation of herbicides.

32 Harvesting and threshing of crops - Maturity symptoms of major crops - Time and methods of harvesting - Threshing and winnowing, drying and post harvesting storage of grains -Harvest index and BC ratio.

Practical

1. Visit to college farm and identification of major crops and varieties
2. Practice of primary tillage implements and puddling
3. Practice of secondary tillage implements
4. Practice of seeding equipment , inter cultivation implements
5. Seed germination and viability test - Study of sowing depth on germination and seedlingvigour
6. Identification of manures, fertilizers and green manure crops/seeds.
7. Practice of manure and fertilizer application
8. Participation in ongoing field operations
9. Participation in ongoing field operations
10. Identification of weeds in field crops and other habitats
11. Study of weed flora in different weed management practices and calculation of herbicide efficiencies (WI & WCE)
12. Herbicide label information and computation of herbicide doses
13. Study of herbicide application equipment and calibration
14. Herbicide application and precautionary measures
15. Study of herbicide phytotoxicity symptoms in different crops
16. Identification of maturity symptoms of different crops

References

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

18 GPB 101 INTRODUCTORY BIOLOGY 2 (1+1)

Course outlines

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 flowing plants. Seed and seed germination. Plant systematic-viz; Brassicaceae, Fabaceae and Poaceae. Role of animals in agriculture.

Practical

Morphology off lowering 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.

Lecture outlines

Theory

1. Introduction to living world - Properties of life or living things – Growth, development and reproduction, regulation and homoeostasis - Diversity of Life – Major domains/ kingdoms of living beings – Bacteria (Eubacteria), Archaea (Archebacteria) and Eukarya (Protista, fungi, plantae, animalia) - Concepts of prokaryotes and eukaryotes, unicellular and multicellular organisms, plants and animals, sporophyte and gametophyte, monocots and dicots - Salient features, classification and alternation of generations of the plants of the following groups
– Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms - Evolutionary relationships and differences among different kingdoms, viruses, viroids, prions and lichens and their special features.
2. Origin of life – Theories of origin of life - Special creation, extra-terrestrial and spontaneous - Location of origin of life - Miller-Urey's experiment, Path of evolution of chemical molecules of living beings, theories of origin of cells – Endosymbiotic theory, Bubble theory.
3. Evolution and eugenics – Theories of evolution, eugenics - History, meanings and types.
4. Nomenclature of living beings - Basics in biological classification, need for classification, importance of classification, nomenclature – Polynomial, binomial and trinomial systems of nomenclature - Rules of binomial nomenclature, hierarchy of classification.
5. Cells – Cell structure and organization of plants and animals - Cell theory and cell as the basic unit of life - Overview of the cell. Prokaryotic cells, ultra structure of plant cell (structure in detail and functions in brief) - Cell membrane, cell wall, cell organelles - Morphology and function: Endoplasmic reticulum, mitochondria, plastids, ribosomes, golgi bodies, vacuoles, lysosomes, microbodies, centrosome and centriole, cilia, flagella, cytoskeleton and nucleus.
6. Chromosomes -Number, structural organization -Nucleosome.
7. Cell cycle, cell division - Somatic cell division or mitosis – Stages and phases - Reproductive cell division or meosis – Stages and phases and significance.
8. Morphology of flowering plants - Roots - Characters, types and modifications of roots, basic external and internal structural organization of root in monocots and dicots.

9. Morphology of flowering plants - Stems - Characters, functions and modification of stems - Basic external and internal structural organization of stem in monocots and dicots.
10. Morphology of flowering plants - Leaf - Parts, functions, types and modifications of leaves - Leaf venation and phyllotaxy.
11. Morphology of flowering plants - Inflorescence - types of inflorescences, types of racemose inflorescence, types of cymose inflorescence - Special types of inflorescences.
12. Morphology of flowering plants - Flower - Structure and parts of flower, types of flowers based on sex distribution, structural symmetry, position of gynoecium, aestivation - Description of types of calyx, corolla, stamens and ovary; Seed - Structure and organization of seed in monocots and dicots - Seed germination - Necessary conditions for germination.
13. Plant systematics – Brassicaceae - Distribution, important plants, economic importance, vegetative and floral characters, pollination, fruit and seed characters.
14. Plant systematics - Fabaceae - Distribution, important plants, economic importance, vegetative and floral characters, pollination, fruit and seed characters.
15. Plant systematics - Poaceae - Distribution, important plants, economic importance, vegetative and floral characters, pollination, fruit and seed characters.
16. Role of animals in agriculture–Animals of draught and milch, fur, wool, etc. - Different animal products used as manure.

Practical

1. External morphology of monocot roots - Rice and maize.
2. External morphology of dicot roots - Brassica and any legume.
3. External morphology of monocot stem - Rice and maize.
4. External morphology of dicot stem - Brassica and any legume.
5. External morphology of monocot leaf - Rice and maize.
6. External morphology of dicot leaf – Brassica and any legume.
7. Structure and organization of plant cell.
8. Study of different types of tissue systems - Parenchyma, collenchyma and sclerenchyma.
9. Study of mitosis through onion root tip cells.
10. Study of meiosis through onion anther cells.
11. Internal anatomy of monocot stems and roots - Rice and maize.
12. Internal anatomy of dicot stems and roots - Brassica and any legume.
13. Internal anatomy of ovary of monocots and dicots - Any millet and legume.
14. Description of Brassicaceae with live specimens.
15. Description of Fabaceae with live specimens.
16. Description of Poaceae with live specimens.

References

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

18 AGR 102 AGRICULTURE HERITAGE 1(1+0)

Course outlines

Theory

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

Lectures outlines

Theory

1. Introduction to Indian agricultural heritage – Definition of heritage, agriculture heritage - Need to study agriculture heritage
2. Genesis of agriculture and its chronological arrangement - Homes of evolution of agriculture and "old and new'' world - Early indigenous domestications.
3. Status of farmers in society and specific role of women in ensuring food security- Farming systems in ancient periods.
4. Status of agriculture and advice by sages to kings on their duties towards farmers- Importance of farmers - Ancient agricultural practices and scientific basis.
5. Soil management in ancient, medieval, pre- modern India - Historical background - Soil management and its relevance in pre-modern India and modern day sustainable agriculture - Use of amendments - Land management, Piercing, tillage, puddling and pre-plant submergence, mulching, fallowing.
6. Soil concept - Ancient systems of soil classification - Ancient systems of soil management - Medieval and pre modern soil management.
7. Heritage of crop and water management – Ancient and pre-historic period; Medieval period.
8. Plant growth and development- Heritage of plant protection through vrikshayurveda and traditional Knowledge
9. Plant protection in ancient India - Plant disorders – Cause, symptoms, treatment materials.
10. Traditional knowledge in crop production and water management
11. Heritage of medicinal plants and their relevance today
12. Seed health in ancient and medieval history and its relevance to present day agriculture-seed health in Hellenistic age – seed health in India – Materials recommended for seed treatments.
13. Description of Indian civilization and agriculture by travellers from China, Europe and USA.
14. Pre-historic cropping patterns.
15. Our journey in agriculture-Green revolution and its impact and concerns.
16. Vision for the future – Challenges ahead.

References

1. Choudary S.L, Sharma, G.S, and Nene, Y.L (eds). 2000. Ancient and Medieval History of Indian agriculture and its relevance to sustainable agriculture in the 21st century; Proceedings of

the summer school held from 28 May to 17 June 1999. Rajasthan college of Agriculture, Udaipur 313001.
2. Nene, Y.L (Ed). 2005. Agricultural Heritage of Asia proceedings of the international conference, 6-8 December 2004, Asian-Agri history Foundation, Secunderabad- 500 009, Andhra Pradesh, India.
3. Nene, Y.L 2007. Glimpses of Agricultural heritage of India. Asian- Agri- History Foundation, 47 – ICRISAT Colony-1 Brig sayeed Road, Secunderabad -500009 A.P India 901PP ISBN-81-903963-0-7.

18 AEX 101 RURAL SOCIOLOGY AND EDUCATIONAL PSYCHOLOGY 2 (2+0)

Objective

This course will enable students to acquire knowledge on basics concepts related to rural sociology and educational psychology. Students will also learn the practical applications of important sociological and psychological concepts.

Theory

UNIT I

Introduction to Sociology, Social groups, Culture and Social Values

Sociology and Rural Sociology – definitions; Society – rural and urban, characteristics, differences and relationships, important characteristics of Indian rural society; Social groups – definition, classification, role of social groups in extension; Culture – concept, cultural traits, characteristics, functions, Ethnocentrism, Acculturation, Cultural lag, Cultural diffusion, Marginal man, Ethos. Social Values – definition, values and norms, characteristics of values, functions;

UNIT II

Social Structure, Social Stratification and Migration

Structure of Rural Society – patterns of rural settlement, social institutions, social organizations, ecological entities (Region, Community, Neighbourhood, Family); Social Stratification – concept, functions, types, differences between class and caste system; Migration – concept, factors influencing migration.

UNIT III

Social Control, Social Customs

Social Control – definition; Customs – conventions, folkways, mores, rituals, taboos; Social Interaction Process – definition, basic social processes; Social Change – concept, factors influencing social change, indicators of social change; Social development :

UNIT IV

Introduction to Educational Psychology, Intelligence, Teaching-Learning Process;

Education – Psychology – Educational Psychology – Social Psychology – definitions, importance in extension; Basic principles of Human behaviour – Sensation, Attention, Cognitive, affective, psychomotor domain Perception – meaning, characteristics; Intelligence – concept, types, measurement, factors affecting intelligence; Personality – concept, types, measurement, factors influencing personality; Teaching–Learning Process – Teaching – definition, meaning, principles of teaching, steps in extension teaching; Learning – definition, meaning, principles, types of learning, learning situation.

UNIT V

Motivation, Attitude

Motivation – concept, Maslow's hierarchy of needs, intrinsic and extrinsic motivation, techniques of motivation, importance in extension; Attitude – concept, factors influencing the development of attitudes.

Theory Schedule

1. Sociology and Rural Sociology – Definitions, nature of rural sociology,
2. Importance of rural sociology in extension education.
3 Society – rural and urban, characteristics, differences and relationship, important characteristics of Indian rural society;
4.. Social Groups – definitions, classification, role of social groups in extension.
5. Culture – concept, cultural traits, characteristics, functions,
6.. Ethnocentrism, Acculturation, Cultural lag, Cultural diffusion, Marginal man, Ethos.
7. Structure of Rural Society – patterns of rural settlement,
8. Social institutions, Social organizations and ecological entities - Region, Community, Neighbourhood, and Family.
9. Social Stratification – concept, functions, types, differences between class and caste system; Social Values – definition, values and norms, characteristics of values, functions.
10.
11. Migration – concept, factors influencing migration.
12. Social Control – definition;
13. Customs – conventions, folkways, mores, rituals, taboos;
14. Social Interaction Process – definition, basic social processes.
15. Social Change – concept, theories, factors and indicators of social change.
16. Social development
17. Mid semester Examination.
18. Education – Psychology – Educational Psychology –definitions, importance in extension.
19. Social Psychology – Definitions, importance in extension.
20. Basic principles of Human behaviour –
21. Cognitive, affective, psychomotor domain
22. Perception – meaning, characteristics.
23. Sensation, Attention
24. Intelligence – concept, types,
25. Intelligence - measurement, factors affecting intelligence;
26 Personality – concept, types,
27. Personality measurement- factors influencing personality
28. Teaching–Learning Process – Teaching – definition, meaning,
29. Principles of teaching, steps in extension teaching.
30. Learning – definition, meaning, principles,
31. Types of learning, learning situation.
32 Motivation – concept, Maslow's hierarchy of needs (including selfless-service), intrinsic and extrinsic motivation,
33. Techniques of motivation, importance of motivation in extension.
34. Attitude – concept, factors influencing the development of attitudes.

Suggested Readings (Textbooks, Reviews, Journals)

- Adivi Reddy, A. 2001. Extension Education, Sree Lakshmi Press, Bapatla, Andhra Pradesh.
- Chatterjee, S. 2000. Advanced Educational Psychology, Books & Allied (P) Ltd., Calcutta.
- Chauhan, S.S. 2001. Advanced Educational Psychology, Vikas Publishing House Pvt. Ltd., New Delhi.

- Chitambar, J.B.1997. Introductory Rural Sociology, New Age International (P) Ltd., Publishers, New Delhi.
- Dahama, O.P. and O.P. Bhatnagar. 2007. Education and Communication for Development, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Kundu, C.L and Tutoo, D.N. 2001. Educational Psychology, Sterling Publishers Pvt. Ltd., New Delhi.
- Lester Crow, D and Alice Crow. 1973. Educational Psychology, Eurasia Publishing House Pvt. Ltd., New Delhi.
- Madumita Gupta. 2011. Fundamentals of Sociology, Pacific Publications, New Delhi.
- Mangal, S.K. 2000. Educational Psychology, Prakash Brothers, Ludhiana.
- Shankar Rao, C.N. 2012. Sociology – Principles of Sociology with an Introduction to Social Thought, S.Chand & Co. Ltd., New Delhi.
- Sharma, R.N. 1968. Principles of Sociology, Asia Publishing House, New Delhi.
- Supe. S.V. 2012. Text book of Extension Education, Agrotech Publishing Academy, Udaipur.
- Usha Rao. 2008. Advanced Educational Psychology, Himalaya Publishing House, New Delhi.
- Vidya Bhushan and Sachdeva, D.R. 2003. An Introduction to Sociology, Kitab Mahal, Allahabad.

Journals

- Indian Journal of Social Research
- Journal of Rural Development
- Journal of Social Sciences
- Journal of Advances in Social Work
- Journal of Asian Social Sciences
- Journal of Social Sciences and Research
- Journal of Current Research in Social Psychology
- Journal of Rural Sociology
- Journal of Extension Education – Coimbatore

Web resources

- www.sociologyguide.com
- eu.wikipedia.org
- www.princeton.edu

18 AEX 102 HUMAN VALUES AND ETHICS 1 (1+0)

Course outlines

Theory

Universal human aspirations: Happiness and prosperity; Human values and ethics: Concept, definition, significance and sources; Fundamental values: Right conduct, peace, truth, love and non-violence; 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.

Ethics: professional, environmental, ICT; Sensitization towards others particularly senior citizens, developmentally challenged and gender.

Spirituality, positive attitude and scientific temper; Team work and volunteering; Rights and responsibilities; Road safety; Human relations and family harmony; Modern challenges and value conflict: Sensitization against drug abuse and other social evils; Developing personal code of conduct (SWOT Analysis); Management of anger and stress.

Lecture outlines

Theory

1. Universal human aspirations, happiness and prosperity
2. Human values and ethics - Concept, definition, significance and sources - Fundamental values - Right conduct, peace, truth, love and non-violence.
3. Principles and philosophy – Self exploration, self awareness, self satisfaction, decision making, motivation, sensitivity, success, selfless service.
4. Case study of ethical lives.
5. Positive spirit, body, mind and soul - Attachment and detachment.
6. Spirituality and spirituality quotient.
7. Examinations.
8. Ethics - Professional, environmental, ICT - Sensitization towards others particularly senior citizens, developmentally challenged and gender.
9. Positive attitude and scientific temper.
10. Team work and volunteering.
11. Rights and responsibilities.
12. Road safety.
13. Human relations and family harmony, modern challenges and value conflict.
14. Sensitization against drug abuse and other social evils.
15. Developing personal code of conduct (SWOT/SWOC/SNAC Analysis).
16. Management of anger and stress.

References

1. Gaur RR, Sanga lR and Bagaria GP. 2011. *A Foundation Course in Human Values and Professional Ethics*. Excel Books.
2. Mathur SS. 2010. *Education for Values, Environment and Human Rights*. RSA International.
3. Sharma RA. 2011. *Human Values and Education – Axiology, Inculcation and Research*. R. Lall Book Depot.
4. Sharma RP and Sharma M. 2011. *Value Education and Professional Ethics*. Kanishka

Publishers.
5. Srivastava S. 2011. *Human Values and Professional Ethics*. S K Kataria and Sons.
6. Srivastava S. 2011. *Environmental Science*. S K Kataria & Sons.
7. Tripathi A.N. 2009. *Human Values*. New Age International (P) Ltd Publishers.
8. R.S. Nagarajan. *Text Book on Professional Ethics & Human Values.*
9. D.R. Kiran. *Professional Ethics & Human Values*
10. Veerendra Kumar. *Human Values and Professional Ethics*.
11. M.Govindarajan. *Engineering Ethics*.

18 NSS 100 NSS/NCC/PHYSICAL EDUCATION & YOGA PRACTICES 2 (0+2)

Course outlines

Introduction and basic components of NSS, NSS programmes and activities, Understanding youth, Community mobilization, 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

Lecture outlines

1 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 2 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

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

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

5 Social harmony and national integration - Indian history and culture, role of youth in nation building, conflict resolution and peace-building

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

7 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

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

9 Importance and role of youth leadership - Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership

10 Life competencies - Definition and importance of life competencies, problemsolving and decision-making, inter personal communication

11 Youth development programmes - Development of youth programmes and policy at the national level, state level and voluntary sector; youth-focused and youthled organstions

12 & Health, hygiene and sanitation - Definition needs and scope of health education;

13 role of food, nutrition, safe drinking water, water born diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programmes and reproductive health

14 Youth health, lifestyle, HIV AIDS and first aid - Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid

15 & Youth and yoga - History, philosophy, concept, myths and misconceptions about

16 yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative

method
17 & Vocational skill development - To enhance the employment potential and to set
18 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
19 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
20 & Disaster management - Introduction and classification of disaster, rehabilitation
21 and management after disaster; role of NSS volunteers in disaster management.
22 Entrepreneurship development - Definition, meaning and quality of entrepreneur; steps in opening of an enterprise and role of financial and support service institution
23 Formulation of production oriented project - Planning, implementation, management and impact assessment of project
24 Documentation and data reporting - Collection and analysis of data, documentation and dissemination of project reports
25 & Youth and crime - Sociological and psychological factors influencing youth crime,
26 cyber crime, pear mentoring in preventing crime and awareness for juvenile justice
27 & Civil/self defence - Civil defence services, aims and objectives of civil defence;
28 needs and training of self defence
29 & Resource mobilisation - Writing a project proposal of self fund units (SFUs) and its
30 establishment
31 & Additional life skills - Positive thinking, self confidence and esteem, setting life
32 goals and working to achieve them, management of stress including time
management.

II Semester

S. No.	Course Code	Title of Course	Credit Hours
1	18BPG 102	Fundamentals of Genetics	3(2+1)
2	18AGM 101	Agricultural Microbiology	2(1+1)
3	18SWE 101	Soil and Water Conservation Engineering	2(1+1)
4	18CRP101	Fundamentals of Crop Physiology	2(1+1)
5	18AEC101	Fundamentals of Agricultural Economics	2(2+0)
6	18PAT101	Fundamentals of Plant Pathology	3(2+1)
7	18AEN101	Fundamentals of Entomology	3(2+1)
8	18AEX103	Fundamentals of Agricultural Extension Education	3(2+1)
9	18ENG101	Communication Skills and Personality Development	2(1+1)
10	18AGR104	Introductory Agro-meteorology & Climate change	2(1+1)
Total			**25(16+9)**

18 GPB 102 FUNDAMENTALS OF GENETICS 3 (2+1)

Course outlines

Theory

Pre-Mendelian concepts of heredity; Mendelian principles of heredity; Cell division – mitosis and meiosis; Probability and Chi-square; Dominance relationships; Gene interaction; Multiple factor hypothesis; Epistatic interactions with examples; Multiple alleles; Linkage and its estimation; Crossing over mechanisms; Chromosome mapping; Pleiotropism and Pseudoalleles; Sex determination and sex linkage; sex limited and sex influenced traits; Structural changes in chromosome; Mutation- classification, mutagenic agents and methods of inducing mutation and ClB technique. Qualitative & quantitative traits; Polygenes and continuous variations; Cytoplasmic inheritance; Gene concept: Gene structure, function and regulation (eg. Lac operon); Nature, structure & replication of genetic material; Protein synthesis- Transcription and translational mechanisms of genetic material.

Practical

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

Lecture outlines

Theory

1. Pre Mendelian concepts of heredity – Early history of heredity, inheritance of acquired traits, preformation theory, pangenesis and germplasm theory.
2. Chromosome - Structure of chromosome, types of chromosomes based on position of centromere.
3. Cell division – Cell cycle – Mitosis - Process of mitosis - Significance.
4. Meiosis - Process - Differences between mitosis and meiosis - Significance.
5. Mendelian principles of heredity – Terminology, Mendel's experiments – Reasons for selection of pea as experimental material- characters studied - Reasons for mendel's success.
6. Mendel's laws – Law of segregation – Law of independent assortment – Principle of dominance – Principle of unit characters – Exceptions to mendel's laws – Rediscovery of mendelian principles.
7. Probability and Chi-square – Concept of probability, predicting results of a monohybrid cross, predicting results of a dihybrid cross - Chi-square test.
8. Dominance relationships – Complete dominance, incomplete dominance, codominance, over dominance, pseudodomiance, lethal factors.
9. Gene interaction - Nonepistatic interaction – Interaction of factors; epistatic interactions – Complementary epistasis, dominant epistasis.
10. Recessive epistasis, duplicate dominant gene action, dominant suppression or inhibitory gene action, duplicate genes with cumulative effect.
11. Multiple alleles – Characteristics of multiple alleles - Blood groups in humans, coat colour in rabbits, self incompatibility alleles in plants - pleiotropism, penetrance and expressivity.

12. Linkage – Definition – Classification of linkage – Characteristic features of linkage – Linkage groups.
13. Detection of linkage – Estimation of linkage - Importance of test cross in linkage studies - significance in plant breeding.
14. Crossing over mechanisms - Mechanism of crossing over – Types of crossing over – Factors affecting crossing over.
15. Significance of crossing over in plant breeding - Cytological proof of crossing over in *Drosophila*.
16. Chromosome mapping - 2-point and 3-point test cross – Cytological maps and genetical maps – Coincidence and interference.
17. Sex determination – Various mechanisms of sex determination – Chromosomal sex determination, genic balance mechanism of sex determination in *Drosophila melanogaster*, male haploidy, single gene effects etc.
18. Sex linkage – White eye colour in *Drosophila*, colour blindness and haemophilia in humans - sex influenced traits – Horns in sheep, baldness in humans, sex limited - Milk production in cattle, beard in man – Pseudohermaphrodites – Gynandromorphs.
19. Qualitative and Quantitative traits, Polygenes and continuous variations – Definition - Inheritance and their differences, multiple factor hypothesis.
20. Cytoplasmic inheritance – Definition – Chloroplast inheritance (leaf variegation in *Mirabilis jalapa)* - mitochondrial inheritance (cytoplasmic male sterility in maize) - Characteristic features of cytoplasmic inheritance - Differences between chromosomal and extrachromosomal inheritance.
21. Nature and structure of genetic material - DNA and its structure -Watson and Crick's model - Function – Experiments to prove DNA as genetic material.
22. Replication of DNA - Modes of DNA replication - Semi-conservative DNA replication - Experimental proof.
23. -Types of RNA - Messenger RNA, ribosomal RNA and transfer RNA - structure of tRNA, dfferences between DNA and RNA.
24. Protein synthesis – Central dogma, tanscription and translational mechanism of genetic material - Genetic code – Properties of genetic code – Wobble hypothesis.
25. Steps in protein synthesis - Transcription and translation.
26. Gene regulation - Lac operon concept – Gene concept – Cistron – Recon – Muton.
27. Mutation - Classification - Gene mutations - Introduction - Definition - Types of mutations - Spontaneous and induced mutations - Point mutations - Characters of mutations - Xenia and metaxenia – Chimeras Types and their significance in plant breeding.
28. Methods of inducing mutations, Physical and chemical mutagens - Detection of sex linked lethals in *Drosophila* (ClB method given by Muller).
29. Molecular basis of mutations - Transitions, transversions and frame shift mutations - Importance of mutations in plant breeding.
30. Structural changes in chromosome - Breakage - fusion - bridge cycle – Deletions (deficiency) - Duplications and their significance in plant breeding.
31. Inversions - pericentric inversions and paracentric inversions - inversions as cross over suppressors.
32. Translocations - simple and reciprocal - their role in plant breeding.

Practical

1. Study of microscope.
2. Study of cell structure.
3. Practice on mitotic cell division.
4. Practice on meiotic cell division.
5. Practice on meiotic cell division.
6. Probability and Chi-square test.
7. Monohybrid and its modifications.
8. Dihybrid.
9. Trihybrid.
10. Test cross and back cross.
11. Epistatic interactions including test cross and back cross.
12. Epistatic interactions including test cross and back cross.
13. Epistatic interactions including test cross and back cross.
14. Determination of linkage and cross over analysis (through two point test cross data).
15. Determination of linkage and cross over analysis (through three point test cross data).
16. Study of models on DNA and RNA structure.

References

1. Pundhan Singh. 2006. *Genetics*. Kalyani Publishers, Ludhiana.
2. Singh, B.D. 2015. *Fundamentals of Genetics*. Kalyani Publishers, Ludhiana.
3. Gupta, P.K.2007. *Genetics*. Rastogi Publications, Meerut.
4. Khanna, V.K. 2002. *Genetics Numerical Problems*. Kalyani publishers. 2nd edition.
5. Pundhan Singh. 2011. *Genetics at a Glance*. Kalyani Publishers, Ludhiana.
6. Verma , P.S. and Agarwal, P.K. 2013. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. S. Chand & Company Pvt. Ltd., Kolkata.
7. Snustad , D.P. and Simmons, M.J. 2010. *Principles of Genetics*. 5th Ed. John Wiley & Sons, 111, River Street, Hoboken, NJ, U.S.A.
8. Strickberger, M.W. 2006. *Genetics*. Prentice – Hall of India Pvt. Ltd., New Delhi.

18 AGM 101 AGRICULTURAL MICROBIOLOGY 2(1+1)

Course outlines

Theory

Introduction- Scope of microbiology &brief history of microbiology. Microbial world- Prokaryotic and eukaryotic microbes and their differences, Bacteria- Detailed cell structure of bacteria, Microbial Nutrition- Autotrophy-chemoautotrophy, photo autotrophy, heterotrophy.Growth-Phases in bacterial growth, synchronous and diauxic Growth. Bacterial genetics- Genetic recombination- transformation, conjugation and transduction, plasmids, transposon. Role of microbes in soil fertility and crop production: Carbon cycle. Nitrogen, Phosphorus and Sulphur cycles. Biological nitrogen fixationsymbiotic, associative and asymbiotic. *Azolla*, blue green algae, Actinorrhizal symbiosis- *Frankia.* Phosphorus solubilizing microrganisms and *mycorrhiza.* Rhizosphere and phyllosphere. PGPRmicroorganisms. Microbes in human welfare, Types of Fermentation and Fermentation technology, Biofertilizers and silage production technology, Biopesticides-Mode of action, types of biopesticides, Biofuel production and biodegradation-Gobar gas and composting technology.

Practical

Introduction to microbiology laboratory and its equipments, Microscope- Parts, principles of microscopy, resolving power and numerical aperture, Micrometry- Measurement of size of microorganisms, Methods of sterilization, Bacterial Staining procedures-Simple staining, Gram's staining and Endospore staining, Nutritional media and their preparations, Enumeration of microbial population in soil- bacteria, fungi and actinomycetes. Methods of isolation, purification and maintenance of microbial cultures.Isolation of *Rhizobium* from legume root nodule. Isolation of *Azotobacter.* Isolation of Phosphate solubilisingbacteria/Phosphate solubilizing fungi. PSB/PSF. Isolation of *Azospirillum* from roots.Staining and microscopic examination of biofertilizer organisms. Isolation *of VAM* from soil by wet sieving and decantation Technique. Determination of *VAM* root colonization by staining the infected roots.

Lecture outlines

Theory

1. Introduction- Definition- The hidden world of microbiology- How microbes evolved on earth- General classification of microbes-Microorganisms and principles of microbiology- Scope of microbiology. Brief History of microbiology - Spontaneous generation theory- Contributions of Antony Van Leeuwenhoek- Francesco Redi- Lazzaro Spallanzani- Franz Schulze- Schroder and Von Dusch- Louis Pasteur- John Tyndall.
2. Role of microbes in fermentation-Contributions of Cagnaird Latour-Theodor Schwann, F.Kutzing- Louis Pasteur - Germ theory of disease - Contribution of Hippocrates-Louis Pasteur- Robert Koch - Pure Culture Methods- Joseph Lister- Robert Koch- Beijerinck-Winogradsky- Francois Appert- Schroder and Von Dush- John Tyndall.
3. Protection against infection-Contributions of Edward Jenner- F. Loeffler- Behirng- Kitasasto- Louis Pasteur - Applied aspects of Microbiology- Agricultural microbiology-Industrial microbiology-Food Microbiology - Medical microbiology – Water Microbiology - Geochemical Microbiology- Pollution microbiology – Air microbiology – Exo-Microbiology - Microbial biotechnology.

4. Morphological types of Bacteria , Bacteria cell Structure- External and internal cell structures- Differences between Prokaryotes and Eukaryotes.
5. Microbial Nutrition- Autotrophy - Chemoautotrophy- Photoautotrophy
6. Heterotrophy – Metabolic pathways-Glycolysis-HMP-ED-TCA cycle.
7. Growth of Microorganisms - Cell Division - Growth cycle of bacteria [Lag phase, Log phase, Stationary and Death phase]- Generation time- Growth rate- Growth yield- Synchronous - Diauxic growth.
8. Bacterial genetics- Genetic recombination- Transformation- Conjugation- Transduction- Plasmids- Transposon.
9. Role of microbes in fertility of soils and plant growth - Rhizosphere- Rhizoplane- Phyllosphere- Phylloplane - Microflora- Carbon cycle- Carbon dioxide fixation.
10. Nitrogen cycle - Mineralisation- Immobilisation- Nitrification- Denitrification- Nitrogen Fixation - Phosphorus cycle, phosphorus solubilisation – Oxidation – Reduction - Sulphur cycle- Oxidation and reduction.
11. Biological nitrogen fixation - Symbiotic- Associative- Asymbiotic- Nitrogen fixation In *Azolla* - *Blue green algae* - Actinorhizal symbiosis - *Frankia*, Phosphate solubilizing microorganisms - *Bacillus* - *Pseudomonas*- *Mycorrhiza* for Phosphorous uptake.
12. PGPR Organisms - *Bacillus – Pseudomonas – Azotobacter – Azospirillum – Rhizobium* - Microbes in human welfare.
13. Types of fermentations - Batch - Batch fed- Continuous - Solid State Fermentations, Common microbial fermentations-Alcohol- Lactic acid- Butyric acid- Formic acid - Butanediol- Propionic Acid- Mixed Acid - Fermentation technology- Alcoholic beverages production.
14. Biofertilizers (Bacterial-Cyanobacterial-Fungal) production technology- Silage Production Technology.
15. Biopesticides- Viruses (*Nucleo polyhedrosis virus* - *Granular viruses*) – Bacteria (*Bacillus thuringiensis, Bacillus papilliae*) - fungi (*Beauveria* - *Verticillium*) – Protozoa (*Malameba locustae-Mattesia Spp*)-Mode of action.
16. Biofuel Production- Biodegradation - Biogas, Biomanures and Composting Technologies.

Practical

1. Introduction to microbiology laboratory and its equipments.
2. Microscope- Parts, principles of microscopy, resolving power and numerical aperture.
3. Micrometry-Measurement of size of microorganisms.
4. Methods of sterilization.
5. Bacterial staining procedures-Simple staining - Gram's staining and Endospore staining.
6. Nutritional media and their preparations.
7 & 8. Enumeration of microbial population in soil- Bacteria, fungi and actinomycetes.
9 Methods of isolation, purification and maintenance of microbial cultures.
10 Isolation of *Rhizobium* from legume root nodule.
11 Isolation of *Azotobacter.*
12 Isolation of phosphate solubilising bacteria/Phosphate solubilizing fungi PSB/ PSF.
13 Isolation of *Azospirillum* from roots.
14 Staining and microscopic examination of biofertilizer organisms.
15 Isolation *of VAM* from soil by wet sieving and decantation technique.
16 Determination of *VAM* root colonization by staining the infected roots.

References

1. *Microbiology*. Pelczar, J.r., M.J.E.C.S.Chan and Krieg, N.R. (5th Ed.) 2015. McGraw Hill Publishers, New York.

2. *Microbiology*. Prescott, L.M., Harley, J.P. and Klein, D.A. (9th Ed.) 2014. McGraw Hill Publishers, New York.

*3. Brock Biology of Microorganisms.*Madigan, M.,Martinko, J.M and Parker, J. (14Ed.) 2015. Prentice hall of India Pvt Ltd., New Delhi.

4. Soil Microbiology: Subba Rao, N.S. (4th Ed.) 2014. Oxford and IBH Publishing Company Pvt. Ltd., New Delhi.

5. Microbiology A Laboratory Manual: James, C and Natile, S. (10th Ed.) 2014. Pearson India Education Services Pvt. Ltd., South Asia.

6. Experiments in Microbiology, Plant Pathology and Biotechnology. Aneja, K.R.2011. New Age International (P) Ltd., Publishers, New Delh

18 SWE 101 SOIL AND WATER CONSERVATION ENGINEERING 2(1+1)

Course outlines

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 Soil Loss 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.

Introduction to irrigation - Irrigation project classification - Methods of microirrigation - Importance of irrigation water measurements – Volumetric area velocity - Discharge methods - Weirs – Orifice – Flumes - Types of wells - Water lifting devices - Classification of pumps – capacity – Power - Discharge calculations - Open channel hydraulics - Discharge calculations - Underground pipeline systems – Functional components of micro irrigation systems and its design like drip - Sprinkler etc. – Water harvesting - Lining of ponds – Tanks - Canals.

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 - Discharge measurements - Irrigation pumps - Different pumps and structural differences - Design of farm ponds - Lining of ponds - Irrigation tank - Water management.

Lecture outlines

Theory

1. Introduction to soil and water conservation and causes of soil erosion.
2. Definition and agents of soil erosion, water erosion - Forms of water erosion - Gully classification and control measures.
3. Soil loss estimation by universal soil loss equation - Soil loss measurement techniques.
4. Principles of erosion control - Introduction to contouring, strip cropping.
5. Contour bund - Graded bund and bench terracing.
6. Grassed water ways and their design.
7. Wind erosion - Mechanics of wind erosion, types of soil movement - Principles of wind erosion control and its control measures.
8. Introduction to irrigation - Classification of irrigation projects.
9. Importance of irrigation water measurements - Volumetric, area velocity, discharge methods - Weirs, orifice, flumes.
10. Open channel hydraulics - Discharge calculations.

11&12. Types of wells - Water lifting devices - Classification of pumps, their capacity, power requirement and discharge calculations.

13. Functional components and working principle of underground pipeline systems.

14&15. Functional components of micro irrigation systems and its design like drip, sprinkler irrigation systems etc.

16. Water harvesting techniques - Lining of ponds, tanks and canal systems.

Practical

1. Practicing survey - Principles and educating to use pacing technique for measurement.
2&3. Area calculations through chain survey - GPS demo for tracking and area measurement.
4. Estimation of soil loss and calculation of erosion index.
5. Leveling concepts and practical utility in agriculture.
6. Preparation of contour maps.
7. Concept of vegetative water ways and design of grassed water ways.
8. Construction of contour and graded bunds.
9. Wind erosion and estimation process.
10&11. Water discharge measurements lab exercises for computing discharge.
12&13. Different irrigation pumps and their constructional differences.
14. Farm pond construction and its design aspects.
15. Farm pond and canal lining and its procedures.
16. Visit to nearby farm pond.

References

1. Ghanshyam Das., 2012. *Hydrology and Soil Conservation Engineering, including Watershed Management.* Second edition, PHI Learning Private Limited, New Delhi - 110001
2. Murthy, V. V.N., 2004. *Land and Water Management Engineering.* Kalayani Publishers, New Delhi
3. Michael A.M., 2007. *Irrigation Theory and Practice*. Second edition. Vikas Publishing House Pvt. Ltd.
4. Mal, B. C. 1995. *Introduction to Soil and Water Conservation Engineering*. Kalayani Publishers, Rajinder Nagar, Ludhiana
5. Kanetakar, T. P. 1993. *Surveying and Leveling*. Pune Vidyarthi Griha, Prakashan, Pune
6. Suresh, R. 2008. *Land and Water Management.* Standard Publishers Distributors, Delhi.

17 CRP 101 FUNDAMENTALS OF CROP PHYSIOLOGY (1+1)

Aim

To impart basic knowledge on various functions and processes related to crop production, mineral nutrition, plant growth regulators and environmental stresses.

Syllabus

Unit I: Plant Water Relations

Importance of Crop Physiology in Agriculture – cell organelle- plasma membrane, chloroplast, mitochondria, peroxisome and vacuole - Structure and role of water –water potential and its components – diffusion – osmosis – imbibition - plasmolysis – Field Capacity and Permanent Wilting Point- Mechanisms of water absorption – Pathways of water movement – Apoplast and symplast - Translocation of water – ascent of sap – mechanisms - Transpiration – significance – structure of stomatal pore- mechanisms of stomatal opening and closing – guttation – antitranspirants

Unit II: Plant Mineral Nutrition

Criteria of essentiality - classification of nutrients – macro, micro, mobile, beneficial elements and immobile – mechanism of nutrient uptake- Physiological functions, deficiencies and disorders of macro and micro nutrients – Hidden hunger- Foliar nutrition-root feeding and fertigation – sand culture, hydroponics and aeroponics

Unit III: Photosynthesis and Respiration

Light reaction – Photosystems- red drop and Emerson enhancement effect- Photolysis of water and photophosphorylation - Z scheme - Photosynthetic pathways – C_3 and C_4, CAM

– difference between three pathways - Factors affecting photosynthesis- Photorespiration – pathway and its significance - Phloem transport – Munch hypothesis - Phloem loading and unloading - Source and sink strength and their manipulations - Glycolysis – TCA cycle - Oxidative phosphorylation – difference between photo and oxidative phosphorylation – energy budgeting - respiratory quotient

Unit IV: Growth and Development

Growth – phases of growth - Factors affecting growth – Hormones- classifications - Biosynthetic pathway and role of auxins - Biosynthetic pathway and role of gibberellins and cytokinins- Biosynthetic pathway and role of ethylene and ABA- Novel and new generation PGR‘s – Brassinosteroids and salicylic acid - Growth retardants – Commercial uses of PGR‘s- Photoperiodism - short, long and day neutral plants – Chailakhyan‘s theory of flowering-Forms of phytochrome - Pr and Pfr - regulation of flowering - Vernalisation - Theories of vernalisation – Lysenko and Chailakhyan‘s theories- Seed germination - physiological and biochemical changes - seed dormancy and breaking methods - Senescence and abscission – physiological and biochemical changes -Physiology of fruit ripening- climacteric and non-climacteric fruits - factors affecting ripening- Manipulations

Unit V: Stress Physiology

Classification of stresses - Physiological changes and adaptations to drought, flooding, high and low temperature, salinity and UV radiation – compatible osmolytes – membrane properties — compartmentalization – stress alleviation - Global warming – green house gases – physiological effects on crops - Carbon Sequestration

Practicals

Preparation of different types solutions -Measurement of plant water potential by different methods - Estimation of photosynthetic pigments- Chlorophylls and Carotenoids - Determination of stomatal index and stomatal frequency - Measurement of leaf area by different methods Physiological and Nutritional disorders in crops plants -Estimation of chlorophyll Stability Index - Estimation of Relative Water Content -Determination of photosynthetic efficiency in crop plants – soluble protein - Estimation of Nitrate Reductase activity -Growth Analysis - Bioassay of Cytokinin and GA - Estimation of proline - Demonstration of Practical applications of PGRs. Field visit for foliar diagnosis

Theory lecture schedule

1. Importance of Crop Physiology in Agriculture – Structure of plasma membrane, chloroplast, mitochondria, peroxisome and vacuole
2. Structure and role of water –water potential and its components – Diffusion – Osmosis – imbibition – Plasmolysis - Field Capacity and Permanent Wilting Point
3. Mechanisms of water absorption – Pathways of water movement – Apoplast and symplast Translocation of water – ascent of sap – mechanisms of xylem transport
4. Transpiration – significance – structure of stomata - mechanisms of stomatal opening and closing – guttation - antitranspirants
5. Mineral nutrition – criteria of essentiality - classification of nutrients – macro, micro, mobile and immobile – mechanism of nutrient uptake Physiological functions and disorders of macro nutrients – Hidden hunger
6. Physiological functions and disorders of micro nutrients - Foliar nutrition- root feeding and fertigation – sand culture, hydroponics and aeroponics
7. Light reaction – photolysis of water and photophosphorylation - Z scheme - Photosynthetic pathways – C_3 and C_4 cycles
8. CAM pathway – difference between three pathways - Factors affecting photosynthesis - Photorespiration – pathway and its significance
9. Phloem transport – Munch hypothesis - Phloem loading and unloading - Source and sink strength and their manipulations - Glycolysis – TCA cycle
10. Oxidative phosphorylation – difference between photo and oxidative phosphorylation – energy budgeting - respiratory quotient

Mid Semester Examination

11. Growth – phases of growth – factors affecting growth – Hormones- classifications - Biosynthetic pathway and role of auxins
12. Biosynthetic pathway and role of gibberellins and cytokinin - Biosynthetic pathway and role of ethylene and ABA
13. Novel growth regulators – Brassinosteroids and salicylic acid – New Generation PGR‘s - Growth retardants and inhibitors -commercial uses of PGR‘s
14. Photoperiodism - short, long and day neutral plants – Chailakhyan‘s theory of flowering -

Forms of phytochrome - Pr and Pfr - regulation of flowering

15. Vernalisation - theories of vernalisation – Lysenko and Chailakhyan's theories - Seed germination - physiological and biochemical changes - seed dormancy and breaking methods
16. Senescence and abscission – physiological and biochemical changes - Physiology of fruit ripening- climacteric and non climacteric fruits - factors affecting ripening and manipulations - Drought - physiological changes - adaptation – compatible osmolytes - alleviation
17. High and low temperature stress – physiological changes - membrane properties - adaptation - Salt stress - physiological changes - adaptation – compartmentalization - alleviation

Practicals schedule

1. Preparation of different types solutions
2. Measurement of plant water potential by different methods
3. Estimation of photosynthetic pigments- chlorophylls and Carotenoids
4. Determination of stomatal index and stomatal frequency
5. Measurement of leaf area by different methods
6. Physiological and Nutritional disorders in crops plants
7. Estimation of chlorophyll Stability Index
8. Estimation of Relative Water Content
9. Determination of photosynthetic efficiency in crop plants – soluble protein
10. Estimation of Nitrate Reductase activity
11. Growth Analysis - LAI, LAD, SLA, SLW, LAR, NAR, RGR, CGR and HI
12. Bioassay of Cytokinin
13. Bioassay of GA
14. Estimation of proline
15. Demonstration of Practical applications of PGRs.
16. Field visit for foliar diagnosis
17. Final Practical Examination

Outcome

Students will come to know basic knowledge on various functions and processes related to crop production, mineral nutrition, plant growth regulators and environmental stresses. In addition, hands on exposure to preparation of solutions, analysis of pigment composition, estimation of growth analytical parameters, diagnosis and correction of nutrient deficiencies, enzyme assays and demonstration of plant growth regulator applications

Text books

1. P. Boominathan, R. Sivakumar, A. Senthil, and D. Vijayalakshmi. 2014. Introduction to Plant Physiology, A.E. Publications. Coimbatore
2. Jain, V.K. 2007. Fundamentals of plant physiology, S.Chand & Company Ltd., New Delhi.
3. Taiz. L. and Zeiger. E., 2010 (Fifth edition). Plant Physiology. Publishers: Sinauer Associates, Inc., Massachusetts, USA.

e- books and e-references

- **http://www.plantphys.org**
- **http://www. Biologie. Uni-hamburg. de/b-online**
- **http://4e.plantphys.net**

18 AEC 101 FUNDAMENTALS OF ECONOMICS 2(2+0)

Course outlines

Theory

Economics: Economic activity and economy-Economics- Meaning, scope and subject matter, definitions, Approaches to economic analysis; micro and macro economics, positive and normative analysis. Nature of economic theory-rationality assumption, economic laws as generalization of human behavior. Basic concepts: scarcity, choice and decision making Goods and services, wants, demand, utility, cost and price, wealth, capital, income, investment, welfare, efficiency ,equilibrium, and firm. Demand: meaning, law of demand, demand schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, Equi-marginal utility principle. Indifference curve analysis, 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: Production process, creation of utility, factors of production, input - output relationship. Laws of returns. Cost: Production costs, Supply: meaning, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply and its measurement

Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; equilibrium price. Market dynamics- changes in demand and supply and prices. Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage interest and profit.

Public Finance/Public policy: meaning importance, Public revenue and public expenditure and their importance. Sources of public revenue, Taxes: meaning, direct and indirect taxes, agricultural taxation, VAT and GST. National income: Meaning and importance, circular flow in the economy, concepts of national income accounting and approaches to measurement, difficulties in measurement. Trends in contribution of different sectors' to GDP .Indian economy in the globalised economy.

Population: Economic importance, Malthusian population theory, technological transition and economic growth, natural and socio-economic determinants, demographic transition in India, population growth, Money, Banking and Credit: Evolution, meaning and functions of money, classification of money, flows of money in the economy, money supply, general price index, inflation and deflation. Banking: Role in modern economy, borrowing and lending,functions of commercial and central bank, credit ; meaning , role of credit in modern economy ,credit policy.

Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.

Lecture outlines

Theory

1. Introduction to Economics– Economic activity and concept of economy and its functions, basic economic problems, three main economic actors-households, firms, governments as basic decision making units - Economics - Meaning, definitions, its importance as a subject to science students.

2. Scope of study of economics as a science -Subject matter of economics – Traditional approach – Consumption, production, exchange, distribution and public finance/ public policy - Modern Approach – Microeconomics and macroeconomics.

3. Methods of economic investigation – Deduction and induction approaches, positive and normative analysis - Nature of economic theory - Rationality assumption, economic laws as generalization of human behavior.

4. Basic concepts: goods and services - Characteristics and classification, scarcity, choice, decision making, wants, substitutes and complements - Utility – Cardinal and ordinal approaches, forms of utility, marginal utility.

5. Cost and price, value and wealth and their characteristics, capital, income, investment, welfare, efficiency, equilibrium and firm - Demand - Meaning, law of demand, demand schedule and demand curve characteristics, determinants, types of demand - Income demand, price demand, cross demand - Product demand, firm demand, market demand.

6. Market dynamics due to changes/ shifts in demand and prices - Contraction and extension, increase and decrease in demand - Law of diminishing marginal utility – Statement, assumptions of law, explanation, limitations of the law - Importance and applications.

7. Law of equi-marginal utility – Meaning, assumptions, explanation of the law - Practical importance and applications, limitations - Consumer's surplus – Meaning, assumptions, explanation with examples, difficulties in measuring, consumer's surplus - Importance and applications - Engels law of family expenditure.

8. Indifference curve analysis - Indifference curves - Meaning, basic assumptions, properties and their importance in economics.

9. Budget line and its properties - Consumer's equilibrium - Graphical and algebraic expressions and its importance.

10. Elasticity of demand – Meaning, elastic and inelastic demand, measurement of elasticity of demand - Types of elasticity of demand - Price elasticity, income elasticity and cross elasticity of demand.

11. Kinds of elasticity of demand - Perfectly elastic, perfectly inelastic, relatively elastic, relatively inelastic, unitary elastic demand - Factors affecting elasticity of demand, practical importance of elasticity of demand.

12. Production - Meaning of production process, creation of utility, factors of production and input - output relationship and production function – Meaning.

13. Laws of returns - Increasing, decreasing and constant laws of returns - Meaning and explanation with examples.

14. Cost - Seven production costs - Meaning and formulas, cost and output relationships - Short run and long run cost curves.

15. Supply – Meaning, definition, law of supply, supply schedule, supply curve and properties, determinants of supply - Market dynamics due to changes/ shifts in supply and prices - Increase and decrease in supply, contraction and extension of supply.

16. Elasticity of supply and its measurement - Kinds of elasticity of supply – Perfectly elastic, perfectly inelastic, relatively elastic, relatively inelastic and unitary elastic - Factors affecting elasticity of supply.

17. Markets and market structure – Meaning, classification of markets based on market structure - Competition and its meaning, basic features of perfectly competitive and imperfect competitive markets.

18&19. Characteristics of monopolistic competition, monopoly, duoploy, oligopoly, monopsony, duopsony and oligopsony with examples.

20. Price determination under perfect competition – Equilibrium analysis – Numerical and graphical explanation.

21. Distribution theory - Meaning, factor market - Concepts of rent - Meaning, types of rent - Ricardian theory of rent.

22. Wages - Meaning, nominal and real wages, working population in India – Labour participation rate, employment rate, unemployment rate - Interest- Meaning of interest and interest rate - Profit and income - Meaning, difference between income and profit.

23. Pricing of factors of production - Modern theory of distribution.

24. Public finance/ Public policy – Meaning, role and importance of public finance/Public policy - Functions of the government – Differences between public finance and private finance - Public revenue - Meaning, major and minor sources of public revenue.

25. Tax – Meaning - Classification – Direct and indirect taxes, methods of taxation - Proportional, progressive, regressive and digressive taxation, agricultural taxation - VAT and GST.

26. Canons of taxation – Adam Smith's canons of taxation – Equality, economy, certainty and convenience – Other canons of taxation.

27. Public expenditure – Meaning, need for public expenditure - Principles of public expenditure – Budget – Meaning - Balanced budget and deficit budget - Fiscal policy - Meaning and its policy instruments.

28. National income accounting system – Meaning and importance, circular flow in the economy.

29. Concepts of national income accounting - Gross domestic product, gross national product, net national product, net domestic product- National income at factor cost, personal income, disposable income, per capita income.

30. Approaches to measurement of national income – Product method, income method, expenditure method and value added method, difficulties in measurement.

31. Trends in contribution of different sectors' to GDP - Indian economy in the globalised world economy - Importance of population in the economy - Malthusian theory, escaping from the Malthusian stagnation - Innovations, technological transition and economic growth.

32. Money - Meaning, evolution of money, functions of money, the money market - Types of demand and supply of money in the economy - Credit - Meaning of credit, borrowing and lending, investments and their role in the modern economy - Credit controls and credit policy.

33. Role of banking in the modern economy, functions of central bank and commercial banks, monetary policy and its instruments - Inflation – Meaning, definition, deflation - Meaning, causes of inflation – Demand pull and cost push inflation.

34. Types of inflation - Comprehensive and sporadic inflation – Suppressed and repressed inflation – Creeping, walking, running and galloping inflation – Mark up inflation - General price index, wholesale price index, consumer price index - Rate of inflation – Measurement.

Reference

1. Dewett, K.K. and Varma, J.D. 2003. *Elementary Economic Theory*. S. Chand and Co., New Delhi.

2. Dewett, K.K and Chand, A. 2009. *Modern Economic Theory.* S.Chand and Co., New Delhi

3. Paul A. Samuelson and Nordhus. 2010. *Economics.* 19th Edition, Tata-Mc Graw Hill Education, New Delhi.

4. Jhingan, M.L.1990. *Advanced Economic Theory*. Vikas Publishing House, New Delhi

5. Koutsoyiannis. 2015. *Modern Microeconomics*. Tata Mac-Graw Hill Publishers, New Delhi

6. *The Economy* 2016, www.core-econ.org.

18 PAT 101 FUNDAMENTALS OF PLANT PATHOLOGY 3 (2+1)

Course outlines

Theory

Importance of plant diseases, scope and objectives of Plant Pathology. Important plant pathogenic organisms, different groups: fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them. Diseases and symptoms due to abiotic causes.

Fungi: General characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual).

Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions, sub-divisions, orders and classes.

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

Viruses: nature, architecture, multiplication and transmission. Study of phanerogamic plant parasites.

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

Practical

Microscopy, 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. Extraction of nematodes from soil.

Lecture outlines

Theory

1. Introduction to Plant Pathology - Definition of Plant Pathology, Plant Pathogen, Plant Disease, Symptom, Disorder. Importance of plant diseases- Brief mention of Important epidemics of international importance – Irish Famine (1845), Bengal Famine (1942), Coffee rust (1868), Wheat Rust (1940), Southern Corn Leaf blight in USA. Epidemics of local significance - Peanut Stem Necrosis Disease (Anantapur dt), Mung bean yellow mosaic virus (AP) *etc*.Brief mention of economic importance of micro organisms. Scope and objectives of Plant Pathology.

2. Important plant pathogenic organisms with one or two examples of important plant diseases caused by them- fungi (rice blast, wheat rust), Chromista (*Pythium* damping off, late blight of potato protozoa (coffee phloem necrosis, club root of crucifers) bacteria (rice bacterial leaf blight (BLB), cotton black arm), fastidious vascular bacteria (sugarcane ratoon stunt, citrus greening), Phytoplasma (sugarcane grassy shoot, sesamum phyllody), *Spiroplasma* (corn stunt), viruses (TMV, MYMV), viroids (potato spindle tuber viroid, coconut cadang cadang).

3. Important plant pathogenic organisms with one or two examples of important plant diseases caused by them (contd)- algae (red rust), phanerogamic plant parasites (*Cuscuta*, *Striga*,

Orabanche, *Loranthus*), nematodes (root knot and cyst nematode). Diseases and symptoms due to abiotic causes (khaira, cotton purple leaf, tomato blossom end rot, black heart of potato).

4. General characteristics of fungi, fungus definition. Somatic structures - types of fungal thalli - plasmodium, unicellular and filamentous. Types of fungi based on reproductive structures - eucarpic, holocarpic. Types of fungi based on their physical presence on or in the host - ectophytic and endophytic (intercellular, intracellular and vascular). Septation in fungi – Primary, adventitious, perforated and dolipore septa. Fungal tissues - plectenchyma (prosenchyma and pseudoparenchyma).

5. Modifications of mycelium (rhizomorphs, sclerotium, stroma, haustorium, rhizoids and appressorium).Ultra structure of fungal cell. Fungal nutrition - groups of fungi based on mode of nutrition - saprophytes (obligate saprophytes and facultative parasite), parasites (obligate parasites and facultative saprophytes) and symbionts (mycorrhizae and lichens).

6. Reproduction in fungi - asexual reproduction (mitospores)- fragmentation (arthrospores, oidia, chlamydospores), fission, budding (blastospores), and sporulation –Sporangium, sporangiole, merosporangium.Spores- Plano and Aplanospores. Planospores – flagellum structure, types of flagella-tinsel, whiplash, Monoflagellate, Biflagellate, Anisokont and Heterokont zoospores. Conidiophore and Conidiospores (conidia). Asexual fruiting bodies with examples.

7. Sexual reproduction – Phases in sexual reproduction, (meiospores).Methods of plasmogamy-planogametic copulation, gametangial contact, gametangial copulation, spermatization and somatogamy.Various life cycle patterns displayed by fungi – haplobiontic haploid, haplobiontic haploid (modified), haplobiontic diploid and diplobiontic life cycles with examples. Parasexual cycle. Sexual spores in fungi.

8. Taxonomy - Nomenclature, Binomial system of nomenclature, rules of nomenclature, Classification of fungi as per Kirk *et al* (2008)- Key to phylum, subphyla, classes, orders and families.

9. Major characteristic features of Kingdom Fungi, Chromista and Protozoa. Characteristics of Phyla Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota and Mitosporic fungi (Anamorphic fungi) in Kingdom Fungi.

10. Kingdom Fungi – Phylum Chytridiomycota, Class Chytridiomycetes – important characteristics of Order Chytridiales – Family Synchytriaceae – disease caused by *Synchytrium endobioticum* (potato wart).

11. Phylum Zygomycota – Subphylum Mucoromycotina – Order Mucorales – Family Mucoraceae, Genus *Rhizopus*, Example of disease caused by *Rhizopus arrhizus* Head rot of sunflower). Family Choanephoraceae, Genus *Choanephora*. Example of disease caused by *Choanephora cucurbitarum* (Choenophora blight of chillies).

12 Phylum Ascomycota - important characteristics of the phylum. Different types of ascocarps. Stile structures in ascocarps. Ascospore development in *Pyronema omphaloides*. Morphology of asci. Types of asci based on structure of ascus wall , asci arrangement -fascicle, hymenium.

13. Phylum Ascomycota, subphylum Taphrinomycotina (=Archiascomycetes) – Class Taphrinomycetes – Order Taphrinales, (i) Family Taphrinaceae – diseases caused by *Taphrina deformans* (peach leaf curl)and*T. maculans*(turmeric blotch).

(ii) Family Protomycetaceae – Disease caused by *Protomyces macrospores*
(stem gall of coriander).

14. Phylum Ascomycota Subphylum Pezizomycotina – (i) Class Eurotiomycetes – Subclass Eurotiomycetidae Order Eurotiales – Genera *Eurotium*, *Emericella* (*Aspergillus flavus* – aflatoxins), *Talaromyces* (*Penicillium italicum* – citrus blue mold). (ii) Class Leotiomycetes Order Erysiphales Family Erysiphaceae - *Erysiphe*, *Leveillula*, *Phyllactinia*, *Uncinula*, *Sphaerotheca*, *Podosphaera* and *Microsphaera* (key for genera of Erysiphaceae based on position of fungus on/in the host, conidial stages, number of asci per cleistothecium and cleistothecial appendages) – Important diseases caused by each of the genera. Order Helotiales Family Sclerotiniaceae Genus *Sclerotinia (Sclerotinia sclerotiorum* – white mold of vegetables*).*

15. Phylum Ascomycota, Subphylum Pezizomycotina –(iii) Class Sordariomycetes, Subclass Sardariomycetidae Order Diaporthales Family Cryphonectriaceae, Genus *Cryphonectria* (chestnut blight). Subclass Hypocreomycetidae Order Hypocreales - Family - Clavicepitaceae, Genus – *Claviceps* (ergot of sorghum and bajra).Family –Hypocreaceae – Genus – *Hypocrea* (Anamorph – *Trichoderma*,biocontrol agent).(iv) Class Dothidiomycetes Subclass – Dothidiomycetidae Order – Capnodiales – Family – Mycosphaerellaceae – Genus – *Mycosphaerella* (*M. arachidicola* (Groundnut early leaf spot), *M. personata* (Groundnut late leaf spot), *M. pinodes* (Ascochyta blight of chickpea). Order – Myriangiales – Family – Elsinoaceae – Genus – *Elsinoe (E. ampelina* – Grape anthracnose). Subclass – Pleosporomycetidae – Order – PleosporalesFamily – Venturiaceae – Genus – *Venturia* (*V. inaequalis* – Apple scab). Family– *Pleosporaceae* – Genus– *Cochliobolus (C. miyabeanus* – brown spot of rice).

16. Phylum Basidiomycota – important characteristics – Primary, Secondary and Tertiary mycelium, dolipore septum, clamp connections. Development of basidium and basidiospores,parts of basidium, dispersal of basidiospores, structure of *Agaricus bisporus* basidiocarp .

17. Phylum Basidiomycota-Subphylum 1. Pucciniomycotina -Class Pucciniomycetes Order Pucciniales -Family –Pucciniaceae- Genera *Puccinia (three rusts of wheat*, groundnut rust) *Uromyces* (rust of green gram and black gram). Family - Melampsoraceae -Genus *Melampsora (M. ricini* – castor rust). *Incertae sedis* (no family),*Hemileia*(*H. vastatrix* – coffee rust),Class Microbotryomycetes (Pucciniomycetous smuts)- Order -Microbotryales -Family Microbotryaceae - Genus -*Sphacelotheca* (Sorghum grain smut, loose smut and head smut of sorghum).

18. Macrocyclic, microcyclic, demicyclic rusts; Autoecious and Heteroecious rusts with examples. Life cycle of *Puccinia graminis tritici* .

19. Phylum Basidiomycota – Subphylum 2. Ustilagomycotina Class Ustilaginomycetes Order Ustilaginales - *Ustilago* (loose smut of wheat, sugarcane whip smut)and*Tolyposporium*(bajra smut). Order Urocystidales-Family - Urocystidaceae-Genus *Urocystis* (Onion smut).*Class* Exobasidiomycetes Order Tilletiales -Family -Tilletiaceae -Genera *Tilletia* (wheat bunts), *Neovossia* (Karnal bunt of wheat). Order Exobasidiales –Family-Exobasidiaceae –Genus *Exobasidium* (Tea blisterblight).

20. Differences between rust and smut fungi. Differences between smuts and bunts Phylum Basidiomycota – Subphylum 3. Agaricomycotina Class Agaricomycetes - *Incertae sedis* (no sub class) Order Polyporales- Family Ganodermataceae –Genus *Ganoderma* (coconut root rot and wilt).

21. Anamorphic Fungi (Mitosporic fungi = Fungi Imperfecti) Characteristics. Saccardoan spore group system. (1)Hyphomycetous anamorphic fungi: Identification features of Genera *Alternaria* (sunflower and sesamum leaf blight), *Botrytis* (castor grey mold), *Helminthosporium* (maize

turcicum leaf blight), *Bipolaris* (rie brown spot), *Cercospora* (groundnut early leaf spot), *Phaeoisariopsis* (groundnut late leaf spot), *Fusarium*(cotton wilt), *Pyricularia* (*rice blast), Verticillium* (cotton wilt), Mycelia Sterilia – *Rhizoctonia(*rice sheath blight, dry root rot), *Sclerotium* (stem rot of groundnut).

22. Acervular Imperfect Fungi – *Colletotrichum* (sugarcane red rot), *Pestalotiopsis* (coconut grey leaf spot), *Pestalotia* (guava leaf spot), *Gloeosporium* (grape anthracnose).Pycnidial Imperfect Fungi – *Ascochyta* (chickpea blight), *Phoma* (blackleg of crucifers), *Phomopsis (brinjal fruit rot), Phyllosticta* (ginger leaf spot), *Macrophomina* (dry root rot) *Diplodia* (rose dieback), *Botryodiplodia* (cirus stem end rot) , *Septoria* (leaf spot of tomato).

23. Kingdom Chromista: Characteristics of Phylum Oomycota. Important characteristics of Class Oomycetes, Subclass- Peronosporomycetidae. Order Pythiales -Family -Pythiaceae –Genus- *Pythium* (damping off of nursery crops). Order Albuginales -Family -Albuginaceae -Genus - *Albugo* (white rust).

24. Order Peronosporales- Family -Peronosporaceae - Genus -*Phytophthora* (late blight of potato). Downy mildew fungi *Sclerospora* (green ear of bajra), *Peronospora* (blue mold of tobacco), *Peronosclerospora* (sorghum downy mildew), *Pseudoperonospora* (cucurbit downy mildew), *Plasmopara* (grape downy mildew)and *Bremia* (lettuce downy mildew) *S*porangiophore branching and sporangial characteristics of downy mildew genera.

25. Characteristics of Class Plasmodiophorea in Kingdom Protozoa. Important characteristics of Order Plasmodiophorida, Family Plasmodiophoraceae - differences in the characteristics of *Plasmodiophora* (club root ofcabbage) and *Spongospora* (potato powdery scab).

26. Prokaryotes – Characteristics of phytopathogenic bacteria, Classification (2nd Edition of Bergey's Manual of Systematic Bacteriology, 2004). Identification of plant pathogenic bacteria based on morphological features. Domain Bacteria – Phyla Proteobacteria, Firmicutes and Actinobacteria Phylum Proteobacteria – Class Alphaproteobacteria- Order- Rhizobiales- Family -Rhizobiaceae -Genus - *Agrobacterium* (crown gall of stone fruits). Also *Candidatus* Liberobacter (citrus greening).

27. Class Betaproteobacteria -Order -Burkholdariales -Family –Burkholdariaceae Genus *Ralstonia* (bacterial wilt of solanaceous crops). Gammaproteobacteria - Order -Xanthomonadales -Family -Xanthomonadaceae -Genera –*Xanthomonas* (BLB, BLS, citrus canker), *Xylella* (Pierce's disease of grapes). Order Pseudomonadales -Family -Pseudomonadaceae -Genus - *Pseudomonas* (wild fire of tobacco). Order *Enterobacteriales*-Family- *Enterobacteriaceae*-Genera-*Erwinia* (Apple fire blight), *Pectobacterium* (Soft rot of vegetables).

28. Phylum Firmicutes. -Class Bacilli -Order -Bacillus -Family -Bacillaceae -Genus - *Bacillus* (Class Mollicutes Order Entomoplasmatales -Family –Spiroplasmataceae -Genus *Spiroplasma* (Corn stunt). Order –Acholeplasmatales- Family - Acholeplasmataceae -Genus -*Candidatus* Phytoplasma (Sesamum phyllody, Brinjal little leaf). Phylum Actinobacteria -Class - Actinobacteria -Order –Actinomycetales -Family -Microbacteriaceae -Genus -*Clavibacter* (Wheat yellow ear rot/tundu, sugarcane ratoon stunt).Family Streptomycetaceae Genus *Streptomyces* (Potato scab).

29. Viruses and viroids - important characteristics of plant viruses and viroids - multiplication - classification of viruses based on nucleic acid (single stranded (ss) RNA, double stranded (ds) RNA, ssDNA and dsDNA). Taxonomy based on ICTV (2005). Important plant viral diseases - Tobacco Mosaic Virus (TMV) and Rice Tungro Virus (RTV).

30. Methods of transmission of plant viruses with examples of vector transmitted virus diseases. Examples of important viroid diseases - potato spindle tuber viroid and coconut cadang cadang. Study of phanerogamic plant parasites with suitable examples – *Cuscuta, Orabanche, Striga, Loranthus.*

31. **Nematodes-**Economic importance in agriculture - General characters of plant parasitic nematodes – classification.

32. **Nematodes-** symptoms and nature of damage caused by plant nematodes (*Heterodera, Meloidogyne, Anguina, Ditylenchus, Tylenchorhynchus, Aphelenchoides* etc.).

Practical

1. Microscopy - study of the parts of microscope.
2. Study of vegetative structures of fungi and their modifications.
3. Study of reproductive (sexual and asexual) structures of fungi.
4. Study of Zygomycetous fungus – *Rhizopus, Choanephora.*
5. Study of downy mildew fungi – *Sclerospora, Peronosclerospora, Pseudoperonospora, Peronospora, Plasmopara* and *Bremia.* Study of *Pythium*, *Phytophthora* and *Albugo.*
6. Study of powdery mildew fungi – *Oidium, Oidiopsis, Ovulariopsis.*
7. Study of ascocarps of *Erysiphe, Phyllactinia, Uncinula, Podosphaera* and *Microsphaera.*.
8. Study of rust fungi – *Puccinia* (different stages), *Uromyces, Hemileia*and *Melampsora.*
9. Study of smut fungi – *Sphacelotheca, Ustilago* and *Tolyposporium.* Study of *Ganoderma* and *Agaricus.*
10. Study of acervulous imperfect fungi – *Colletotrichum* and *Pestalotiopsis.* Study of pycnidial imperfect fungi – *Septoria.*
11. Study of imperfect fungi – *Aspergillus*, *Penicillium* and *Pyricularia, Helminthosporium*, *Alternaria.*
12. Study of imperfect fungi – *Cercospora* and *Phaeoisariopsis, Fusarium*, *Rhizoctonia* and *Sclerotium.*
13. Isolation of phytopathogenic bacteria (locally available diseased plant material) and study of colony characteristics.
14. Demonstration of mechanical transmission of plant viruses.
15. Extraction of plant parasitic nematodes from soil.
16. Study of morphological features and identification of plant parasitic nematodes.

References: For Fungi:

1. Dube, H. C. 2013. *An Introduction to Fungi.4th (Edition).*Scientific Publishers, Jodhpur, India. (major text book)
2. Webster, J. 1989. *Introduction to fungi.* Cambridge Univ. Press (for life cycles of Fungi)
3. Dasgupta, M. K. 1987. *Principles of Plant Pathology*. Allied Publ. Pvt Ltd. p985. (for rust life cycles)
4. Students are also advised to refer Introductory Mycology by Alexopoulus, Mims and Blackwell (4th Edition) for Fungi.
5. For Bacteria, Viruses, Viroids, Phanerogamic Plant Parasites, Nematodes
6. Agrios, G. N. 2006. *Plant Pathology*. Elsevier Publishers, New Delhi.

18 AEN 101 FUNDAMENTALS OF ENTOMOLOGY 3(2+1)

Course outlines

Theory

History of Entomology in India.Factors for insect's abundance. Major points related to dominance of Insecta in Animal kingdom. Classification of phylum Arthropoda upto classes.Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and moulting. 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 organs.Metamorphosis and diapause in insects.Types of larvae and pupae.Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretory (Endocrine) and reproductive systems in insects.Types of reproduction in insects.

Major sensory organs like simple and compound eyes and chemoreceptors. 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, Miridae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Lymantridae, Saturniidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Apionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae, Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyzidae, Culicidae,Muscidae and 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.

Lecture outlines

Theory

1 History of Entomology in India - Contributions of eminent entomologists – Locations and year of establishment of entomological institutions - Arthropoda – Mention of insects in scripts – Contributions of Aristotle, J.C. Fabricius, J.G. Koenig, Carolius Linnaeus, Cramer, Dury, Dr. Kerr, Rev Hope Rothney, Ronald Ross, L De Niceville, H.M Lefroy, T.B.Fletcher, E.P. Stebbing, T.V. Ramakrishna Ayyar, B.V. David, Y.Ramachandra Rao, M S Mani, S Pradhan, H.S. Pruthi, M.R.G.K. Nair and S. Pradhan; ML Roonwal, T.Kumara Swami, M R G K

Nair,K.K. Nayar and N. Ananthakrishnan - Locations and year of establishment of Division of Entomology, IARI, Zoological Survey of India (ZSI), Directorate of Plant Protection, Quarantine and Storage (DPPQS), Indian Institute of Natural Resins and Gums (IINRG), National Bureau of Agricultural Insect Resources (NBAIR), National Institute of Plant Health Management (NIPHM), National Centre for Integrated Pest Management (NCIPM) and Forest Research Institute (FRI).

2 Contributory factors for abundance of insects – Major structural characters, developmental characters and protective characters (Morphological, physiological, behavioural and construction of protected niches) of Insecta in Animal Kingdom.

3 Classification of Phylum Arthropoda up to Classes – Different Classes of Arthropoda and comparison of characters of Class Insecta with Arachnida, Crustacea, Symphyla, Chilopoda, Diplopoda and Onychophora;

4 Structure and functions of body wall and moulting – Different layers, chemical composition, functions of body wall and cuticular appendages – Cuticular processes and cuticular invaginations – Chaetotaxy – Moulting – Apolysis, ecdysis and sclerotization.

5 Body segmentation of the insects – Head (Syncephalon) – Procephalon and gnathocephalon, types of head, sclerites and sutures of insect head - Thorax – Segments and appendages (wings and legs).

6 Abdomen – Segments, pre and post genital appendages (Furcula, cornicles, tracheal gills and pseudo ovipositor in Diptera - Propodeum, petiole and gaster in Hymenoptera) - Male and female genital organs - Epimorphic and anamorphic development in insects.

7 Antenna – Structure of typical antenna and its modifications in different insects with examples.

8 Mouthparts – Biting and chewing, sucking (Piercing and sucking, Rasping and sucking, Chewing and lapping, Sponging and Siphoning/ Simple sucking), mask and degenerate types with examples.

9 Legs – Structure of a typical insect leg and modifications of insect legs with examples, 10 Wings – Venation, margins and angles – Types of wings and wing coupling organs with examples.

11 Types of Metamorphosis and diapause – Metamorphosis- Ametamorphosis- Incomplete Metamorphosis or Direct or Simple Metamorphosis- Intermediate metamorphosis - Complete Metamorphosis or Complex or Indirect Metamorphosis- Hypermetamorphosis with examples - Diapause- Obligate and facultative diapauses – Stage of occurrence of diapause with examples.

12 Types of larva and pupa – Differences between nymph and larva - Larva- Protopod- Oligopod (Campodeiform and Scarabaeiform)- Polypod and Apodus with examples - Pupa- Obtect- Exarate- Coarctate- Chrysalis with examples.

13 Digestive system – Alimentary canal – Structure of foregut, midgut and hindgut – histology, functions, filter chamber and peritrophic membrane – Process of digestion- Extra intestinal digestion.

14 Circulatory system – Open and closed types – Organs of circulatory system – Dorsal blood vessel (diaphragms, sinuses and accessory pulsatile organs) – Process of circulation - Types of haemocytes –Properties and functions of haemolymph.

15 Excretory system – Structure, functions and modifications of malpighian tubules ¬ – Structure and functions of other organs of excretion.

16 Respiratory system – Tracheal system – Structure of spiracle and trachea – Classification based on functional spiracles and other means of respiration.

17 Nervous system – Neuron and its types (based on structure and function) – Synapse, ganglia, central nervous system, sympathetic nervous system and peripheral nervous system.
18 Reproductive system – Structure of male and female reproductive systems – Structure and types of ovarioles and structure of follicle – Types - Special modes of reproduction in insects.
19 Secretory (endocrine) system – Structure and functions of neurosecretory organs (neuro secretory cells of brain, corpora cardiaca, corpora allata, prothoracic glands and ring gland).
20 Sense organs – Compound eyes – Structure of ommatidium – Ocelli – Dorsal ocelli and lateral ocelli - Types of images and auditory organs (auditory hairs, tympanum, Jhonston's organ and pilifer organ) – Chemoreceptors.
21 Taxonomy – Importance - History – Binomial nomenclature - Holotype, allotype and paratype – Suffixes of tribes, subfamily, family and superfamily – Law of priority – Synonyms and homonyms - Definitions of biotype - Subspecies - Species – Genus - Family and Order. Characters of Class Insecta - Economic classification of insects- Classification upto Orders – Subclasses - Apterygota and Pterygota– Names of Orders of Apterygota and Pterygota with examples - Orthopteroid, Hemipteroid and Panarpoid group of orders.
22 Orthoptera – General characters - Gryllidae, Acrididae, Tettigonidae and Gryllotalpidae – Characters with examples.
23 Dictyoptera – General characters – Blattidae and Mantidae– Characters with examples - Odonata - General characters with examples.
24 Isoptera – General characters –Termitidae –Characters with examples - Order – Thysanoptera – General characters –Thripidae –Characters with examples
25 Hemiptera – General characters - Sub order Heteroptera – Characters - Cimicidae - Miridae, Pentatomidae, Lygaeidae, Coreidae, Pyrrhocoridae - Characters with examples.
26 Hemiptera - Suborder Homoptera – Characters – Delphacidae, Cicadellidae, Aleurodidae, Aphididae, Coccidae, Pseudococcidae, Lopophidae- Characters with examples -Neuroptera – General characters - Chrysopidae- characters with examples.
27 Lepidoptera-General characters - Differences between moths and butterflies - Noctuidae, Lymantriidae and Sphingidae and Pieridae- Characters with examples.
28 Lepidoptera- General characters - Pyralidae, Crambidae, Gelechiidae, Lycaenidae, Arctiidae, Papilionidae, Saturniidae and Bombycidae - Characters with examples.
29 Coleoptera - General characters – Scarabaeidae, Coccinellidae, Chrysomelidae, - Characters with examples.
30 Coleoptera - General characters – Cerambycidae, Bruchidae, Apionidae and Curculionidae - Characters with examples.
31 Hymenoptera - General characters – Tenthredinidae, Ichneumonidae, Braconidae, Chalcididae, Trichogrammatidae, and Apidae- Characters with examples.
32 Diptera -General characters - Culicidae, Cecidomyiidae, Muscidae, Tachinidae, Agromyzidae and Tephritidae - Characters with examples.

Practical

1 Methods of collection and preservation of insects including immature stages.
2 External features of Grasshopper / Blister beetle.
3 Study of types of mouthparts – Biting and chewing, piercing and sucking, rasping and sucking, chewing and lapping, sponging and siphoning.
4 Study of different types of insect antennae and legs.

5 Study of wing venation, types of wings and wing coupling mechanisms.
6 Study of different types of insect larva and pupa.
7 Dissection of digestive system in insects (Grasshopper).
8 Dissection of female and male reproductive systems in insects (Grasshopper).
9 Study of characters of Orders - Orthoptera, Dictyoptera and their families and Odonata.
10 Study of characters of Orders - Isoptera and Thysanoptera and their families.
11 Study of characters of Orders -Hemiptera and its sub order Heteroptera and their families.
12 Study of characters of Sub Order - Homoptera and its families.
13 Study of characters of Order- Neuroptera and Lepidoptera and their families.
14 Study of characters of Order- Coleoptera and its families.
15 Study of characters of Order- Hymenoptera and its families.
16 Study of characters of Order - Diptera and its families.

References

1. Chapman, R. F 2013 *Insects: Structure and Function.* Ed by Simpson, S. J. and Douglas, A. C. Cambridge Univ. Press, UK.
2. Richards, O.W. and Davies, R.G 1977. *Imm's General Text Book of Entomology* (Vol. I and II). Chapman and Hall, London.
3. Wigglesworth, V.B 2013. *Insect Physiology*. Springer (Originally published by Chapman and Hall, London, 1974).
4. Pant, N.C. and Ghai, S. 198. *Insect Physiology and Anatomy*. ICAR, New Delhi.
5. Kapoor, V. C 2008. *Theory and Practice of Animal Taxonomy.* Oxford and IBH Publishing, New Delhi.
6. Charles A Triplehom and Norman F. 2005. Borror and De Long's *Introduction to the Study of Insects.* Johnson Thomson Brooks/Cole Publishing. U.S.A.
7. Snodgrass, R.E. 2001. *Principles of Insect Morphology.* CBS Publishers & Distributors, Delhi.
8. Timbhare, D.B. 2015. *Modern Entomology,* Himalaya Publishing House.

18 AEX 103 FUNDAMENTALS OF AGRICULTURAL EXTENSION 3 (2+1)

Course outlines

Theory

Education: Meaning, definition & Types - Formal, Non - Formal and Informal Education; Extension Education - meaning, definition, Concepts, Characteristics 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, Sevagram, 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, T & V System, KVK, IVLP, ORP, ND, NATP, ATMA, SREP,ATIC, NAIP, NFSM, RKVY etc.). New trends in agriculture extension: privatization extension, cyber extension/ eextension, market-led extension, farmer-led extension, expert systems, etc.

Community Development - meaning, definition, concept & principles, Philology of C.D. Rural Development: meaning, Definitions, concept, Characteristics, Objectives, Importance and Problems in Rural Development: various rural development programmes launched by Govt. of India - National Extension Service (NES). Panchayat Raj Systems / Democratic Decentralization and Panchayat Raj – Need, Three Tiers of Panchayat Raj System - Powers, Functions and Organization Set Up; Mandal System in Andhra Pradesh. Social Justice & Poverty Alleviation Programmes - ITDA, IWDP, NREP, IRDP, JRY, SGRY, SGSY, MGNREGP Women Development Programmes - ICDS, DWCRA, RMK, MSY,IKP, Participatory Rural Appraisal (PRA), Rural Leadership: Meaning, Definition and concept, types of leaders in rural context, Roles of Leaders, different Methods in Selection of a Leader, Training of Leaders - Lay and Professional Leaders, Advantages and Limitations in using Local Leaders in Agricultural Extension; extension administration: meaning, definition and concept, principles and functions. Monitoring and evaluation - Meaning, definition, concept, Objectives, Types and Importance. and monitoring and evaluation of extension programmes; transfer of technology: concept and models, capacity building of extension personnel and Farmers- Training Meaning , definition,

Types of Training - Pre Service Training, In - Service, Orientation, Induction Training, Refresher Training and Training for Professional Qualification; Training of Farmers, Farmwomen and Rural Youth - Farmers' Training Centre (FTC): Objectives – Trainings Organized; District Agricultural Advisory and Transfer of Technology Centre (DAATTC) - Objectives.extension teaching methods: meaning, classification, individual, group and mass contact methods, media mix strategies; and communication: meaning and definition; Functions of Communication, models - Aristotle, Shannon Weaver, Berlo, Schramm, J. P. Leagans, Rogers and Shoemaker, Litterer, Westley Macleansand barriers to communication. Agriculture journalism - Meaning – Scope Importance Characteristics of News Factors determining the News Value - Types of News and Sources of News; Diffusion and Adoption of innovation: Meaning, Definition, Concepts and process and Stages &Models of Adoption Process - Five (5) and Seven (7) Stage Models; Attributes of Innovation - Relative Advantage, Compatibility, Complexity, Trialability – Observability and Predictability,Innovation - Decision Process - Meaning - Stages (Knowledge,

Persuasion, Decision, Implementation and Confirmation); Concepts: Dissonance – Rejection: Active Rejection and Passive Rejection; Discontinuance - Replacement and Disenchantment

Discontinuance - Over Adoption - Rate of Adoption and Innovativeness; Adopter Categories and their Characteristics; Factors influencing Adoption Process Social, Personal and Situational.

Practical

To study and familiarize university extension system. Group discussion – Simulated Exercise; Handling and use of audio visual equipments such as public address equipment (PAE) system, Still camera, digital camera and; Audio-visual Aids - meaning, importance and classification. Selection, planning, preparation, evaluation, presentation and use of Audio -visual aids. - Posters & Charts, Liquid Crystal Display (LCD) projector, Power Point Slides, ICT Tools - Interactive white board and Digital / Electronic podium, Text messages, Voice Mail, Interactive Video recording (IVR) and New Applications (Apps) for Transfer oo Technology in Agriculture, Planning and preparation of extension literature – leaflet, folder, pamphlet, booklet with different DTP softwares. A visit to village to understand the problems being encountered by the villagers / farmers by administering the PRA techniques and understanding their applications in Village Development Planning; Visit to KrishiVigyan Kendra (KVK), Farmers' Training Centre, (FTC), District Agricultural Advisory and Transfer of Technology Centre (DAATTC): Visit to study organization and functioning of DRDA, DWMA, ATMA, JDA Office and other development departments at district level; visit to NGO and learning from their experience in rural development; Writing for Print media – News Stories and Success Stories; Visit to community radio and television studio for understanding the process of programme production. Writing for electronic media. Developing script for radio and television.

Lecture Outlines

Theory

1. a) Education - Meaning, definition and Types – Formal, non-formal and informal education.
b) Extension Education – Meaning, definition, concepts - Characteristics, scope and process.
2. Objectives and principles of extension education.
3. Extension programme planning – Meaning, process, principles.
4. Extension programme planning – Steps in programme development.
5. Extension systems in India.
6. Extension efforts in pre-independence era – Sriniketan, Marthandam, Sevagram, Firka Development Scheme, Gurgaon Experiment, etc.
7. Extension efforts in post-independence era - Etawah pilot project, Nilokheri experiment etc.
8. Extension/Agriculture development programme launched by ICAR/Govt. of India – IADP, IAAP and HYVP.
9. Extension / Agriculture development programme launched by ICAR / Govt. of India – SFDA, MFAL and T & V System.
10. a) Extension / Agriculture development programme launched by ICAR / Govt. of India, KVK, ORP and ND.
b) IVLP.
11. a) Extension / Agriculture development programmes launched by ICAR / Govt. of India – NATP, ATMA, SREP, ATIC.
b) NAIP.
12. New trends in agriculture extension – Privatization extension and cyber extension / e-extension.

13. New trends in agriculture extension – Market led extension, farmer-led extension, expert systems, etc.
14. Community development – Meaning, definition, concept and principles - Philology of C.D.
15. Rural development - Meaning, definitions, concept, characteristics, objectives, importance and problems in rural development.
16. Rural development launched by Govt. of India – National Extension Service (NES), Panchayat Raj Systems/ Democratic Decentralization and Panchayat Raj – Need.
17. Rural development launched by Govt. of India – Three tiers of Panchayat Raj system – Powers, functions and organization set up -Mandal system in Andhra Pradesh.
18. Social justice and poverty alleviation programmes – ITDA, IWDP and NERP.
19. Social justice and poverty alleviation programmes – IRDP, JRY, SGRY, SGSY and MGNREGP.
20. Women development programmes – ICDS, DWCRA, RMK, MSY, ANTWA and IKP.
21. Participatory Rural Appraisal (PRA)
22. Rural leadership - Meaning, definition and concept, types of leaders in rural context, roles of leaders and different methods in selection of a leader.
23. Training of leaders – Lay and professional leaders, advantages and limitations in using local leaders in Agricultural Extension.
24. Extension administration - Meaning, definition and concept, principles and functions - Monitoring and evaluation – Meaning, definition and concept, objectives - Types and importance and monitoring and evaluation of extension programmes.
25. Transfer of technology - Concept and models and capacity building of extension personnel farmers – Training – Meaning, definition, types of training – Pre-Service training - In-service, orientation, induction training, refresher training and training for professional qualification.
26. Training of farmers, farm women and rural youth – Farmers' Training Centre (FTC) - Objectives – Training organized - District Agricultural Advisory and Transfer of Technology Centre (DAATTC) – Objectives.
27. Extension teaching methods - Meaning, classification, individual, group and mass contact methods, media mix strategies and communication - Meaning and definition
28. Functions of communication, models – Aristotle, Shannon, Weaver, Berlo, Schramm, J.P. Leagans, Rogers and Shoemaker, Litterer, Westley – Macleans and barriers to communication.
29. Agriculture journalism – Meaning – Scope – Importance - Characteristics of News – Factors determining the News value – Types of News and sources of News.
30. Diffusion and adoption of innovation - Meaning, definition, concepts and process and stages and Models of adoption process – Five (5) and Seven (7) stage models - Attributes of innovation – Relative advantage, compatibility, complexity, trialability – obsrevability and predictability.
31. Innovation – Decision process – Meaning – Stages (Knowledge, persuasion, decision, implementation andconfirmation) - Decision process – Meaning – Stages (Knowledge, persuasion, decision, implementation and confirmation) – Concepts - Dissonance – Rejection – Active rejection and passive rejection – Discontinuance – Replacement and disenchantment discontinuance – Over adoption – Rate of adoption and innovativeness.
32. Adopter categories and their characteristics - Factors influencing adoption process – Social, personal and situational.

Practical

1. Audio-visual aids – Meaning, importance and classification - Selection, planning, preparation, evaluation, presentation and use of audio-visual aids – Charts.
2. Selection, planning, preparation, evaluation, presentation and use of audio-visual aids – Charts, posters, flip charts, flash cards, plannel graphs.
3. Selection, planning, preparation, evaluation, presentation and use of audio-visual aids – Power point slides.
4. Planning and preparation of extension literature – Leaflet, folder, pamphlet, booklet, news stories and success stories.
5. Handling and use of audio visual equipments such as public address equipment (PAE) system and still camera and digital camera and Liquid Crystal Display (LCD) Projector.
6. Group discussion – Simulated exercise.
7. Visit to a village to study on going rural development and agricultural developmental programmes.
8. To study and familiarize university extension system.
9. Visit to KVK.
10. Visit to Farmers' Training Centre (FTC).
11. Visit to District Agricultural Advisory and Transfer of Technology Centre (DAATTC).
12. Visit to study organization and functioning of DRDA, DWMA, ATMA, JDA Office and other development departments at district level.
13. Visit to a village to exercise PRA techniques.
14. Visit to community radio and television studio for understanding the process of programme production, Script writing.
15. Developing script for radio.
16. Developing script for television.

References

1. Adivi Reddy, A. 2006. *Extension Eduation*. Sree Lakshmi Press, Bapatla.
2. Dahama, O.P. and Bhatnagar, O.P. 1999. *Extension and Communication for Development*. Oxford & IBH Private Limited, New Delhi/Mumbai.
3. Ganesh, R., Mohammad Iqbal and Ananda Raja. 2003. *Reaching the Unreached – Basics of Extension Education*. Associate Publishing Company, New Delhi.
4. Jalihal, K.A. and Veerabhadraiah, V. 2007. *Fundamentals of Extension Education and Management in Extension*. Concept Publishing House, New Delhi.
5. Ray, G.L. 2006. *Extension Communication and Management*. NayaProkash/Kalyani Publishers, Kalkatta/Ludhiana.
6. Rayudu, C.S. 1997. *Communication*. Himalaya Publishing House, New Delhi.
7. Rogers, E.M. 2003. *Diffusion of Innovation*. Free Press, New Delhi.
8. Soma Sundaram, T. 1977. *Producing Agricultural Information Materials*. Kansas State University, USA and APAU, Hyderabad.
9. Yella Reddy, N. 1998. *Audio-Visual Aids for Teaching, Training and Extension*. Haritha Publishing House, Hyderabad.
10. Vasantha R and Kiran. 2012 *Extension Education* - New Horizons – Kalyani Publishers.
11. Sagar Mondal and G.L. Ray. 2007. *Text book of Rural Development*. Kalyani Publishers, Kolkata/Ludhiana.

12. Ray, G.L. and Mondal S. 2005. *Journalism*. KalyaniPublishers,Kalkatta/Ludhiana
13. Jana, B.L. and Mitra. 2010. *Farm Journalism.* Agrotech Publishing Academy,Udaipur
14. AnandarajaN ,Chandrakandan K and Ramasubramaniam. 2008. *Extension of Technologies from Labs to Lands*. New India Publishing Agency, New Delhi

18 AGR 104 INTRODUCTORY AGROMETEOROLOGY AND CLIMATE CHANGE 2(1+1)

Course outlines

Theory

Earth atmosphere, composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, long wave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, energy balance of earth; Atmospheric humidity, concept of saturation, vapor pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking; Monsoon, mechanism and importance in Indian agriculture; Weather hazards, drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and coldwave; 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 long wave radiation, and its estimation using Planck's intensity law; Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS; Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis, measurement of soil temperature and computation of soil heat flux; Determination of vapor pressure and relative humidity. determination of dew point temperature; Measurement of atmospheric pressure and analysis of atmospheric conditions; Measurement of wind speed and wind direction, preparation of windrose; Measurement, tabulation and analysis of rain; Measurement of open pan evaporation and evapotranspiration, computation of PET and AET

Lecture outlines

Theory

1. Introduction: The three spheres of the earth; Terminology and definitions: Meteorology, Climatology, Agrometeorology, Agroclimatology climate and weather - Scope and importance of agrometeorology.
2. Agro climatic regions of India and Agroclimatic zones of Andhra Pradesh.
3. Atmosphere -Composition of the atmosphere-Weather elements- Extent and structure of the atmosphere.
4. Solar Radiation: Nature and properties of solar radiation - Conduction – Convection - Radiation - Solar Spectrum - Distribution of solar radiation within the crop canopies- Physiological response of different bands of incident radiation - Definitions of solar constant, net radiation, albedo - Solar radiation and crops

5. Temperature: Temperature and heat, definitions- Temperature inversion- Adiabatic lapse rate - Daily and seasonal variations of temperature – Vertical profile of temperature- Energy balance of earth

6. Low air temperature and plant injury and high air temperature and plant injury- Soil temperature- Factors affecting soil temperature- Temperature and crops.

7. Humidity: Concept of saturation- Vapour pressure- Types of humidity- Humidity and crops- Atmospheric Pressure: Definitions of pressure, atmospheric pressure, standard atmospheric pressure

8. Wind:Types of wind**;** Planetary winds (trade winds, westerlies, polar easterlies, cyclones and anti cyclones) periodic winds and local winds (sea and land breezes, mountain and valley winds) Daily and seasonal variation of winds- Effect of wind on crops

9. Precipitation: Process of precipitation, types of rainfall(orographic, convectional and cyclonic)- Definition of cloud – WMO classification of clouds.

10. Forms of precipitation (solid, liquid and mixed) and condensation (dew, fog, mist, frost, cloud) - Artificial rain making- Monsoon:Indian monsoons, SW monsoon & NE monsoon.

11. Importance of monsoon in Indian agriculture- date of onset, significant features of Indian monsoon; length of growing season.

12. Weather hazards**:** Drought-Floods-Cyclones-Heat and cold-waves and their management.

13. Weather Forecasting**:** Importance-Types of weather forecast and their uses-Synoptic charts - Remote sensing-Applications of remote sensing in agriculture - Agrometeorological Advisory services in India.

14. Climate change- variability-Global processes and effects- Green house effect- Temperature changes on the earth- Precipitation changes on the earth- Changes in extreme events- Sea level raising- Tracking climate change- Impacts of climate change on agriculture- Climate neutral

15. Summary of evidence for climate change- Basic models for evaluating climate change Impacts -Specific weather related effects due to climate change.

16. Micro climate- micro climate scales – Modifications of crop microclimate – Examples of manipulation of climate- Climatic normals for crop and livestock production

Practical

1. Visit to Agrometeorological Observatory, site selection and layout plan for observatory.

2. Exposure to agrometeorological instruments and weather data recording.

3. Measurement of total, shortwave and longwave radiation and its estimation by using Planck’s intensity law.

4. Measurement of albedo and sunshine duration.

5. Computation of radiation Intensity using bright sun shine hours.

6. Measurement of maximum and minimum air temperatures and interpretation of decennial temperature data.

7. Tabulation of maximum and minimum air temperatures, trend and variation analysis for climate change of the region.

8. Measurement of soil temperature and computation of soil heat flux.

9. Determination of atmospheric pressure and vapour pressure.

10. Determination of relative humidity.

11. Determination of dew point temperature- Measurement of atmospheric pressure and analysis of atmospheric conditions.

12. Measurement of wind speed and wind direction, preparation of windroses- Measurement, tabulation and analysis of rainfall data.
13. Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET-Preparation of synoptic chart and report
14. Computation of climate change and variability
15. Crop planning for climate change
16. GDD, HTU and PTU calculations and their interpretation using their efficiencies

References

1. Radha Krishna Murthy,V.2016. Principles and practices of agricultural disaster management. B.S Publications, Koti, Hyderabad.
2. Reddy, S.R.2014. Introduction to Agriculture and Agrometeorology. Kalyani Publishers, Ludhiana, Punjab.
3. Radha Krishna Murthy, V. 2002. Basic Principles of Agricultural meteorology. B.S Publications, Koti, Hyderabad.

III Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 AGR 201	Crop Production Technology - I (Kharif Crops)	2(1+1)
2	18 AGR 202	Education of Tour	1(0+1)
3	18 AEC 201	Agricultural Finance and Co-operation	2(1+1)
4	18 AMP 201	Livestock and Poultry Management	3(2+1)
5	18 ENS 201	Environmental Studies and Disaster Management	3(2+1)
6	18 FMP 201	Farm Machinery and Power	2(1+1)
7	18 GPB 201	Fundamentals of Plant Breeding	3(2+1)
8	18 HOR 201	Production Technology for Vegetables and Spices	2(1+1)
9	18 COM 201	Agro-Informatics	2(1+1)
10	18 MAT 201	Statistical Methods	2(1+1)
11	18 AGR 203	Farming System & Sustainable Agriculture	1(1+0)
Total			**23(13+10)**

18 AGR 201 Crop production technology – I *(Kharif crops)* (1+1)

Theory:

Unit - I: Cereals

Rice, Maize, - Origin, geographic distribution, economic importance, soil and climatic requirements, varieties, cultural practices (from land preparation to harvest) and yield.

Unit - II: Millets

Sorghum, Pearl millet, Small millets - Finger millet, Foxtail millet, little millet, Kodo millet, Barnyard millet and Proso millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

Unit - III: Pulses

Redgram, Blackgram, Greengram, , Cowpea, - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

Unit - IV: Oilseeds (Kharif)

Groundnut, sesame, Soybean- Origin, and geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Unit - V: Fibre and forage

Cotton, jute, fodder sorghum, cumbu napier- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Cereals	Rice, maize
Millets	Sorghum, pearl millet, finger millet and minor millets
Pulses	Pigeonpea, green gram, black gram, cowpea,
Oilseeds	Groundnut, sesame, soybean
Fibre & Forage	Cotton, jute, fodder sorghum, Cumbu napier

Theory Lecture Schedule:

1. Importance and area, production and productivity of major cereals and millets of India and Tamil Nadu.
2. Importance and area, production and productivity of pulses and oilseeds crops of India and Tamil Nadu.
3. Rice - Origin - geographic distribution - economic importance - varieties - soil and climatic requirement.
4. Rice - cultural practices - yield - economic benefits.
5. Special type of Rice cultivation – SRI - and Hybrid rice cultivation.

6. Maize - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
7. Sorghum and Pearl millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
8. Finger millet and Minor millets - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
9. **Mid semester Examination.**
10. Pigeonpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
11. Greengram, Blackgram and Cowpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield - Agronomy of rice fallow pulses.
12. Groundnut - Origin, geographical distribution, economic importance, soil and climatic requirements - varieties, cultural practices yield and economics.
13. Sesame and Soybean - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
14. Cotton - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
15. Jute- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
16. Fodder sorghum- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
17. Cumbu napier- Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.

Practical Schedule:

1. Identification of cereals, millets, pulses and oilseed crops in the crop cafeteria.
2. Practicing various nursery types and main field preparation for rice crop.
3. Nursery and main field preparation for important millets, pulses and oilseeds.
4. Acquiring skill in different seed treatment techniques in important kharif crops.
5. Estimation of plant population per unit area for important kharif crops.
6. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for cereals and millets.
7. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for pulses and oilseeds.
8. Acquiring skill in using seed drill for sowing operations.
9. Acquiring skill in foliar nutrition for important field crops.

10. Observations on growth parameters of cereals and millets.
11. Observations on growth parameters of pulses and oilseeds.
12. Study of yield parameters and estimation of yield in cereals and millets.
13. Study of yield parameters and estimation of yield in pulses and oilseeds.
14. Working out cost and returns of important cereals, millets, pulses and oilseeds crops.
15. Visit to farmers field / research stations to study the cultivation techniques of cereal, millets, pulses, cotton and oilseeds.
16. Visit to nearby Agricultural Research Station / Farmer's field.
17. **Practical Examination.**

References:

1. Ahlawat, I.P.S., Om Prakash and G.S. Saini. 1998. Scientific Crop Production in India. Rama publishing House, Meerut.
2. Chidda Singh. 2010. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
3. Singh. S.S. 2015. Crop management under irrigated and rainfed conditions. Kalyani Publishers, New Delhi.
4. Reddy,S.R. 2012. Agronomy of field crops. Kalyani publishers, New Delhi. Joshi, M. 2015. Textbook of Field crops. PHI Learning Pvt. Ltd., New Delhi ICAR 2015. Hand book of Agriculture. Indian Council of Agricuture, New Delhi Crop production Guide 2012. Directorate of Agriculture, Chennai.

E-References:

1. www.crida.org
2. www.cgiar.org
3. www.tnau.ac.in/agriportal

18 GPB 201 FUNDAMENTALS OF PLANT BREEDING 3(2+1)

Course outlines

Theory

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding;Heritability and genetic advance; modes of reproduction and apomixes; self – incompatibility and male sterility- genetic consequences, cultivar options; Domestication, Acclimatization, introduction, Centre of origin/diversity; Genetic basis and breeding methods in selfpollinated crops-mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept; Concepts of population genetics and Hardy- Weinberg Law; Genetic basis and methods of breeding cross pollinated crops, modes of selection; Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops, clonal selection and hybridization; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding; mutation breeding-methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding.

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; Handing of segregation populations; Methods of calculating mean, range, variance, standard deviation. Designs used in plant breeding experiment, analysis of Randomized Block Design; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Work out the mode of pollination in a given crop and extent of natural out crossing; Prediction of performance of double cross hybrids.

Lecture outlines

Theory

1 Historical developments, concept, nature and role of plant breeding, major achievements and future prospects - Definition, aim, objectives, history and developments of plant breeding, scientific contributions of eminent scientists - Landmarks in plant breeding - Scope of plant breeding.

2 Modes of reproduction and apomixis - Asexual reproduction (vegetative reproduction and apomixis) and sexual reproduction - Their classification and significance in plant breeding.

3 Modes of pollination - Classification of crop species on the basis of mode of pollination– self pollination – mechanisms promoting self pollination – Genetic consequences of self pollination – Cross pollination – Mechanisms promoting cross pollination – Genetic consequences of cross pollination – Often cross pollinated crops.

4 Self– incompatibility - Classification – Heteromorphic, homomorphic, gametophytic and sporophytic systems of incompatibility – Advantages and disadvantages – Utilization in crop improvement.

5 Male sterility- Genetic consequences, cultivar options - Different types – Genetic, cytoplasmic and cytoplasmic genetic male sterility – Inheritance and maintenance– utilization of male sterile lines in hybrid seed production – Their advantages and disadvantages.

6 Domestication, acclimatization and introduction - Plant introduction – Primary introduction and secondary introduction – Plant introduction agencies in India – National Bureau of Plant Genetic Resources (NBPGR) and its activities – Procedure of plant introduction – Merits and demerits of plant introduction.

7 Centre of origin/diversity - Centres of diversity– Centres of origin – Classification – law of homologous series – Types of centres of diversity – Germplasm collections – Genetic erosion – Main reasons of genetic erosion – Extinction - Gene sanctuaries - Introgression – Gene banks – Types of gene banks.

8 Breeding methods in self pollinated crops - Modes of selection - Selection – Natural and artificial selection – Basic principles of selection – Basic characteristics and requirements of selection – Selection intensity – Selection differential, heritability (narrow and broad sense) – Genetic advance as per cent of mean.

9 Mass selection – Procedure for evolving a variety by mass selection – Modification of mass selection – Merits, demerits and achievements.

10 Pure line selection - Johannsen's pure line theory and its concepts and significance – Origin of variation in pure lines – Characters of pure lines – Progeny test, genetic basis of pure line selection – General procedure for evolving a variety by pure line selection – Merits, demerits and achievements – Comparison between mass and pure line selection.

11 Hybridization techniques - Hybridization – Aims and objectives – Types of hybridization – Pre-requisites for hybridization – Procedure / steps involved in hybridization.

12 Handling of segregating population - Pedigree method – Procedure – Merits, demerits and achievements.

13 Bulk method – Procedure – Merits, demerits and achievements – Comparison between pedigree and bulk methods - Single seed descent method – Merits and demerits.

14 Backcross method of breeding–Its requirements and applications – Procedure for transfer of single dominant gene - Procedure for transfer of single recessive gene – Merits, demerits and achievements - comparison between pedigree and backcross method.

15 Multiline concept - Definition – Characteristics of a good multiline – Development of multiline varieties – Achievements.

16 Concepts of population genetics and Hardy - Weinberg Law - Hardy Weinberg Law – Factors affecting equilibrium frequencies in random mating populations - Selection without progeny testing – Selection with progeny testing - Merits and demerits of progeny selection – Line breeding– achievements.

17 Recurrent selection – Different types – Detailed procedure of simple recurrent selection and other recurrent selection methods – Conclusion on the efficiency of different selection schemes.

18 Heterosis - Heterosis and hybrid vigour – Luxuriance – Heterobeltiosis – Brief history– heterosis in cross pollinated and self pollinated species – Manifestations of heterosis-

19 Genetic basis of heterosis – Dominance, over dominance and epistasis hypotheses – Objections and their explanations – Comparison between dominance and overdominance hypotheses – Physiological basis of heterosis – Commercial utilization.

20 Inbreeding depression - Brief history – Effects of inbreeding – Eegrees of inbreeding depression – Procedure for development of inbred lines and their evaluation.

21 Development of inbred lines and hybrids - Exploitation of heterosis – History of hybrid varieties – Important steps in production of single and double cross hybrids – Brief idea of hybrids in maize, pearl millet, sunflower and rice.

22 Composite and synthetic varieties - Production procedures – Merits, demerits and achievements – Factors determining the performance of synthetic varieties – Comparison between synthetics and composites.

23 Breeding methods in asexually propagated crops, clonal selection and hybridization - Characteristics of asexually propagated crops – Characteristics of clones –Clonal selection – Procedure – Advantages and disadvantages – Problems in breeding asexually propagated crops – Genetic variation within a clone – Clonal degeneration – Achievements – Comparison among clones, purelines and inbreds - Breeding of annual asexually propagated species through hybridization – Interspecific hybridization.

24 Wide hybridization and pre breeding - History – Objectives – Barriers for the production of distant hybrids– Techniques for production of distant hybrids – applications of wide hybridization in crop improvement – Sterility in distant hybrids – Limitations and achievements - use of gene pools to develop intermediate breeding material.

25 Polyploidy in relation to plant breeding - Polyploidy – Autopolyploids – Origin and production – Morphological and cytological features– Applications in crop improvement – Limitations– Allopolyploidy – Morphological and cytological features– Applications in crop improvement – Limitations.

26 Mutation breeding - Methods and uses - Mutation breeding – Procedure of mutation breeding – Applications – Advantages, limitations and achievements.

27 Breeding for important biotic and abiotic stresses - Disease resistance – Mechanisms of disease resistance in plants (disease escape, tolerance, resistance, immunity and hypersensitivity) – Genetic basis of disease resistance – Gene for gene hypothesis – sources of disease resistance – Breeding methods for disease resistance – Achievements.

28 Insect resistance – Mechanism of insect resistance in plants (non preference, antibiosis, tolerance and avoidance) – Nature of insect resistance – Genetics of insect resistance – Horizontal and vertical resistance– Sources of insect resistance – breeding methods for insect resistance – Problems in breeding for insect resistance – Achievements.

29 Drought resistance – Mechanisms of drought resistance (drought escape, avoidance, tolerance, and resistance) – Features associated with drought resistance – Sources of drought resistance – Breeding methods for drought resistance – Limitations – achievements - Resistance to water logging – Effects of water logging – Mechanism of tolerance – Ideotype for flooded areas.

30 Salt tolerance – Response of plants to salinity – Symptoms – Mechanisms of salt tolerance – Breeding methods for salt tolerance – Problems – Achievements. Cold tolerance – Chilling resistance – Effects of chilling stress on plants – Mechanism of chilling tolerance – Sources of chilling tolerance – Selection criteria.

31 Biotechnological tools - DNA markers and marker assisted selection - Definition and classification of DNA markers and applications.

32 Participatory plant breeding - Definition – Goals – Methodology – Advantages and limitations.

Practical

1 Plant Breeder's kit.
2 Study of germplasm of various crops.
3 Emasculation and hybridization techniques in self pollinated crops – rice, groundnut.
4 Emasculation and hybridization techniques in self pollinated crops – greengram, sesame.
5 Emasculation and hybridization techniques in cross pollinated crops – maize, castor.
6 Emasculation and hybridization techniques in often cross pollinated crops – cotton, redgram.
7 Consequences of inbreeding on genetic structure of resulting populations.
8 Study of male sterility systems.
9 Handling of segregation populations.
10 Methods of calculating mean, range, variance, standard deviation.
11 Designs used in plant breeding experiments.
12 Layout of field experiment.
13 Analysis of Randomized Block Design.
14 Estimation of heterosis, inbreeding depression and heritability.
15 Prediction of performance of double cross hybrids.
16 Work out the mode of pollination in a given crop and extent of natural out crossing.

References

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

18 AEC 201 AGRICULTURAL FINANCE AND CO-OPERATION 2(1+1)

Course outlines

Theory

Agricultural Finance- meaning, scope and significance, capital and credit needs and their role in Indian agriculture. credit: meaning, definition, need, classification. Credit analysis: 3 R's, and 5C's and 7 Ps of credit analysis. Sources of agricultural finance: institutional and non-institutional sources, social control and nationalization of commercial banks, RRBs, Lead bank scheme,. Crop loan scheme,Scale of finance and unit cost. Cost of credit, KCC. Financial inclusion,Micro financing, and schemes for financing weaker sections. Crop insurance, AICI,PMFBY.

Introduction to higher financing institutions– RBI, NABARD, World bank group institutions. Recent developments in agricultural credit.Agril.Projects – project- meaning, importance, Project cycle and phases., Basic guidelines for preparation of project reports.

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

Practical

Determination of most profitable level of capital use. Optimum allocation of limited amount of capital among different enterprises. 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 of lending and sanction of loans .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 value added products. Seminar on selected topics.

Lecture outlines

Theory

1. Agricultural Finance - Meaning, definition, nature and scope - Significance – Micro and macro finance - Capital and credit problems, need and their importance in Agriculture.
2. Credit - Meaning and definition - Classification of credit based on different criteria with examples.
3. Credit analysis - Economic feasibility tests - 3 R's of credit analysis - Returns to investment - Repayment capacity - Meaning, causes of poor repayment capacity of farmers, suggestions to improve repayment capacity - Risk bearing ability - Meaning, sources of risk, means to strengthen RBA.
4. Five Cs of credit – Character – Capacity – Capital - Condition and Commonsense - Seven Ps of credit - Principle of Productive purpose - Principle of personality - Principle of productivity -

Principle of phased disbursement - Principle of proper utilization - Principle of payment and Principle of protection.

5. Social control and nationalisation - Meaning, objectives and their importance - Privatisation of commercial banks - Need and importance for institutional sources and structure of agricultural lending from different sources.

6. Lead bank scheme - Origin, objectives, functions - District credit plan – Regional Rural Banks (RRBs) - Origin, objectives, functions — RRBs in Andhra Pradesh.

7. Crop loan system - Objectives, importance, features of crop loan system - Scale of finance - Meaning and estimation and role of district level consultative committee - Term loans – Objectives and meaning of unit costs, fixation of unit costs and NABARD guidelines.

8. Financial inclusion - Meaning and importance - Micro finance - Meaning, importance, agencies providing microcredit banks, NBFCs, NGOs, and Govt. agencies - SHGs and their role in microfinance and bank linkages - Micro finance lending and control act in Andhra Pradesh - Objectives and important features.

9. Schemes for financing weaker sections - Differential interest rate (DIR) – Integrated rural development programme (IRDP) - Swarnajayanti gram swarozgar yojana (SGSY) - Self help groups (SHGs) etc., Srinidhi, MUDRA.

10. Higher financing agencies - Reserve Bank of India (RBI) - Objectives and functions and role in agricultural development and finance. National Bank for Agricultural and Rural Development (NABARD) - Origin, functions, activities and role in agricultural development.

11. World Bank (WB) - Objectives and functions -World Bank group institutions – role and functions of International Bank for Reconstruction and Development (IBRD) - International Development Agency (IDA) - International Finance Corporation (IFC), MIGA, ISID.

12. Crop insurance - Meaning and its advantages and limitations in application - Agricultural insurance company of India - Objectives and functions - Indemnity - Meaning, premiums and claims - Prime Minister's Fasal Bhima Yojana (PMFBY) - Salient features - Weather based crop insurance - Salient features and its importance.

13. Agricultural project - Meaning, characteristics of agril. projects, project cycle and explanation of different phases of project cycle - Basic guidelines for preparation of project reports.

14. Co-operation - Meaning, Scope, importance and definition - Principles – Objectives of co-operation, significance of cooperatives in Indian agriculture.

15. Brief history of cooperative movement development in India - Recent developments in Indian cooperative movement - Short comings of Indian co-operative movement and remedies.

16. Agricultural Cooperative institutions in India - co-operative credit structure in India and Andhra Pradesh – Objectives and functions of state level (APCOB), district level (DCCB) and Village level (PACS) cooperative societies - Functions of marketing, consumer societies, multi-purpose cooperatives, farmers' service cooperative societies, dairy cooperatives - Andhra Pradesh mutually aided Co-operative Societies Act (1995) - Role of International Cooperative Alliance (ICA), National cooperative Union of India (NCUI), National Cooperative Development Council (NCDC).

Practical

1. Estimation of credit requirement of farm business – A case study.
2. Estimation of scale of finance - Unit costs and KCC.

3. Determination of most profitable level of capital use.

4. Analysis of progress and performance of priority sector lending by commercial banks, Cooperatives, RRBs and non-institutional sources using published data. Working out different repayment plans with examples.

5. Lump sum repayment /straight-end repayment - Variable or quasi variable repayment.

6. Amortized decreasing repayment plan and amortized even repayment plan.

7. Estimation of indemnity for crop insurance claims.

8. Visit and study of a commercial bank to acquire firsthand knowledge of their management, schemes and procedures of lending and sanction of loans.

9. Visit and study of a cooperative bank - PACS/ DCCB to acquire firsthand knowledge of their management, schemes and procedures of lending and sanction of loans.

10. Visit and study of a cooperative society - dairy/ consumers to acquire firsthand knowledge of their management, schemes and activities.

11. Preparation and analysis of balance sheet – A case study.

12. Preparation and analysis of income statement – A case study.

13. Appraisal of a loan proposal – A case study.

14-16. Techno-economic parameters for preparation of projects - Preparation of bankable projects for various agricultural products and value added products.

References

1. Johil S.S. and C.V. Moore. 1970. *Essentials of Farm Financial Management*. Today and Tomorrow Printers and Publishers, New Delhi.

2. John, J. Hamptron.1983. *Financial Decision Making: Concepts, Problems and Cases, of India*. New Delhi.

3. Mamoria, C.B. and R.D. Saksena. 1973. *Co-operatives in India*. Kitab Mahal, Allahabad,

4. Mamoria, C.B. and Saxena. *Agricultural Problems in India*. Kitab Mahal, Allahabad

5. Mukhi, H R. 1983. *Cooperation in India and Abroad.* New Heights Publishers, New Delhi.

6. Muniraj, R. 1987. *Farm Finance for Development*, Oxford & IBH Publishing Company Ltd., New Delhi,

7. Subba Reddy, S. and P. Raghuram. *Agricultural Finance and Management*. Oxford & Publishing Company Private Ltd., New Delhi, 2005

8. Subba Reddy, S., Raghu Ram., P., Sastry, T.V.N and Bhavani Devi, I. 2016. *Agricultural Economics*. Oxford & IBH Publishing Company Private Ltd., New Delhi.

9. Pandey, U.K. *Agricultural Finance in India*.

10. William, G. Murray and Nelson Aarson, G. *Agricultural Finance*. The Iowa State University Press, Ames, Iowa state University press Ames, IOWA.

11. www.rbi.org

12. www. nabard. Org

13. www.wb.org.

18 COM 201 AGRICULTURAL INFORMATICS 2(1+1)

Course outlines

Theory

Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System, definition and types. Applications of MS-Office for creating, Editing and Formatting a document, Data presentation, tabulation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, creating database, uses of DBMS in Agriculture, Internet and World Wide Web (WWW), Concepts, components and creation of web, HTML, XML coding. e-Agriculture, concepts, design and development. Application of innovative ways to use information and communication technologies (IT) in Agriculture. ICT for Data Collection, formation of development programmes, monitoring and evaluation of Programmes. Computer Models in Agriculture: statistical, weather analysis and crop simulation models, concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone mobile apps in Agriculture for farm advises, market price, postharvest management etc; Geospatial technology, concepts, techniques, components and uses for generating valuable agri-information. Decision support systems, taxonomy, components, framework, classification and applications in Agriculture, DSS, Agriculture Information/Expert System, Soil Information Systems etc for supporting Farm decisions. Preparation of contingent crop-planning and crop calendars using IT tools.

Practical

Study of Computer Components, accessories, Introduction of different operating systems such as windows, Unix, Linux, Creating, Files & Folders, File Management. Use of MS-WORD and MS Powerpoint for creating, editing and presenting a scientific Document, Handling of Tabular data, animation, video tools, art tool, graphics, template & designs. MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros. MS-ACCESS: Creating Database, preparing queries and reports, demonstration of Agri-information system. Introduction to World Wide Web (WWW) and its components, creation of scientific website, presentation and management agricultural information through web. Preparation of Inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools. Use of smart phones and other devices in agro-advisory and dissemination of market information. Introduction of Geospatial Technology, demonstration of generating information important for Agriculture. Hands on practice on preparation of Decision Support System.

Lecture outline

Theory

1. Introduction to computers- Advantages- Disadvantages- Applications – Anatomy of Computers- Input / output devices -Memory Concepts - Units of Memory - RAM – ROM – PROM – EPROM - EAPROM - Cache Memory.
2. Operating system - Definition and types - WINDOWS OS – Features – Desktop – Icons etc.
3. Applications of MS-Office - MS- Word - Creating - Editing and formatting a document.

4. MS Word - Features of good word processor - Mail merge – Drop cap- Auto text- Track changes – Equation editor etc.
5. MS- Excel - Data presentation, Tabulation – Merging of cells and graph creation - Mathematical expressions.
6. MS- Excel - Data analysis tool pack – Pivot table and graph etc.,
7. MS Access – Database - concepts and types - creating database - Uses of DBMS in agriculture.
8. MS Access - Objects of data base – Types of fields etc.,
9. Internet and World Wide Web (WWW) – Concepts - Components and creation of web.
10. HTML - XML coding.
11. e-Agriculture - Concepts - Design and development - Application of innovative ways to use information and communication technologies (IT) in Agriculture.
12. ICT for Data Collection - Formation of development programmes – Monitoring and evaluation of Programmes - Computer Models in Agriculture statistical weather analysis and crop simulation models – Concepts – Structure – Inputsoutputs files – Limitation - Advantages and application of models for understanding plant processes – Sensitivity –Verification - Calibration and validation.
13. IT application for computation of water and nutrient requirement of crops - Computer controlled devices (automated systems) for Agri-input management - Smartphone mobile apps in Agriculture for farm advises - Market price - Postharvest management etc,.
14. Geospatial technology – Concepts – Techniques - Components and uses for generating valuable agri-information.
15. Decision support systems – Taxonomy – Components – Framework – Classification and applications in Agriculture - DSS - Agriculture Information/Expert System - Soil Information Systems etc for supporting Farm decisions.
16. Preparation of contingent crop-Planning and crop calendars using IT tools.

Practical

1. Booting of computer and its shut down - Practicing Windows operating system - Use of mouse -Title bar – Minimum, maximum and close buttons - Scroll bars - Menus and tool bars.
2. Windows explorer- Creating folder - Copy and paste functions - Control panel- Notepad - Wordpad etc.
3. MS word - Creating a document, saving and editing
4. Use of options from tool bars – Format - Insert and tools (Spelling and Grammar) - Alignment of paragraphs and text.
5. Creating a table - Merging of cells - columns and row width - Formats etc.
6. MS- Excel - Creating a spreadsheet - Alignment of rows - columns and cells using format tool bar.
7. Entering formula expression through formula tool bar and use of in-built functions Sum – Average – Stdev –Maximum and minimum.
8. Data analysis using inbuilt tool packs test of significance.
9. Data analysis using inbuilt tool packs correlations and regressions.
10. Creating graphs and saving with and without data.
11. MS- Power Point - Creating slides, layouts, action buttons, multimedia features.
12. MS- Access - Creating a data base, structuring with different types of fields.

13. Use of query facility for accessing the information.
14. Transforming the data of word - Excel and Access to other formats.
15&16. Internet concepts - Creating Email - Search Engines - Website designing.

References

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

18 FMP 201 FARM MACHINERY AND POWER 2(1+1)

THEORY

Unit I: Farm Power & IC engines

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 IC engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication, fuel supply.

Unit-II : Tractor & functional components

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,

Unit –III: Tillage implements

Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture.

Unit-IV: Sowing & Intercultural implements

Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, implement for intercultural operations.

Unit-V: Plant Protection and Harvesting equipments

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 board 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.

LECTURE SCHEDULE:

1. Farm power in India - sources of farm power and their use in agriculture
2. Working principles of IC Engines-Two stroke and Four stroke engines - applications – comparison-Engine terminology.
3. Components of IC engine and systems of IC engine – air cleaning, cooling, lubricating and fuel supply systems.
4. Tractors- types - transmission system- clutch, gearbox, differential and final drive - hydraulic system.

5. Cost analysis of tractor with attached implement.
6. Tillage, objectives, types - ploughing methods. Primary tillage- mould board plough, disc plough, chisel plough and subsoil plough - components and functions, types, advantages and disadvantages
7. Secondary tillage equipment – cultivators, harrows, levelers, land forming equipment – rotovators – puddlers - manure tramplers and cage wheels, Implements for Hill agriculture.
8. Sowing methods - seed drills and planters- seed cum fertilizer drills - components and functions-Calibration.
9. Mid semester examination
10. Paddy transplanters, types, working principle, field and nursery requirements
11. Implements for intercultural operations – cultivators, sweep, junior hoe, manual weeders and power operated weeders for wet land and garden land
12. Sprayers and their functions, classification, manually operated sprayers, terminology, Nozzle types.
13. Power operated sprayers – Tractor operated boom sprayer, Knapsack mist blower cum duster – Tall tree sprayer-dusters, types and uses.
14. Tools for horticultural crops – propagation tools, planters and harvesting tools and machinery
15. Threshing of crop, thresher and its principles of operation - threshing losses.
16. Harvesting equipment – reapers - mowers and combine harvesters – types, construction and operation-Balers.
17. Harvesting machinery for groundnut, tuber crops, Cotton and sugarcane

PRACTICAL SCHEDULE:

1. Study of working of two and four stroke IC engines and their systems with solved problems.
2. Study of Tractor clutch, gearbox, differential and final drive. Study of brake steering, and hydraulic control.
3. Learning driving of tractor and power tiller
4. Study of tractors and power tillers – their operation and maintenance
5. Study of mould board plough, - methods of ploughing- with solved problems.
6. Disc plough and subsoiler and their components- Hitching and adjustment of plough - field operation of different tractor drawn primary tillage machinery.
7. Study of cultivator, disc harrows, Rotavator, bund former, ridger, leveller and puddling implements and their operation.
8. Study of seed drills, planters and seed-cum-fertilizer drills and their components and metering mechanisms - calibration- simple problems on calibration.
9. Study and operation of machinery for rice cultivation - puddling implements- rotary puddlers and cage wheels, tray seeder for rice nursery, transplanters- types operation and maintenance- Drum seeder, conoweeder, power weeder and finger type weeder.
10. Study of different inter-cultivation equipment for uplands - manual, animal drawn, power operated - tractor and power tiller operated - field operation
11. Study of plant protection equipment – manually operated sprayers and dusters, knapsack mist blower cum duster, tractor operated sprayers- their operation, adjustment, calibration and safety requirements

12. Study of tools for Hill agriculture and horticultural crops – propagation tools, vegetable transplanter, harvesting tools -lawn mower, hole diggers, tree climber, shredders for crop residue.
13. Threshing machinery for paddy and identification of its components- different threshing drums - calculation of efficiency and losses.
14. Study of paddy reaper and paddy combine- their systems, method of operation and adjustment.
15. Study of harvesters for root crops - turmeric and tapioca and groundnut diggers
16. Problems on cost of operation of tractor operated machinery.
17. Final practical examination

References:

1. Jagadishwar Sahay, 2010 - **Elements of Agricultural Engineering**. Standard Publishers Distributers, Delhi. ISBN 978-8180140440
2. Ojha, T. P. and Michael, A.M. **Principles of Agricultural Engineering**. Vol. I, Jain Brothers, 16/893, East Park Road, Karol Bagh, New Delhi – 110005
3. S.C.Jain and C.R.Rai. **Farm Tractor – Maintenance and Repair**. Standard Publishers, 1705-B, Nai Sarak, Delhi – 110006
4. Senthilkumar, T., R. Kavitha and V.M.Duraisamy 2015. **A Text Book of Farm Machinery**, Thannambikkai Publications, Coimbatore . ISBN: 978-9381102305

E- RESOURCES:

www.agricoop.nic.in/dacdivision/Machinery1/directory.htm

www.farmmachineryshow.org

http://www.hillagric.ac.in/edu/coa/agengg/lecture/243/agriengg-243.htm

http://www.digitalbookindex.org/subject_search/search010agricultureequipmenta

http://ecoursesonline.iasri.res.in/course/view.php?id=540

18 HOR 201 Production technology of vegetables and spices 2(1+1)

Theory

Vegetables

Unit I: Scope, Importance and classification of vegetables

Importance of vegetable growing –area and production of vegetables in India and Tamil Nadu- National economy- nutritive value of vegetables and human nutrition.

Unit II: Production technology of tropical vegetable crops

Origin - climate and soil – varieties and hybrids – seeds and sowing – transplanting – water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulators - physiological disorders - maturity indices – harvest – pest and diseases – seed production

Crops: Tomato, chilli, brinjal, bhendi, gourds (ash gourd, pumpkin, bitter gourd, ridge gourd, bottle gourd, snake gourd and watermelon) onion, cassava, amaranthus and moringa.

Unit III: Production technology of temperate vegetable crops

Origin -climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrient and plant growth regulators-physiological disorders- maturity indices – harvest – pest and diseases – seed production

(**Crops:** Cabbage, cauliflower, potato, carrot, radish, beetroot, peas and french beans, Protected cultivation of vegetables (tomato, capsicum and cucumber).

SPICES

Unit IV: Crop production techniques of major spices

Spices- scope and importance - classification of spices - origin, area and production - role of commodity boards- export potential of spices.

Climate and soil - varieties - propagation - nursery management and planting – cropping systems-training practices - nutrient, water and weed management - shade regulation - maturity indices - harvest and yield - pests and diseases - processing - value addition.

Black pepper, Cardamom, Turmeric, Ginger and Garlic

Unit V: Crop production techniques in seed spices, tree spices and other spices

Climate and soil- varieties - propagation, nursery management and planting- training , pruning canopy management- weed and water management- shade regulation- nutrient management including drip and fertigation – harvest and yield – pests and diseases – processing – value addition.

Coriander, Fenugreek, Cumin, Fennel, Clove, Nutmeg, Cinnamon, Curry leaf, Tamarind and Herbal spices

Practical

Vegetables

Layout of kitchen garden – seed sowing – nursery management – grafting in vegetables water and nutrient management – fertigation – weed management – practices in use of plant growth regulators - Special horticultural practices in vegetable production - study of maturity indices - Identification of physiological disorders - protected cultivation - visit to vegetable nursery unit/ protected cultivation unit.

Spices

Identification of spices - description of varieties - Propagation methods - rapid multiplication techniques, seed collection and extraction - raising of nurseries - seed sowing - seed treatment - fertilizer application - harvesting – pests and diseases - processing - cost economics - visit to spice gardens

Black pepper, Cardamom, Turmeric, Ginger, Coriander, Fenugreek, Curry leaf, Clove, Nutmeg and Cinnamon

Theory lecture schedule

1. Importance of vegetable growing –area and production of vegetables in India and Tamil Nadu- National economy- nutritive value of vegetables and human nutrition.
2. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of tomato, chilli and brinjal
3. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of bhendi and onion.
4. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield– pest and diseases – seed production of gourds (ash gourd, pumpkin, bitter gourd, ridge gourd, bottle gourd, snake gourd and watermelon)
5. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator-physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of cassava and potato
6. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator -physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of moringa and amaranthus.
7. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of cabbage and cauliflower.

8. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of carrot , beetroot and radish.
9. **Mid -semester examination**
10. Climate and soil – varieties and hybrids – seeds and sowing – transplanting - water and nutrient management – fertigation – weed management – use of micronutrients and plant growth regulator - physiological disorders - maturity indices – harvest and yield – pest and diseases – seed production of french beans and peas.
11. Protected cultivation of vegetables (tomato, capsicum and cucumber)
12. Spices- scope and importance - classification of spices - origin, area and production - role of commodity boards- export potential of spices. **Black pepper** - climate and soil- varieties – propagation – rapid multiplication techniques - nursery management and planting- nutrient, water and weed management - special horticultural practices - role of growth regulators - shade regulation- maturity indices - harvest and yield - pests and diseases –post harvest practices-processing and value addition.
13. **Cardamom** - climate and soil - varieties - propagation - nutrient, water and weed management-shade regulation- mulching - maturity indices - harvest and yield - pests and diseases –post harvest practices- processing and value addition.
14. **Turmeric , Ginger and Garlic** - Climate and soil- varieties - propagation, nursery management and planting- nutrient, water and weed management- inter cropping- physiological disorders -maturity indices - harvest and yield - pests and diseases –post harvest practices- processing and value addition.
15. **Seed spices** - climate and soil- varieties - seed treatment/ sowing – nutrient, water and weed management- intercropping - maturity indices - harvest and yield - pests and diseases –post harvest practices- processing and value addition.(**Coriander, Fenugreek, Cumin and Fennel**)
16. **Tree spices** - climate and soil - varieties - propagation, nursery management and planting - nutrient, water and weed management- training and pruning practices- cropping system- special horticultural practices maturity indices - harvest and yield - pests and diseases –post harvest practices- processing and value addition.(**Clove, Nutmeg and Cinnamon**)
17. **Tamarind, Curry leaf and herbal spices** - climate and soil- varieties - propagation, nursery management and planting- nutrient, water and weed management- canopy management - maturity indices - harvest and yield - pests and diseases – post harvest practices- processing and value addition.

Practical schedule

1. Layout of kitchen garden.
2. Seed treatment and sowing practices in direct sown vegetables
3. Nursery management of transplanted ,bulb and tuber vegetable crops

4. Grafting in vegetable crops
5. Water and nutrient management – fertigation in vegetable crops
6. Practices in use of plant growth regulators in vegetable crops
7. Special horticultural practices in vegetable production
8. Identification of physiological disorders in vegetable crops
9. Study of maturity standards and harvesting of vegetables
10. Practices in protected cultivation of vegetable crops
11. Visit to vegetable nurseries/protected vegetable cultivation unit
12. Black pepper and cardamom- identification and description of varieties – seed propagation and vegetative propagation – fertilizers application - preparation of plant bio regulators and application – pests and diseases- harvest and post harvest practices.
13. Turmeric and ginger- identification and description of varieties- propagation, fertilizers application - preparation of plant bio regulators and application – pests and diseases- harvest and post harvest practices.
14. Coriander and Fenugreek - identification and description of varieties - seed treatment, sowing fertilizer application - pests and diseases- harvest and post harvest practices.
15. Clove, Nutmeg and Cinnamon - identification and description of varieties – seed collection and extraction - propagation – fertilizer application – training and pruning – pests and diseases- harvest and post harvest practices.
16. Tamarind and curry leaf - identification and description of varieties – seed collection and extraction - propagation – fertilizer - application – canopy management – pests and diseases- harvest and post harvest practices.
17. Visit to spice gardens or commodity boards and working out cost economics of spice crops.

REFERENCES

1. Gopalakrishnan, T.R. 2007. Vegetable Crops. Horticultural Science Series (Series Editor K.V.Peter). New India Publishing Agency.
2. Mandal, R.C. 2006. Tropical root and tuber crops. Agrobios (India) Peter.K.V. 2000. Genetics and Breeding of Vegetables, ICAR, Publication.
3. Singh, P.K., S.K. Dasgupta and S.K. Tripathi, 2006. Hybrid Vegetable Development. International Book Distributing Co.
4. Mini, C. and Krishnakumar, K. 2004. Leaf Vegetables. Agro tech Publishing Academy, Udaipur Thamburaj, S. and Narendra Singh .2001. Vegetables, Tuber crops and Spices, Directorate of information and publications of agriculture, ICAR,NewDelhi.
5. Veeraragavaththam ,D., M.Jawaharlal and SeemanthiniRamadas 2000 " Vegetable Culture"
6. Kumar, N. 2014. Introduction to Spices, Plantation, Medicinal and Aromatic crops, IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Alice Kurian and Peter, K.V. 2007. Horticulture science series Vol. 08, New India Publishing Agency, New Delhi.

8. Veeeraragavathatham, D and et al., 2004. Scientific fruit culture, Sun Associates, Coimbatore.
9. Henry Louis, I. 2002. Coconut- The wonder palm. Hi - Tech Coconut Corporation, Nagercoil.

E-References

1. http://www.jhortscib.com
2. http://journal.ashspublications.org
3. http://www.actahort.org/
4. http://www.aphorticulture.com/crops.htm
5. http://cpcri.nic.in/ http://indiancoffee.org

18 ENS 201 Environmental Studies and Disaster Management 3(2+1)

Theory

Unit 1:

Multidisciplinary nature of environmental studies Definition, scope and importance

Unit 2:

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.

Unit 3:

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)

Unit 4:

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-sports 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.

Unit 5:

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. Pollution case studies.

Unit 6:

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.

Unit 7:

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. Case Studies.

DISASTER MANAGEMENT

Unit 8:

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.

Unit 9:

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.

Unit 10 : 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

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

Lecture Schedule

1. Multidisciplinary nature of environmental studies - Definition, scope and importance - Natural Resources: Renewable and non-renewable resources - Natural resources and associated problems
2. Forest resources: Use and over-exploitation, deforestation, case studies - Timber extraction, mining, dams and their effects on forest and tribal people
3. Water resources: Use and over-utilization of surface and ground water - Floods, drought, conflicts over water, dams - benefits and problems

4. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies - Food resources: World food problems, changes caused by agriculture and overgrazing

5. Effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Case studies.

6. 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

7. 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

8. Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem and Desert ecosystem

9. Introduction, types, characteristic features, structure and function of Aquatic ecosystems : ponds, streams, lakes - Rivers, oceans, estuaries

10. 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

11. Biodiversity at global, National and local levels - India as a mega-diversity nation - Hotspots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts

12. Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

13. Environmental Pollution - Definition, cause, effects and control measures of Air pollution and Noise pollution

14. Definition, cause, effects and control measures of Water pollution and Soil pollution

15. Definition, cause, effects and control measures of Marine pollution, Thermal pollution and Nuclear hazards

16. Solid Waste Management: Causes, effects and control measures of urban and industrial wastes

17. Mid Semester Examination

18. Role of an individual in prevention of pollution - Pollution case studies - Social Issues and the Environment - From Unsustainable to Sustainable development - Urban problems related to energy

19. Water conservation, rain water harvesting, watershed management - Environmental ethics: Issues and possible solutions, climate change, global warming

20. Acid rain, ozone layer depletion, Nuclear accidents and holocaust - Wasteland reclamation- Consumerism and waste products

21. Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act
22. Issues involved in enforcement of environmental legislation - Public awareness - Human Population and the Environment: Population growth, variation among nations, population explosion, Family Welfare Programme
23. Environment and human health: Human Rights, Value Education, HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health - Case Studies
24. **Disaster Management** - Natural Disasters - Meaning and nature of natural disasters, their types and effects - Floods, drought
25. Cyclone, earthquakes, Landslides, avalanches
26. Volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion
27. Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, Building fire, coal fire, forest fire, oil fire
28. Air pollution, water pollution, deforestation, industrial waste water pollution
29. Road accidents, rail accidents, Air accidents, sea accidents
30. Disaster Management - Effect to migrate natural disaster at national and global levels
31. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements
32. Role of NGOs, community - based organizations and media in disaster management
33. Central, state, district and local administration in disaster management
34. Armed forces in disaster response - Disaster response; Police and other organizations.

Practical schedule

1. Visit to a local area to document environmental assets river/forest/grassland/hill/mountain
2. Energy: Biogas production from organic wastes
3. Visit to wind mill / hydro power / solar power generation units
4. Biodiversity assessment in farming system
5. Floral and faunal diversity assessment in polluted and un polluted system
6. Visit to local polluted site-Urban/Rural/Industrial/Agricultural to study of common plants, insects and birds
7. Environmental sampling and preservation
8. Water quality analysis: pH, EC and TDS
9. Estimation of Acidity, Alkalinity
10. Estimation of water hardness
11. Estimation of DO and BOD in water samples
12. Estimation of COD in water samples
13. Enumeration of *E. coli* in water sample

14. Assessment of Suspended Particulate Matter (SPM)
15. Study of simple ecosystem – pond/river/hills
16. Visit to areas affected by natural disaster
17. **Practical Examination**

References

1. Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi
2. Tyler Miller and Scot Spoolman. 2009. Living in the Environment (*Concepts, Connections, and Solutions).* Brooks/cole, Cengage learning publication, Belmont, USA
3. P.D. Sharma, 2009, Ecology and Environment, Rastogi Publications, Meerat, India
4. De. A.K., 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN:13–978 81 224 2617 5. 384 pp

E-References

1. Dhar Chakrabarti. P.G., 2011. Disaster management - India's risk management policy frameworks and key challenges. Published by Centre for Social Markets (India), Bangalore. 36 pp.
2. Proceedings of 2nd India disaster management congress, New Delhi. Organized by National Institute of Disaster Management, New Delhi during 4 – 6, November 2009.

18 MAT 201 STATISTICAL METHODS 2(1+1)

SCOPE OF THE COURSE

Students will acquire knowledge in basis techniques that are applicable to agricultural sciences. Further the course will provide them good introduction to various statistical analysis used in biological sciences.

OBJECTIVE

To understand and apply fundamental concept of statistical applications in biology and to acquire about theoretical concept of descriptive statistics, testing of hypothesis, correlation, regression and basic design of experiments.

THEORY

Unit I: Descriptive Statistics

Introduction – Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode –Merits and demerits. Measures of dispersion: Range, Quartile deviation, Mean deviation, standard deviation, and coefficient of variation - Skewness and kurtosis – Merits and demerits.

Unit II: Sampling Theory and Probability Distributions

Sampling theory – population – sample – parameter and statistic – sampling distribution - sampling vs complete enumeration –Types of sampling - simple random sampling – selection using random numbers – Stratified - Systematic sampling.

Probability distributions – Discrete distributions: Bernoulli, Binomial and Poisson. Continuous distribution: Normal distribution – definitions and properties.

Unit III: Testing of hypothesis

Null and alternative hypothesis – types of errors - critical region and tests of significance. Large sample test – single mean and difference between two means – single proportion and difference between two proportions.

Small sample tests – F-test - t-test for testing the significance of single mean – independent and paired t test – chi square test for testing the association of r x c contingency table.

Unit IV: Correlation and Regression

Correlation – Scatter diagram - Karl Pearson‘s correlation coefficient – Spearman‘s rank correlation - computation and properties.

Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient.

Unit V: Analysis of Variance and Experimental Designs

Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD).

Text Books

1. Rangaswamy, R. 2009, A Text book of Agricultural Statistics, Wiley Eastern Limited, New Delhi.
2. Dhamu. K. P and K. Ramamoorthy. 2007. Statistical Methods. Agrobios (India), Jodhpur.

References

1. Gupta.S.C and V.K.Kapoor. 1977. Fundamentals of Applied Statistics. Sultan Chand & Sons, New Delhi.

2. Gupta S.P, Statistical Methods, 2004, Sultan Chand & Sons, New Delhi.

3. S.C. Gupta & V.K. Kapoor. 2003. Fundamentals of Mathematical Statistics. Sultan Chand & Sons, New Delhi.

4. Panse. V. G and P.V. Sukhatme. 1954. Statistical methods for agricultural workers. ICAR, New Delhi.

5. Dhamu. K. P and K. Ramamoorthy. 2009. Fundamentals of Agricultural Statistics. Scientific Publishers (India), Jodhpur.

6. Kailasam. G and R.Gangaiselvi. 2010. Applied Statistics. Kalyani Publishers. New Delhi.

Theory Schedule

1. Introduction – Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode –Merits and demerits. TBI 1-5, TBI 25 - 35
2. Measures of dispersion: Range, Quartile deviation, Mean deviation, standard deviation, and coefficient of variation - Skewness and kurtosis. TBII 41 – 48
3. Sampling theory – population – sample – parameter and statistic – sampling distribution - sampling vs complete enumeration –Types of sampling - simple random sampling – selection using random numbers Stratified - Systematic sampling. TBII 316 - 321
4. Probability distributions – Discrete distributions: Bernoulli TBI 55 - 57
5. Binomial and Poisson distribution TBI 58 - 61
6. Continuous distribution: Normal distribution TBI 55 - 57
7. Null and alternative hypothesis – types of errors - critical region and tests of significance. TBII.16-17
8. Large sample test – single mean and difference between two means. Single proportion and difference between two proportions. TBII 20-24
9. **Mid Semester Examination**
10. Small sample tests–F-test - t-test for testing the significance of single mean TBII 26- 28
11. Independent and paired t test TBII 29-38
12. Chi square test for testing the association of r x c contingency table. TBII 43-45
13. Correlation – Scatter diagram - Karl Pearson‘s correlation coefficient – Spearman‘s rank correlation - computation and properties. TBI 142 – 145
14. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient. 157 - 165
15. Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs. TBI 227 - 231
16. Completely Randomized Design (CRD) – Randomized Block Design (RBD). TBI 269 - 284
17. Latin Square Design (LSD). TBI 315 - 320

Practical schedule

1. Computation of arithmetic mean, geometric mean, harmonic mean, median and mode
2. Computation of range, standard deviation, variance, coefficient of variance
3. Selection of sample using simple random sampling method
4. Simple problems in Bernoulli distribution
5. Simple problems in Binomial distribution and Poisson distribution
6. Simple problems in Normal distribution
7. Large sample test – test for single proportion and difference between two proportions
8. Large sample test – test for single mean and difference between two means
9. Small samples test – t-test for single mean – t test for difference between two sample means (equal variances only)
10. Paired t-test
11. Chi square test
12. Computation of Karl Pearson‘s correlation coefficient
13. Fitting of simple linear regression equation y on x – correlation and regression using MS Excel functions
14. Analysis of Completely Randomised Design (CRD) – for equal replications only
15. Analysis of Randomised Block Design (RBD)
16. Analysis of Latin Square Design (LSD) – analysis of CRD, RBD and LSD
17. **Final Practical Examination**

Web resources

1. http://www.statistics.com/resources/glo.ssary/
2. www.statsoft.com
3. http://www.iasri.res.in/ebook/EB_SMAR/index.htm

4. www.stats.gla.ac.uk/steps/glossary/index.html
5. http://davidmlane.com/hyperstat/
6. http://www.stattrek.com/
7. http://www.businessbookmall.com/Statistics Internet Library.htm
8. http://www.stat-help.com/
9. www.statsci.org/jourlist.html

18 AMP 201 LIVESTOCK AND POULTRY MANAGEMENT 3(2+1)

Theory

Unit I: Introduction to Livestock Management

Significance of Livestock and Poultry in Indian Economy – Livestock and Poultry census – Different livestock development programs of Government of India and Tamil Nadu-Various systems of livestock production-extensive – semi intensive - intensive- mixed-Integrated and specialized farms.

Unit II: Dairy Cattle Management

Important White and Black cattle breeds-classification-indigenous and exotic – Breed characteristics – Breeding - Cross breeding- Upgrading - Economic traits of cattle –Culling - Estrus Cycle – Artificial Insemination – Introduction to Embryo transfer – Housing – Space requirement calf and adult stock – System and types of housing - Feeding and Management of Calf, Heifer, Pregnant, Milch animal and working animals – Nutrition – Ration – Balanced Ration - Characteristics of ration and classification of feed and fodder –Total Mixed Ration – composition of concentrate mixture for different stage - Milking methods - Clean milk production – Factors affecting milk composition – Common diseases of cattle – classification

– symptoms - preventing and control measures.

Unit III: Sheep and Goat Management

Breeds - Sheep and goat classification — Economic traits - system of rearing - Housing Management – Floor space requirement - Care and Management of young and adult stock – Nutrition – Feed and fodders of Small ruminants – Flushing - Common diseases – prevention and control.

Unit IV: Management of Swine

Classification of breeds – Economic traits - Housing - Nutrition – creep feeding - Care and Management of Adult and Young Stock - Common disease- prevention and control.

Unit V: Poultry Management

Classification of breeds - Commercial Strains of broilers and layers – Housing – brooding – deep litter and cage system – care and Management of broilers and layers - Nutrition of Chick, grower, Layer and broiler – Incubation and Hatching of Eggs - Common Diseases - Control and prevention.

Practical

Study of external parts of Livestock - Identification of livestock and poultry-Tattooing-ear tags-wing and leg bands-Common restraining methods-Disbudding (or) Dehorning-Different methods of castration- Dentition-Study of type design of animal and poultry houses-Selection of dairy cow and work bullock-Determination of specific gravity, fat percentage and total solids of milk- Demonstration of cream separation, - Identification of feeds and fodder- Economics Dairy, Goat and Swine farming - Study of external parts of Fowl - Preparation of Brooder House - Brooder management-Identification of layer and non layer- Debeaking, delousing and deworming of poultry-Vaccination schedule for broiler and layer-Dressing of broiler chicken - Economics of Broiler and Layer Farming - Visit to a modern Dairy and commercial layer and broiler farms - Demonstration of incubator and setter.

Lecture schedule

S.No.	Lecture Unit	Reference Book & Page No
1	Significance of livestock and poultry in Indian economy-livestock and poultry census. Different livestock development programmes of Government of India and Tamil Nadu	www.indiastat.com, Livestock census 2012, Dairying in Tamil Nadu 2014 by NDDB
	Various systems of livestock production-extensive – semi intensive, intensive- mixed- integrated and specialized farms.	357- 396 Handbook of Animal Husbandry - ICAR
	Definition of breed-classification of indigenous white and black cattle-breed characteristics of Tamil Nadu cattle breeds and Indian breeds -Sindhi, Gir and Sahiwal.	1-53- Handbook of Animal Husbandry - ICAR
	Breed-characteristics of exotic cattle -Jersey and Holstein Friesian – Indian Buffaloes- Murrah, Surti and Toda.	1-53- Handbook of Animal Husbandry - ICAR
	Breeding-cross breeding-upgrading-economic traits of cattle-culling importance and methods	1-53- Handbook of Animal Husbandry - ICAR
	Estrous cycle – signs of estrous - artificial insemination-merits and demerits-Principles and outline of embryo transfer	722-723 Handbook of Animal Husbandry - ICAR
	Housing management-farm site selection and floor space requirement for calves, heifer, milch animal and work bullocks.	364-379 Handbook of Animal Husbandry - ICAR
	Systems of housing-single row system-double row system- head to head and tail to tail-merits and demerits - Type design of house.	364-379 Handbook of Animal Husbandry - ICAR

	Care and management of new born calf and heifers	358-362 Handbook of Animal Husbandry - ICAR
0	Care and management of pregnant animal and lactating animals.	362-363 Handbook of Animal Husbandry - ICAR
1	Care and management of dry cows and work bullock.	756-757 Handbook of Animal Husbandry - ICAR
2	Nutrition-definition-ration-balanced ration-desirable characteristics of a ration. Classification of feed stuffs-concentrate and roughage-comparison, Total Mixed Ration	395-447 Handbook of Animal Husbandry - ICAR
3	Model composition of concentrate mixture of young and adult stock-age wise feed and fodder requirement-Importance of green fodder.	395-447 - Handbook of Animal Husbandry - ICAR
4	Milking methods-clean milk production-factors affecting milk yield and composition	363 Handbook of Animal Husbandry – ICAR
5	Diseases-classification-viral, bacterial and metabolic-general control and preventive measures.	448-551 Handbook of Animal Husbandry - ICAR
6	Viral diseases-foot and mouth disease, bacterial diseases, anthrax, hemorrhagic septicemia- black quarter - metabolic- tympanites, acidosis, ketosis and milk fever	448-551 Handbook of Animal Husbandry - ICAR
7	**Mid semester examination**	
8	Sheep and goat farming-classification of breeds of Indian and exotic origin – economic traits.	54-120 Handbook of Animal Husbandry - ICAR
9	Systems of rearing-housing management - type design-floor diagram-space requirement for adult and young stock.	101 Handbook of Animal Husbandry - ICAR
0	Care and management of ram, ewe and lamb-nutrition-feeds and fodder for small ruminants.	99-101 Handbook of Animal Husbandry - ICAR
1	Care and management of buck, doe and kid- nutrition-flushing.	102 Handbook of Animal Husbandry - ICAR
2	Common ailments of sheep and goat-sheep pox-foot and mouth-blue tongue- PPR- enterotoxaemia- Ecto and endo parasites.	448-551 Handbook of Animal Husbandry - ICAR
3	Swine husbandry –Common breeds of exotic origin-Large White Yorkshire, Landrace and Duroc -economic traits- housing of Swine.	256-271Handbook of Animal Husbandry - ICAR
4	Care and management of sow, boar and piglets-nutrition-creep feeding.	256-271Handbook of Animal Husbandry - ICAR
5	Disease prevention and control of swine diseases –hog cholera, foot and mouth, ecto and endo parasites.	448-551 Handbook of Animal Husbandry - ICAR
6	Classification of breeds - commercial strains of layer and	206-255 Handbook of Animal

	broiler.	Husbandry - ICAR
7	Care and management of Chicks-brooder management.	206-255 Handbook of Animal Husbandry - ICAR
8	Systems of housing- deep litter and cage system- floor space requirement-common litter material-litter management-merits and demerits.	206-255 Handbook of Animal Husbandry - ICAR
9	Care and management of Grower and Layers-vaccination schedule.	206-255 Handbook of Animal Husbandry - ICAR
0	Care and management of broilers-vaccination schedule.	206-255 Handbook of Animal Husbandry - ICAR
1	Incubation and hatching of eggs.	206-255 Handbook of Animal Husbandry - ICAR
2	Nutrition-feed formulation-composition of chick, grower, layer broiler- starter and Finisher mashes-Feed Conversion Ratio/dozen egg or / kg of meat production.	206-255 Handbook of Animal Husbandry - ICAR
3	Classification of disease –viral – bacterial - protozoan-causative organisms, symptoms and prevention – viral diseases- Ranikhet – IBD-avian flu	448-551 Handbook of Animal Husbandry - ICAR
4	Bacterial disease-E.coli-coryza-salmonellosis-protozoan–coccidiosis-casuative organism, symptoms and preventive measures. Management of dead birds and manure	448-551 Handbook of Animal Husbandry - ICAR

Practical:

1. Study of external parts of livestock
2. Identification of livestock and poultry
3. Common restraining methods of livestock
4. Disbudding, Dehorning, Castration and Dentition of livestock
5. Study of type design of animal and poultry houses
6. Selection of dairy cow and work bullock
7. Determination of specific gravity, fat %, total solids, solids not fat
8. Demonstration of cream separation
9. Identification of feed &fodder

10. Economics of dairy, goat and swine Farming

11. Study of external parts of fowl. Preparation of brooder house

12. Identification of layer and non- layer

13. Debeaking, delousing, deworming of poultry Vaccination schedule for broiler and layer

14. Demonstration of dressing of broiler. Economics of layer and broiler farming

15. Visit to a modern dairy and commercial layer and broiler farms

16. Demonstration of incubator and setter

17. **Practical examination**

Reference books:

ICAR (2002) Hand of Animal Husbandry, ICAR, New Delhi.

E- reference:

http://www.elearnvet.net/
http://agridr.in/expert_system/cattlebuffalo/Breeding%20management%20of%20cattle%20and%20buffaloes-2.html

18 AGR 203 FARMING SYSTEMS AND SUSTAINABLE AGRICULTURE 1(1+0)

Course 0utlines

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.

Lecture outlines

Theory

1. Farming System – introduction – scope of farming system – importance – concept – principles of farming system.
2. Types of farming systems – advantages and limitations - suitability – factors affecting the farming system
3. Farming systems – system and systems approach - determinants of farming system – cropping systems(navadhanya concept) and related terminology
4. Allied enterprises – significance of integrating crop and livestock enterprises – components and maintenance- dairying and sheep and goat rearing – breeds – housing– feed and fodder requirements – biogas plant
5. Allied enterprises – poultry farming – breeds – housing –feed and fodder requirements – apiculture – species and management
6. Allied enterprises – sericulture – moriculture and silkworm rearing – agro-forestry systems suitable for dryland farming
7. Tools for determining production and efficiencies in different farming and cropping systems.
8. Adverse effects of modern agriculture - sustainable agriculture –definition –concept – goals – elements.
9. Problems related to soil, water and environment - adaptation and mitigation strategies - indicators of sustainability.
10. Conservation agriculture – concept – need - management of natural resources - land, water and vegetation.
11. Techniques for sustainability - Low External Input Agriculture (LEIA)and Low External Inputs for Sustainable Agriculture (LEISA) and HEIA (High External Input Agriculture).
12. Integrated farming system-historical background, objectives and characteristicsadvantages,
13. Site specific development of IFS models for different agro climatic zones of India and A.P.

14. Resource use efficiency – optimization of resource use by different methods in an IFS(Annapurna model)
15. Resource cycling - flow of energy in different farming systems.
16. Visit of IFS model in different agro-climatic zones of nearby states University/ institutes and farmers field

References

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

IV Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 AGR 204	Crop Production Technology - II (Rabi Crops)	2(1+1)
2	18 AGR 205	Irrigation Water Management	2(1+1)
3	18 AEC 202	Agricultural Marketing Trade & Prices	3(2+1)
4	18 AEX 201	Communication Skills and Personality Development	2(1+1)
5	18 ERG 211	Renewable Energy and Green Technology	2(1+1)
6	18 HOR 202	Production Technology for Fruit and Plantation Crops	2(1+1)
7	18 PAT 201	Principles of Integrated Pest and Disease Management	2(1+1)
8	18 SAC 201	Problematic Soils and their Management	2(1+1)
9	18 SST 201	Principles of Seed Technology	3(2+1)
10	18 OPT 201	Elective Course	3(2+1)
Total			**23(13+10)**

18 AGR 204 Crop Production Technology – II (Rabi Crops) 2(1+1)

Theory:

Unit - I: Sugar Crops

Sugarcane and Sugarbeet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Unit - II: Fibre Crops

Cotton, Jute and Mesta - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Unit - III: Forage Crops

Sorghum, Maize, Pearlmillet, Guinea grass, Cumbu - Napier, Water grass, Buffalo grass, Elephant grass, Kolukkattai grass, Lucerne, Berseem, Desmanthus, Stylosanthus and Cowpea - Economic importance, soil and climatic requirement, varieties, cultural practices and yield.

Unit - IV: Green Manure Crops

Daincha, Sunhemp *S.rostrata,* Glyricidia, Kolingi - Origin, geographic distribution, economic importance, soil and climatic requirement, Varieties, cultural practices, yield.

Unit V: Narcotics

Tobacco, Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices.

Practical:

Identification of sugar, fibre, forage and narcotics - nursery preparation and management for sugarcane and tobacco - main field preparation; Seed treatment techniques - Sowing and manuring - Seeding equipment‘s - Estimation of population - After cultivation practices - Study of growth and yield parameters and yield estimation, harvesting of above crops; Fodder preservation techniques - Silage and hay making, Cost and returns - Visit to institutes and industries - Farmers‘ fields.

Theory - Lecture Schedule:

1. Sugar crops - Sugarcane - Origin, geographical distribution, economic importance, soil and climatic requirements - varieties, cultural practices and yield.

2. Sugarcane - Crop logging, maturity and ripening sugar and gur manufacture - Value

addition and byproduct utilization.

3. Sugarbeet - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield and by product utilization.

4. Fibre crops - Cotton - Origin, geographical distribution, economic importance, soil and climatic requirements, cultural practices, yield and quality parameters.

5. Rainfed Cotton, Rice fallow Cotton and transgenic cotton.

6. Jute - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.

7. Mesta - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.

8. **Mid-semester Examination.**

9. Sunhemp - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.

10. Forage crops - Cumbu Napier Hybrid grass and Guniea grass: Economic importance, soil and climatic requirement, varieties, cultural practices and yield.

11. Forage crops - Sorghum, Maize, Oats and Cowpea: Economic importance, soil and climatic requirement, varieties, cultural practices and yield.

12. Forage crops - Cenchrus, Lucerne, Hedge lucerne: Economic importance, soil and climatic requirement, varieties, cultural practices and yield.

13. Berseem and Desmodium Economic importance, soil and climatic requirement, varieties, cultural practices and yield.

14. Silage and hay making - green manure and green leaf manure crops.

15. Sesbania sp., Kolingi and Glyricidia - economic importance, soil and climatic requirement, varieties, cultural practices and yield.

16. Narcotics - Tobacco - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices - yield, curing methods.

17. Sugarcane and Cotton based cropping systems in India and Tamil Nadu.

Practical Schedule:

1. Identification of sugar crops, fibre, forage, green manure and narcotics in the crop cafeteria.

2. Nursery preparation and management for Sugarcane and Tobacco.

3. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations.

4. Acquiring skill in different seed treatment techniques and foliar nutrition of crops.

5. Estimation of plant population per unit area for crops.

6. Acquiring skill in after - cultivation practices in sugarcane - detrashing, Cotton –

   Earthing up, Tobacco - topping.

7. Study on growth parameters of sugar, fibre, forage crops, Greenmanures and narcotics.

8. Study on yield parameters and estimation of yield in sugar / fibre.

9. Study on yield parameters and estimation of yield in forage and narcotics.

10. Cost and returns of important sugar, fibre forage and narcotics.

11. Visit to Sugarcane Breeding Institute/ Research Station to study cultivation of sugarcane and its by products.

12. Visit to - nearby sugar mill, for observing juice extraction, quality assessment, sugar manufacture and by products.

13. Visit to - Cotton Research Station, nearby ginning factory and Tobacco curing centre.

14. Visit to Dairy Unit / farmers field to acquire skill in hay, silo and silage making.Visit to farmers field to study sugarcane and cotton based cropping systems.

15. On / Off Farm visit to study forage crops and green manures.
16. Practical examination

References:

Rajendra Prasad. 2012. Text Book on Field Crop Production, Indian Council of Agrl.

Research, New Delhi.

Ahlawat,I.P.S., Om Prakash and G.S. Saini. 2010. Scientific Crop Production in India. Rama publishing House, Meerut

Chidda Singh, Prem Singh and Rajbir Singh. 2011. Modern Techniques of Raising Field Crops. Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.

E.References:

http://sugarcane.tn.nic.in
http://fibre.tn.nic.in
www.tnau.ac.in/agriportal

18 ERG 201 RENEWABLE ENERGY AND GREEN TECHNOLOGY 2(1+1)

Course outlines

Theory

Classification of energy sources - Contribution of non-conventional energy sources in agricultural sector - Familiarization with biomass utilization for biofuel production and its application - Familiarization with types of biogas plants and gasifiers – Biogas - Bio-alcohol - Biodiesel and bio oil production and their utilization as bioenergy resource - Introduction of solar energy - Collection and its 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 its application - Introduction of wind energy and their application.

Practical

Familiarization with renewable energy gadgets - To study biogas plants - 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.

Lecture outlines

Theory

1. Introduction - Renewable energy sources, classification, advantages and disadvantages.
2. Biomass - Importance of biomass, classification of energy production – Principles of combustion, pyrolysis and gasification.
3. Biogas - Principles of biogas production, advantages, disadvantages, utilization.
4. Biogas plants - Classification, types of biogas plants, constructional details of biogas plants.
5. Types of gasifiers - Producer gas and its utilization.
6. Briquettes, briquetting machinery – Types and uses of briquettes - Shredders.
7. Solar energy – Application of solar energy, methods of heat transfer, conduction, convection and radiation.
8. Solar appliances - Flat plate collectors, focusing type collectors, solar air heater.
9. Solar space heating and cooling - Solar energy gadgets, solar cookers, solar water heating systems.
10. Solar grain dryers, solar refrigeration system, solar ponds.
11. Solar photovoltaic system - Solar lantern, solar street lights, solar fencing, solar water pumping system.
12. Wind energy - Advantages, disadvantages, wind mills and types.
13. Constructional details of wind mills, applications of wind mills.
14. Biofuels – Characteristics of various biofuels, different parameters and calorific values.
15. Bio diesel production – Applications, extraction from jatropha.
16. Ethanol from agricultural produce (sugarcane and corn).

Practical

1. Availability and uses of non - conventional energy in agricultural sector.
2. Bio-fuel production from biomass and its application.
3. Practical approach to biogas production and biogas plants capacity and design calculations.
4. Running gasifies and production details of producer gas.
5. Production details of briquettes from briquetting machine.
6&7. Experimenting with solar gadgets like solar-cooler and solar water heater for their performance.
8. Performance of solar photovoltaic system and observing various factors influencing efficiency of the photo-voltaic system.
9. Evaluation of solar pump for agriculture.
10. Study of solar drying system.
11. Study of solar distillation and solar pond.
12. Steps adopted for erecting solar fence.
13&14. Visit to solar wind farm.
15&16. Visit to solar photovoltaic farm.

References

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

18 SAC 201 PROBLEMATIC SOILS AND THEIR MANAGEMENT 2(1+1)

Course outlines

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. Bio remediation through multipurpose tree species of soils, land capability and classification, land suitability classification. Problematic soils under different Agroeco systems.

Practical

Field identification of problem soils. Determination of soil pH, EC, gypsum requirement of alkali soils, lime requirement of acid soils, calcium carbonate content in soils. Water quality assessment (pH, EC, alkalinity, chlorides, SAR, RSC).

Lecture outlines

Theory

1. Problem soils –Definition – Different types of problematic soils – Extent and distribution of problematic and wastelands soils in different agro-eco systems and in Andhra Pradesh.
2. Salt affected soils – Origin and formation - Distribution of salt affected soils in India and Andhra Pradesh - sCharacteristic features of saline, sodic and saline – sodic soils – Diagnostic criteria based on properties.
3. Saline soils – Visual symptoms for identification of saline soils – Build up of salinity - Effect of salinity on plant growth and nutrient availability - Reclamation and management.
4. Sodic soils - Visual symptoms for identification of sodic soils - Effect of sodicity on plant growth and nutrient availability - Reclamation and management.
5. Acid soils – Extent of area in India and Andhra Pradesh – Formation – Characteristics of acid soils – Sources of soil acidity – nutrient limitations and toxicity – Reclamation of acid soils - Different liming materials used for reclamation – Benefits of liming – Harmful effects of over liming.
6. Acid sulphate soils – Origin – Types – Characterization - Constraints and management.
7. Land degradation - Eroded, compacted, flooded and water logged soils – Biologically sick soils – Effects on plant growth – Management.
8. Polluted soils – Definition – Sources of pollution – Bio solid wastes –Industrial effluents (distillery, paper mill, tannery, textiles industrial effluents) – Mechanism of interaction of wastes with soil.
9. Soil pollution - Potentially toxic elements - Excessive use of fertilizers, pesticides and weedicides – Heavy metal contamination – Management.
10. Bio-remediation of problem soils through Multi Purpose Tree Species.
11. Taxonomic classification of soils - Land Capability Classification.

12. Land suitability classification - Index – Criteria - Different approaches – Land suitability for different crops.
13. Remote Sensing and GIS techniques in diagnosis, mapping and management of degraded and problematic soils.
14. Soil health and quality – Definition - Concepts – Soil resilience – Factors affecting soil quality (Physical, chemical and biological) – Assessment of soil quality - Management and improvement of soil quality.
15. Irrigation water – Quality and standard parameters - Classification based on ICAR, CSSRI and USDA criteria.
16. Guidelines for judging quality of water - Utilzation of saline water in agriculture.

Practicals

1. Field identification of problematic soils and visit to degraded lands.
2. Determination of infiltration rates of light soils.
3. Determination of infiltration rates of heavy soils.
4. Determination of aggregate stability of sodic soils.
5. Determination of pH, ECe of acid, saline and sodic soils.
6. Determination of ESP of sodic soils.
7. Determination of GR of sodic soils.
8. Determination of LR of acid soils.
9. Determination of lime content ($CaCO_3$) of cacarious soil.
10. Determination of pH and EC of saline, sodic and good quality irrigation water.
11. Determination of CO_3, and HCO_3 in irrigation water.
12. Determination of chlorides in irrigation water.
13. Determination of Ca and Mg content in irrigation water.
14. Determination of Na and K content in irrigation water.
15. Computation of quality class, RSC and SAR of irrigation water.
16. Evaluation and interpretation of analytical data of problematic soils and suggesting ameliorating practices.

References

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

18 HOR 202 PRODUCTION TECHNOLOGY OF FRUITS AND PLANTATION CROPS 2 (1+1)

Course outlines

Theory

Importance and scope of fruit and plantation crop industry in India; Production technologies for the cultivation of major fruits-Mango, Banana, Citrus, Grape, Guava & Litchi, Papaya, Apple, Pear, Peach , Minor fruits- Pineapple, Pomegranate, Jackfruit, Strawberry, Nut crops (Almond & Walnut), Plantation crops-Coconut, Areca nut, Cashew, Tea, Coffee & Rubber.

Practical

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

Lecture outlines

Theory

1. Importance and scope of fruit crops - High density planting - Canopy management - Use of rootstocks in fruit crops.

2. Production technologies of Mango - Botanical name - Family – Origin – Introduction - Varieties – Climate – Soil- Propagation - Planting - Manuring- Irrigation – Inter Cultivation – Harvesting – Yield – Pests - Stem borer - Nut weevil -Fruit fly - Leaf webber - Diseases - Powdery mildew - Anthracnose - Sooty mould - Mango malformation - Physiological disorders- Fruit drop-Alternate bearing- Spongy tissue.

3. Production technology of Banana - Botanical name- Family – Origin - Importance- Varieties – Climate – Soil - Propagation- Planting – Manuring - Irrigation – Inter Cultivation practices – Harvesting – Yield – Pests - Rhizome weevil - Pseudo Stem weevil- diseases - Sigatoka leaf spot - Panama wilt - Rhizome rot - Bunchy top.

4. Production technology of Citrus - Botanical name – Family - Origin- Introduction - Varieties – Climate – Soil - Propagation - Planting - Manuring - Irrigation – Inter Cultivation – Harvesting – Yield – Pests -Butter fly - Fruit sucking moth – Citrus leaf miner - Diseases – Gummosis – Canker - Tristeza - Physiological disorders - Fruit drop – Granulation.

5. Production technology of Grape- Botanical name- Family- Origin- Introduction - Varieties – Climate – Soil - Propagation- Planting- Manuring- Irrigation – Inter Cultivation – Harvesting – Yield – Pests-Flea beetles – Mealy bug - Stem girdler Diseases- Powdery mildew - Downy Mildew – Anthracnose – Physiological disorders- Pink berries.

6. Production technology of Guava and Litchi - Botanical name- Family- Origin- Introduction - Varieties – Climate – Soil- Propagation - Planting- Manuring- Irrigation – Inter Cultivation – Harvesting – Yield – Pests of Guava - Tea mosquito bug - Mealybug - Diseases of Guava – Wilt.

7. Production technology of Papaya - Botanical name - Family- Origin- Introduction- Varieties – Climate – Soil – Propagation – Planting – Manuring - Irrigation – Inter Cultivation – Harvesting – Yield – Pests - Nematode**s** - diseases - Powdery mildew - Foot rot – Mosaic.

8. Production technology of Apple, Pear, Peach - Botanical name – Family – Origin – Importance – Varieties – Climate – Soil – Propagation - Planting- Manuring- Irrigation – Inter Cultivation – Harvesting – Yield – Pests of Apple - Wooly aphid, Codling moth - Pests of Peach - Fruit Fly - Diseases of Apple- Scab – Powdery mildew- Physiological disorder in apple - Bitterpit - Diseases of Pear- Fruit spot - Diseases of Peach- Leaf curl.

9. Production technology of Minor fruits- Pineapple, Pomegranate - Botanical name- Family- Origin- Importance- Varieties – Climate – Soil- Propagation- Planting- Manuring- Irrigation – Inter cultivation – Harvesting – Yield - Pests of pineapple- Mealy bug -Pests of pomegranate- Butterfly -Fruit sucking moth - Diseases of pineapple - Leaf and fruit rot - Diseases of pomegranate - Anthracnose and bacterial leaf spot - Physiological disorders of pomegranate - Fruit cracking.

10. Production technology of Jackfruit, Strawberry, Nut crops (Almond & Walnut) - Botanical name- Family- Origin- Importance- Varieties – Climate – Soil- Propagation- Planting- Manuring- Irrigation – Inter cultivation – Harvesting – Yield – Pests of Jackfruit - Spittle bug - Fruit borer – Diseases of Jackfruit - Rhizopus rot - Die back.

11. Plantation crops- Scope and Importance - Coconut – Botanical name- Family- Origin- Importance- Varieties – Climate – Soil- Propagation- Planting- Manuring- Irrigation – Inter cultivation – Harvesting – Yield – Processing – Pests of Coconut - Black headed caterpillar - Rhinoceros beetle - Red palm weevil diseases of Coconut – Ganoderma - Tatipaka - Drey blight.

12. Production technology of Arecanut - Botanical name- Family- Origin- Importance- Varieties – Climate – Soil- Propagation- Planting- Manuring- Irrigation – Inter cultivation – harvesting – Yield – Processing - Pests of Arecanut - Mite – Spindle bug Diseases of Arecanut - Mahali (Fruit rot)- Foot rot.

13. Production technology of Cashew - Botanical name- Family- Origin- Importance- Varieties – Climate – Soil- Propagation- Planting- Manuring- Irrigation – Inter cultivation – Harvesting – Yield – Processing - Pests of Cashewnut - Stem borer - Tea mosquito bug - Diseases of Cashewnut - Die back or Pink disease – Anthracnose.

14. Production technology of Tea - Botanical name- Family- Origin- Importance- Varieties – Climate – Soil- Propagation- Planting- Manuring- Irrigation – Inter cultivation – Harvesting – Yield - Processing- Pests of Tea - Tea mosquito bug- Red spider mite - Diseases of Tea - Algal leaf spot- Blister blight.

15. Production technology of Coffee - Botanical name- Family- Origin- Importance- Varieties – Climate – Soil- Propagation- Planting- Manuring- Irrigation – Inter cultivation – Harvesting – Yield - Processing- Pests of Coffee -White borer – Red borer and Green scales – Diseases of Coffee - Rust- Die back -Berry blotch.

16. Production technology of Rubber - Botanical name- Family- Origin- Importance- Varieties – Climate – Soil- Propagation- Planting- Manuring- Irrigation – Inter cultivation – Harvesting – Yield - Processing- Pests of Rubber - Scale insect - Mealy bug and mite - Diseases of Rubber - Birds eye spot - Pink disease.

Practical

1. Seed propagation-Scarification and stratification of seeds.
2. Propagation methods for fruit crops.
3. Propagation methods for plantation crops.
4. Micro-propagation.

5. Description and identification of fruit crops.
6. Preparation of plant bio regulators and their uses.
7. Pests and diseases of Mango, Banana, Citrus.
8. Pests and diseases of Grape, Papaya, guava.
9. Pests and diseases of Apple, Pear, Peach.
10. Pests and diseases of Pineapple, Pomegranate, Jackfruit.
11. Pests and diseases of Coconut, Arecanut.
12. Pests and diseases of Cashew, Rubber.
13. Pests and diseases of Coffee and Tea.
14. Physiological disorders of fruit crops – Mango, Citrus, Grape.
15. Physiological disorders of the plantation crops.
16. Visit to commercial plantations/ fruit orchards.

References

1. Bose, T.K. and Mitra, S.K. 1990. *Fruits – Tropical and Sub-tropical*. Naya Prakashan, Calcutta.
2. Chattopadhya, P. K. Year.*Text Book on Pomology (Fundamentals of Fruit Growing)*. Kalyani Publishers, Ludhiana.
3. Bijendra Singh. 2012. *Horticulture at a Glance*. Kalyani Publishers, Ludhiana
4. Parthasarathy, V. A., P.K.Chattopadhyay and Bose, T.K. 2006. *Plantation Crops*. Vol I and II. Parthasankar basu Naya Udyog, Kolkata.
5. Kumar, N., Abdul Khader, J.B.M, Rangaswamy, P. and Irulappan, I. 2004. *Introduction to Spices, Plantation crops, Medicinal and Aromatic Crops.* Oxford and IBH publishing Co, New Delhi.

18 SST 201 Principles of Seed Technology 3(2+1)

Theory

Unit I – Seed: Importance and biology

Seed and seed technology: definition -importance -Characters of good quality seed -Seed development and maturation - Germination - phases of seed germination - Dormancy - types of seed dormancy - Different classes of seed - generation system of seed multiplication in supply chain - Seed replacement rate and varietal replacement - Seed Multiplication Ratio -Seed renewal period. Varietal deterioration of crops - causes and maintenance.

Unit II – Seed Production

Principles of seed production- Foundation and certified seed production of varieties and hybrids - Cereals - rice, maize, sorghum and bajra - Pulses - greengram, blackgram and redgram - Oilseeds - groundnut, sesame, sunflower and castor - Cotton, Forage crops - Cenchrus sp and lucerne - Vegetables - tomato, brinjal, chillies, bhendi, onion and gourds - bittergourd, ashgourd, snakegourd, ribbedgourd, bottlegourd and pumpkin. Principles of GM crop and organic seed production.

Unit III – Post harvest handling of seeds

Post harvest handling of seeds - threshing methods - drying - methods of seed drying - Seed processing - seed cleaning and grading - Processing equipments -cleaner cum grader - Upgrading equipments - specific gravity separator, colour sorter, indented cylinder separator, spiral separator, magnetic separator, needle separator - working principles - Seed quality enhancement techniques - importance - seed fortification, seed priming, seed coating, seed pelleting.

Unit IV – Seed Quality Control and Seed Testing

Seed certification - phases of certification, procedure for seed certification, field inspection, field counts, field and seed standards. Post harvest inspection - processing, bagging and tagging. Seed Act and Rules - Seed law enforcement. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983 - Salient features of PPV&FRA 2001 - National Seed Policy 2002 - Seed Bill 2004. Seed testing for quality assessment - importance - Varietal identification through grow out test, molecular and biochemical test. Detection of genetically modified crops.

Unit V - Seed Storage and marketing

Seed storage – principles- factors affecting seed longevity during storage – Seed treatments and packaging materials - measures for pest and disease control during storage and godown sanitation. Seed marketing - structure and organization - sales promotional activities. factors affecting seed marketing and demand - International seed movement - role of international organizations, WTO and OECD in seed trade.

Practical

Study on seed structure of major cereals - rice, wheat, maize, sorghum and bajra - Pulses - greengram, blackgram, redgram, bengalgram and field pea - Oilseeds - groundnut, sesame, sunflower, castor, soybean and mustard - Cotton - Forage crops - Vegetable crops. Seed production techniques - identification of physical and genetic contaminants - supplementary pollination in hybrid rice - detasselling techniques in hybrid maize - emasculation and dusting technique in cotton - supplementary pollination in sunflower - pre-germinative technique and enhancing female flowers in cucurbits - assessment of physiological maturity indices - seed extraction methods in vegetables. Visit to seed production farms - Seed enhancement techniques - seed coating, seed priming and seed pelleting. Visit to seed processing plant. Seed certification - field inspection and counting procedure - Seed sampling and testing - seed moisture content, physical purity, seed germination, viability - Seed and seedling vigour test - Seed health test- Genetic purity test -grow out test and electrophoresis - Seed production planning - economics - Visit to seed testing laboratory.

Theory lecture schedule:

1. Seed and seed technology - definition -importance -Characters of good quality seed.
2. Seed development and maturation.
3. Germination - phases of seed germination - Dormancy - types of seed dormancy.
4. Different classes of seed - generation system of seed multiplication in supply chain - Seed replacement rate and varietal replacement - Seed Multiplication Ratio -Seed renewal period.
5. Varietal deterioration of crops - causes and maintenance.
6. Principles of seed production - factors affecting seed production - physical and genetic contaminants.
7. Seed production techniques in varieties and hybrids of rice.
8. Seed production techniques in varieties and hybrids of maize.
9. Seed production techniques in varieties and hybrids of sorghum and bajra.
10. Seed production techniques in greengram and blackgram varieties.
11. Seed production techniques in varieties and hybrids of redgram.
12. Seed production techniques in varieties and hybrids of sunflower and groundnut varieties.
13. Seed production techniques in varieties and hybrids of castor and sesame varieties.
14. Seed production techniques in varieties and hybrids of cotton.
15. Seed production techniques in Cenchrus species and lucerne.
16. Seed production techniques in varieties and hybrids of tomato, brinjal and chillies.
17. Seed production techniques in varieties and hybrids of bhendi and onion.
18. **Mid semester examination.**
19. Seed production techniques in varieties and hybrids of gourds - bittergourd, ashgourd, snakegourd, ribbedgourd, bottlegourd and pumpkin.
20. Principles of GM crop and organic seed production.

21. Post harvest handling of seeds - threshing methods - drying - methods of seed drying.
22. Seed processing - principle - importance - seed processing sequence for different crops - equipments.
23. Principles and mechanism of seed cleaning and grading - processing equipments - cleaner cum grader - specific gravity separator.
24. Principles and mechanism of upgrading equipments - colour sorter - indented cylinder separator - spiral separator - magnetic separator - needle separator
25. Seed quality enhancement techniques - importance - seed fortification - seed priming - seed coating - seed pelleting.
26. Seed certification - phases of certification, procedure for seed certification, field inspection, field counts, field and seed standards - post harvest inspection - processing - bagging and tagging.
27. Seed Act and Rules - Seed law enforcement - Duties and powers of seed inspector - offences and penalties - Seeds Control Order 1983.
28. Salient features of PPV&FRA, 2001 - National Seed Policy, 2002 - Seed Bill, 2004.
29. Seed testing for quality assessment - importance - methods.
30. Varietal Identification - grow out test - molecular and biochemical test - Detection of genetically modified crops.
31. Seed storage - principles - factors affecting seed longevity during storage.
32. Seed treatment and packaging materials - measures for pest and disease control during storage and godown sanitation.
33. Seed marketing - structure and organization - sales promotional activities - factors affecting seed marketing and demand.
34. International seed movement - role of international organizations - WTO and OECD in seed trade.

Practical schedule:

1. Study on external and internal seed structure and identification of major cereals - pulses - oilseeds - cotton - forage crops and vegetable crops.
2. Practicing supplementary pollination techniques in hybrid rice and detasselling techniques in hybrid maize.
3. Practicing emasculation and dusting technique in cotton and supplementary pollination in sunflower.
4. Practicing pre-germinative technique and female flowers production enhancement techniques in cucurbits.
5. Assessment of physiological maturity indices in various crops and seed extraction methods in vegetables.
6. Visit to seed production farms.

7. Seed enhancement techniques - Seed coating - seed priming and seed pelleting.
8. Seed certification - field inspection and counting procedure - identification of physical and genetic contaminants in seed production plots and roguing.
9. Seed testing - seed sampling - mixing - dividing - equipments.
10. Estimation of seed moisture content and physical purity.
11. Seed germination testing - tetrazolium test for viability - evaluation.
12. Genetic purity test - grow out test - electrophoresis.
13. Seed health testing - methods.
14. Seed and seedling vigour test - brick gravel test, paper piercing test - cool and cold test - accelerated ageing test.
15. Seed production planning - economics.
16. Visit to seed processing plant and seed testing laboratory.
17. **Final practical examination.**

References

1. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.
2. Bhaskaran, M., A.Bharathi and K.Vanangamudi. 2013. Text Book on Principles of seed production and quality control. Kalyani Publishers, New Delhi.
3. Indian Minimum Seed Certification Standards. 2014. Published by GOI, MOA, New Delhi.
4. Seed legislations. 2014. Published by GOI, MOA, New Delhi.

E-References

1. www.fao.org
2. www.seednet.gov.in
3. www.agricoop.nic.in
4. www.online library.willey.com
5. www.sciencedirect.com
6. Seed Science Research (www.jgateplus.com)
7. Seed Science and Technology **(**www.jgateplus.com**)**

18 AEC 202 AGRICULTURAL MARKETING, TRADE AND PRICES 3 (2+1)

Course outlines

Theory

Agricultural Marketing: concepts and definitions of market, marketing, agricultural marketing, market structure, 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 agricommodities. Marketing process and functions: Marketing process-concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transportation 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 and their meaning. Marketing channel-definition and meaning, marketing channels for different farm products and farm inputs.

Marketing mix and Market segmentation. 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; Market 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. agencies in agricultural marketing: Public sector institutions- CWC, SWC, FCI, & DMI – their objectives and functions; cooperative marketing in India- NAFED, MARKFED**.**

Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; Risk in marketing: Types of risk in marketing; speculation & hedging; An overview of futures trading in agricultural commodities and role of commodity exchanges. Role of regulatory bodies in futures markets- SEBI, etc

Trade: Concept of International Trade and its importance in globalised world economies, theories of absolute and comparative advantage. Present status and prospects of Indian agri-commodities trade in international trade. WTO: its genesis, objectives, functions and principles of multilateral trade, WTO agreements- Agreement on Agriculture (AoA) and its implications on Indian agriculture; TRIPS and Intellectual property rights and their implications to Indian agriculture.

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 –, SWC, CWC, FCI, cooperative marketing society —DCMS, etc. to study their objectives, role, organization and

functioning; Application of principles of comparative advantage of international trade. Seminar on selected topics

Lecture outlines

Theory

1. Agricultural Marketing - Concepts and definitions of market, marketing, agricultural marketing - Components of market, dynamics of market structure.
2. Classification and characteristics of each type of agricultural markets.
3. Demand and supply of agri-commodities, factors affecting the demand and supply of farm products, producers surplus - Meaning and types and producer's surplus of agri-commodities in India.
4. Meaning of marketable surplus and marketed surplus, importance and their measurement. marketable surplus and marketed surplus of agri-commodities in india, factors affecting them.
5. Marketing process and functions - Marketing process - Concentration, dispersion and equalization - Thompsons classification.
6. Exchange functions – Buying and selling, methods - Physical functions – Storage, transportation and processing.
7. Facilitating functions – Packing and packaging, branding, grading, standardization, FAQs for major crop produce, quality control and labeling - AGMARK, HACCP, FSSAI, CODEX - Need for codex certification and relevance.
8. Market functionaries - Types and importance of agencies involved in agricultural marketing and their role - Producers, middlemen (merchant middlemen, agent middlemen, speculative middlemen, processors, facilitative middlemen).
9. Meaning and definition of marketing channels and supply chain management and their importance.
10. Marketing mix - Meaning, 4Ps of marketing - Product, price, place and promotion - Their importance and characteristics in agriculture.
11. Meaning and stages in PLC (Product Life Cycle) - Characteristics of PLC – Strategies in different stages of PLC.
12. Pricing and promotion strategies - Pricing considerations and approaches – Cost based and competition based pricing.
13. Market promotion – Advertising, personal selling, sales promotion and publicity – Their meaning and merits and demerits.
14. Market segmentation-Meaning and its importance, types of market segmentation and benefits.
15. Market Integration - Meaning, definition - Marketing efficiency - Meaning, definition, measurement of marketing efficiency - Types of market integration and marketing efficiency.
16&17. Marketing costs, margins and price spread - Meaning and measurement, factors affecting cost of marketing - Reasons for higher marketing costs of farm commodities - Ways of reducing marketing costs.
18. Regulated markets-Definition - Important features of regulated markets - Functions, progress and defects.
19. Model regulated market act, objectives and features - APMC Act in Andhra Pradesh - Objectives and features and functions

20. Govt. interventions in agricultural marketing, their need, importance, and role - Important market acts - Public sector institutions - CWC, SWC, FCI, & DMI – Objectives and functions.
21. Cooperative marketing - Meaning and its need and importance, cooperative marketing agencies in India - NAFED, MARKFED – Objectives and functions and activities.
22. Risk in marketing - Types of risk in marketing - Measures to minimize risks, speculation and hedging - Meaning, differences between speculation & hedging, advantages, disadvantages and process of speculation and hedging.
23. An overview of futures trading in agricultural commodities - Forward/future markets
- Meaning, advantages and disadvantages of forward markets.
24. Commodity exchanges – Role and importance - Commodity exchanges in India - MCX,NCDX,NCMX,ACX, Safal - Role of regulatory bodies in futures markets - SEBI, etc, Contract farming - Meaning, procedures and advantages - Contract farming act in Andhra Pradesh.
25. Meaning and functions of price - Characteristics of agricultural product prices - Agricultural price stabilization - Need for agricultural price policy - Role of Commission for Agricultural Costs and Prices (CACP) - Meaning of administered prices - Minimum support price, procurement price and issue price, levy price.
26. Concept of International Trade and its importance in globalised world economies - Free trade and protectionism - Meaning, pros and cons of free trade and protectionism.
27. Theory of absolute and comparative advantage and their importance international trade.
28. Trends, present status and prospects of Indian agri-commodities trade in international trade.
29. WTO - Genesis, objectives, functions and principles of multilateral trade.
30 & 31. WTO agreements - Agreement on Agriculture (AoA) - Market access, Aggregate Measures of Support (AMS), export subsidies, sanitary and phyto santitary measures (SPS) and their implications and impact on Indian agriculture.
32. TRIPS and intellectual property rights and their implications to Indian agriculture - Meaning of patents, copy rights, trademarks, geographical indications, industrial designs, trade secrets, integrated circuits, and plant varieties protection.

Practical

1. Plotting and study of demand and supply curves for major agricultural commodities.
2. Calculation of elasticities for important agricultural commodities.
3. Study of relationship between market arrivals and prices of some selected commodities.
4. Computation of marketable and marketed surplus of important commodities.
5. Study of price behaviour over time for some selected commodities.
6 &7. Construction of index numbers- moving averages -General PI , WPI, CPI.
8 & 9. Visit to a local markets to study various marketing functions performed by different agencies, identification of marketing channels for selected commodities, collection of data regarding marketing costs.
10 Estimation and calculation of marketing costs, margins and price spread and presentation of report in the class.
11 Visit to SWC/CWC to study their objectives, role, organization, functioning and performance.
12 Visit to FCI and study its objectives, role, organization and functioning and performance.
13 Visit to cooperative marketing society – DCMS/ MARKFED, etc. to study their objectives, role, organization and functioning.

14 - 16. Study of comparative advantage of different agricultural commodities of India in International trade.

Reference

1 S S Acharya and N L Agarwal. 2012. *Agricultural Marketing in India*. Oxford & IBH Publications Co. Pvt. Ltd., New Delhi.

2 S S Acharya and N L Agarwal. *Agricultural Price: Analysis and Policy*. Oxford & IBH Publications Co. Pvt Ltd., New Delhi.

3 Subba Reddy, S., P.Raghu Ram., Sastry, T.V.N and Bhavani Devi, I. 2016. *Agricultural Economics*. Oxford & IBH Publishing Company Private Ltd., New Delhi,

4 Kahlon, A.S and Tyagi.D S. 1983. *Agricultural Price Policy in India*. Allied Publishers Pvt. Ltd., New Delhi.

5 Mamoria, C.B. and Joshi. R L.1995. *Principles and Practices of Marketing in India.* Kitab Mahal, Allahabad

6 Philip Kotler, Kevin Lane Keller, Abraham Koshy and Mithileswar Jha. 2009. *Marketing Management: A South Asian Perspective*. International 13th edition. Pearson Prentice Hall

7 www.wto.org.

8 www.agricoop.nic.in

18AGR205 IRRIGATION WATER MANAGEMENT 2(1+1)

Course outlines

Theory

Irrigation : Definition and objectives; Water resources, Irrigation projects (major, medium & minor) in India and Andhra Pradesh; Soil - plant - water relationships; Methods of soil moisture estimation; Evapotranspiration and Crop water requirement; Duty of water; Conjunctive use of water; Scheduling of irrigation; Methods of irrigation - Surface, Subsurface, Sprinkler and Drip irrigation; Irrigation efficiency and Water use efficiency; Irrigation water quality criteria and its management; Waterlogging; Agricultural drainage.

Practical

Measurement of bulk density, study of soil moisture measuring devices, determination of field capacity and permanent wilting point, measurement of infiltration rate, irrigation water, scheduling of irrigation by IW/CPE ratio method, calculations on soil moisture, irrigation water needs, duty of water and irrigation efficiencies, layout of surface methods of irrigation, demonstration of drip and sprinkler irrigation, visit to micro irrigation systems in farmers fields ,water management practices in different crops.

Lecture outlines

Theory

1 Introduction – importance – definition and objectives - water resources of world.

2 Surface and ground water resources in India and Andhra Pradesh–important major irrigation projects in India and Andhra Pradesh.

3 Soil-water relations – physical properties of soil viz., depth, soil texture, soil structure, particle density, bulk density and porosity influencing water retention, movement and availability.

4 Water retention in soil – adhesion and cohesion – soil moisture tension – pF – soil moisture characteristic curves- Water movement in soils – infiltration – percolation – seepage – permeability – hydraulic conductivity – saturated and unsaturated water flow.

5 Kinds of water in soil – gravitational water – capillary water – hygroscopic water – their importance in crop production - Soil moisture constants – saturation – Field capacity (FC) – Permanent Wilting Point (PWP) – Available Soil Moisture (ASM) – hygroscopic coefficient – theories of soil water availability.

6 Plant-water relationships – rooting characteristics – effective root zone depth – moisture extraction pattern – moisture sensitive periods of crops – Soil Plant Atmospheric Continuum (SPAC).

7 Evapotranspiration – evaporation – transpiration – factors influencing evapotraspiration – Reference crop evapotraspiration (ETo) – Crop coefficient – Crop Evapotranspiration (ETc) - daily, seasonal and peak period consumptive use.

8 Crop water requirement – irrigation requirement – net and gross irrigation requirement – irrigation interval – irrigation period – seasonal water requirement of important crops – duty of water – base period – relation between duty and base period – conjunctive use of water – advantages of conjunctive use.

9 Scheduling of irrigation – different criteria – soil moisture regime approach – feel and appearance method – soil moisture tension and depletion of available soil moisture method -

climatological approach – Irrigation Water (IW) / Cumulative Pan Evaporation (CPE) ratio method.

10 Scheduling of irrigation – plant indices approach – visual symptoms – soil cumsand mini plot technique – growth rate – relative water content – plant water potential – canopy temperature – indicator plants and critical growth stages.

11 Methods of irrigation - surface methods – wild flooding check basin, ring basin, border strip, furrow and corrugations – advantages and disadvantages- Sub surface irrigation.

12 Micro irrigation systems - sprinkler irrigation – merits and demerits – system components and layout – suitable crops – rain guns.

13. Drip irrigation (surface and sub surface) – merits and demerits – system components and layout – suitable crops - fertigation and maintenance of micro irrigation systems.

14. Water Use Efficiency (WUE) – crop and field water use efficiency – factors influencing WUE – climatic, genetic and management (agronomic) factors - Irrigation efficiencies – water conveyance efficiency, water application efficiency, water storage efficiency, water distribution efficiency and project efficiency.

15. Quality of irrigation water – salinity hazard, sodium hazard, residual sodium carbonate and boron toxicity – criteria and threshold limits – management practices for using poor quality water.

16. Water logging – causes for waterlogging – drainage- surface and sub-surface drainage systems – relative merits.

Practical

1. Determination of bulk density
2. Determination of soil moisture content by gravimetric and volumetric method
3. Installation and working with tensiometer and resistance blocks
4. Determination of infiltration rate
5. Determination of field capacity by field method
6. Measurement of soil moisture content by moisture probe
7. Measurement of irrigation water through flumes, weirs and V notches
8. Scheduling of irrigation by IW / CPE ratio method
9. Calculation of irrigation water requirements
10. Lay out of surface irrigation methods
11. Problems on duty of water and irrigation efficiencies
12. Demonstration of drip irrigation system (filter cleaning, flushing of laterals and fertigation)
13. Demonstration of operation of sprinkler irrigation system
14. Visit to micro irrigation systems in farmers fields.
15. Water management practices in rice, wheat and maize.
16. Water management practices in groundnut, sunflower and sugarcane.

References

1. Michael, A.M. 2006. Irrigation – Theory and Practice. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Reddy, S.R. 2016.Irrigation Agronomy 3 rd Edition.Kalyani Publishers, Ludhiana.
3. Sankara Reddi, G.H. and Yellamanda Reddy, T. 2006.Efficient Use of Irrigation Water.Kalyani Publishers, Ludhiana.
4. Majumdar, D.K. 2013. Irrigation water management: Principles and practices. PHI learning Pvt Ltd, Delhi-92

18 AEX 201 COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT (1+1)

Theory

Communication Skills: 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.

Unit I Communication Skills: meaning and process of communication, verbal and nonverbal communication

Unit II Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures.

Unit III Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting

Unit IV Individual and group presentations, impromptu presentation, public speaking **Unit V** 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

Theory Schedule

1. Communication – meaning and process –Functions and Types of communication
2. Communication models - Aristotle, Shannon and Weaver, Schramm, Berlo Westly and Maclean, Leagan, Rogers and Shoemaker, Littererls model and Dance's Helical Model – Elements of communication – communication barriers
3. Verbal and Non verbal communication – Verbal communication – definition and meaning – Verbal vs Oral communication – Types – Styles - Barriers to effective verbal communication ;
4. Non verbal communication – definition and meaning – Proxemics, Chronemics, Movement and body position, Posture, Facial Expression, Gestures and Eye Contact – importance of non verbal communication
5. Listening – Definition – Listening vs Hearing – Active listening – Types of listening – Guidelines for effective listening – Developing listening skills - Barriers to listening – Listening misconceptions
6. Writing skill – Importance – Effective writing - Components of writing : Introduction , Audience and format ,Composition and style, Structure, Grammatical errors , Proofing and Conclusion – Ways to improve writing skills – Technical writing
7. Oral presentation skills – Basics of effective oral presentation : Planning , preparing (Introduction, Body and conclusion), Delivery, Body language and Handling anxiety – Strategies for giving oral presentation
8. Field diary – Definition – Components to be included – Parts of field diary – Field diary in social sciences

9. Lab record : Definition –Importance of keeping a lab record - Features of a lab record - Contents of lab record – Guidelines for keeping a lab record
10. **Mid semester examination**
11. Indexing – Definition – Importance – Types of indexing with advantages and limitations
12. Footnote and Bibliographic procedure : Footnote system of citation ; Bibliographic procedures : Citation in Text, Citation in Journal, Citation from Book(One author / Multiple authors), Citation from an Edited Book, Citation of Seminar/Conference Proceedings, Citation from Institutional Publication, Citing Government Publications, Abbreviations for Names of Journals, Paraphrasing, Abbreviations in citations (Art of publication)
13. Reading skills – Definition – Kinds of reading skills – Critical reading skills – Reading readiness skills-Guidelines for effective reading- Extensive reading- Intensive reading. Comprehension : Definition and meaning – Comprehension skills-Readability Index
14. Precise writing – Derivation and Meaning – Skills required – Method or procedure – Guidelines; Summarising – Meaning- Steps to write a summary
15. Abstracting : Definition - Purpose of abstract – Types of abstract - Abstract Styles – Steps for Writing Effective Abstracts- Some Do's Don'ts in preparing abstracts
16. Individual presentation - Meaning –Steps for individual presentation; Group presentation – Meaning – Stages of group presentation ; Impromptu presentation
17. Public speaking : meaning – Points to be considered in public speaking – Effective public speaking:
    Group Discussion: Meaning –Procedure – Advantages – Limitations ;Seminar Conferences : Definition and meaning – Steps in organizing seminar / conferences / symposium / workshop

Practical Schedule

1. Practicing active listening
2. Exercise on note taking methods
3. Exercise on technical writing and practicing proof correction
4. Practicing oral presentation
5. Exercise on writing field diary and Lab record
6. Visit to library and learn indexing
7. Exercise on preparing foot notes and citations
8. Practice on effective reading skills
9. Comprehension of technical article
10. Comprehension of general article
11. Exercise on precise writing
12. Practice on summarizing articles
13. Practice on preparing abstracts

14&15 Developing skill on individual presentation

16. Developing skill on group presentation
17. **Practical Examination**

Referecnce

G.L. Ray and Sagar mondal. 2010. Journalism –Farm journalism and communication skills. Kalyani publishers.

Sagar Mondal. 2016. Agricultural extension , Kalyani publishers

G. L. Ray 2007 Extension Communication and Management , Kalyani publishers

Communication and Instructional Technology, By: Indu Grover, Shusma Kaushik, Lali Yadav, Deepak Grover & Shashikanta Verma
Indu Grover, Lali Yadav & Deepak Grover Extension Management, Agrotech

Everett Rogers, and Floyd Shoemaker, Communication of Innovation – a Cross Cultural Approach, New York Free Press.

Knapp, Mark L., & Hall, Judith A .(2007) Nonverbal Communication in Human Interaction. (8th ed.) Wadsworth: Thomas Learning.

Kathleen M. German, Bruce E Gronbeck Principles of Public Speaking

e- Referecnce

1. www.managementstudyguide.com
2. www.ajms.co.in
3. www.mindtools.com

18 PAT 201 PRINCIPLES OF INTEGRATED PEST AND DISEASE MANAGEMENT 2 (1+1)

Course outlines

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.

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.

Lecture outlines

Theory

Plant Pathology

1. Integrated disease management – Introduction, concept, Total system approach, Subsystem of IPM, IPM strategies, Integration of practices, Benefits and limitations.

2. Disease triangle, Disease pyramid, Factors affecting disease epidemics, Disease incidence-disease severity, Area under disease progress curve, Descriptive disease scales in important crops with examples. Survey and surveillance of plant diseases: Objectives, methodology and reporting results. Use of Remote sensing technology in Plant Pathology.

3. Plant disease forecasting – meaning – advantages, methods in forecasting, information needed for forecasting, examples of disease forecasting models.

4. Classification of fungicides based on chemical group and antibiotics with examples.

5& 6. Methods of disease control: Host plant resistance – advantages– Flor's gene for gene hypothesis – types of resistance – vertical and horizontal resistance – mechanism of resistance. Cultural methods, mechanical methods and physical methods with examples. Biological control – Biocontrol organisms – mechanisms of biocontrol – examples- mass multiplication methods.

7. Integrated disease management in important crops : Rice , Groundnut, Cotton and Chillies

8. Integrated disease management in important crops – Mango, Banana, Citrus and Brinjal

Entomology

9 Economic importance of insect pests. Pest risk analysis - Calculation and dynamics of economic injury level and importance of Economic threshold level.

10 Methods of detection and diagnosis of insect pests – types of insect damage on crop plants based on the types of mouth parts (biting and chewing, piercing and sucking, lacerating and sucking, siphoning and degenerate types)

11 Ecological management of crop environment - Ecological principles – importance of ecosystem concept – ecological niche – Agro ecosystem components and services in management of crop environment.

12 Introduction to conventional and botanical pesticides for the insect pests and disease management.

13 Survey & surveillance and forecasting of Insect pests, Case histories of IPM programmes – success stories. Development and validation of IPM modules for major crops – problem identification – Research and development of IPMs – Modules for major Agricultural and horticultural crops and validation.

14 Implementation and impact of IPM (IPM module for Insect pest) - IPM modules for major field crops (paddy, sugarcane, cotton, pulses and ground nut) major vegetables (brinjal, tomato, okra, cabbage and cauliflower), mango and coconut – Impact studies of IPM modules and constraints in implementation.

15 Political, social and legal implication of IPM - Safety issues in pesticide uses – legislative measures – Awareness about IPM, Farmers participation – Government support.

16 Safety issues in pesticide uses – Pesticide risk assessment, management and communication, use in agriculture. Environmental impact – health effects – residues, resurgence and resistance – effect on non target organisms – Strengths and weaknesses of pesticides.

Practicals:

Plant Pathology

1. Identification of plant diseases based on symptoms and signs.
2. Laboratory methods used in the diagnosis of Plant diseases.
3. Methods of measurement of plant diseases, descriptive disease scales for important diseases. Plotting AUDP curves.
4. Methods to assess crop yield losses due to crop diseases with examples.
5. Identification of disease biocontrol agents – *Trichoderma, Pseudomonas, Bacillus* spp. – Laboratory isolation procedures.
6. Mass multiplication of biocontrol agents :*Trichoderma* and *Pseudomonas.*
7. Crop monitoring for assessment disease dynamics – Decision making.
8. IDM and non IDM methods – Cost benefit analysis – Case studies.

Entomology

9 Methods of diagnosis and detection of various insect pests.

10 Identification, nature of damage and dynamics of important insect pests and their management in different major crop ecosystems (paddy, maize, cotton, sugarcane, groundnut, castor, mango, citrus, coconut, brinjal and tomato).

11 Agro Eco System Analysis in major field crops (paddy and cotton).

12 Ecological engineering for rice.

13 Methods of assessment of insect pests population, damage and crop yield losses and calculation of cost benefit ratios (paddy/cotton).
14 Identification of natural biocontrol agents in different crop ecosystems.
15 Planning and assessment of insect pest preventive strategies (IPM module) and decision making.
16 Awareness campaign at farmer's fields.

References:

1. Dhaliwal, G. S. and Ramesh Arora 2001. *Integrated pest management*: Concepts and approaches, Kalyani Publishers Ludhiana.
2. Metcalf, R. L .and Luckman, W. H. 1982. *Introduction to insect pest management*. Wiley inter science publishing, New York.
3. Larry P Pedigo 1991. Entomology and pest management, Prentice Hall of India Private Ltd., New Delhi.
4. Venugopala Rao, N., Umamaheswari, T., Rajendraprasad, P., Naidu, V.G and Savithri, P. 2004. *Integrated Insect Pest Management*. Agrobios (India) Limited, Jodhpur.
5. Chaube, H.S. and Ramji Singh. 2001. *Introductory Plant Pathology*. International Book Distribution Co., Lucknow. 136.
6. Mehrotra, R.S. 1980. *Plant Pathology*. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
7. Singh, R.S. 2002. *Introduction to Principles of Plant Pathology*. Oxford & IBH Publ. Co.P. Ltd., New Delhi.
8. Vidyasekharan, P. 1993. *Principles of Plant Pathology*. CBS Publishers and Distributors, New Delhi.
9. Y. L. Nene and P.N. Thaplial, 1993., Fungicides in Plant Disease Control. Oxford and IBH Publishing Co.

V Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 GPB 301	Crop Improvement - I (Kharif Crops)	2(1+1)
2	18 AGR 301	Rainfed Agriculture & Watershed Management	2(1+1)
3	18 AGR 302	Practical Crop Production - I (Kharif Crops)	2(1+1)
4	18 AEN 301	Pests of Crops and Stored Grain and their Management - I	3(2+1)
5	18 AEX 301	Entrepreneurship Development and Business Communication	2(1+1)
6	18 HOR 301	Production Technology for Ornamental Crops, MAP and Landscaping	2(1+1)
7	18 PAT 301	Diseases of Field and Horticultural Crops and their Management - I	2(1+1)
8	18 SAC 301	Manures, Fertilizers and Soil Fertility Management	3(2+1)
9	18 IPR 301	Intellectual Property Rights	1(1+0)
10	18 OPT301	Elective Course	3(2+1)
Total			**22(13+9)**

18 SAC 301 MANURES, FERTILIZERS AND SOIL FERTILITY MANAGEMENT 3(2+1)

Unit-l-Essential Nutrients

Soil fertility and productivity. Essential nutrients

Aim:

To impart knowledge on essential nutrients, soil fertility, nutrient transformations in soil, manures, fertilizers and soil fertility management through various approaches.

Syllabus-Theory

- functions, deficiency and toxicities. Concepts and methods of soil fertility evaluation.

Unit-ll- Nutrient Dynamics

Nutrients - sources, forms, mobility, transformations, fixation, losses and availability of nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, iron, manganese, zinc, copper, boron, molybdenum, nickel, chloride in soils - Beneficial elements -Nutrient interactions

Unit-III-Classification of Fertilizers

Fertilizers - Definition and classification, sources, properties and reactions of primary, secondary and micro nutrient fertilizers in soil - Manufacture of urea, ammonium sulphate, SSP, DAP, MOP and SOP. Complex, mixed fertilizers, customized / Specialty fertilizers - Water soluble fertilizers, liquid fertilizers. Micro nutrient mixtures and chelated micronutrients - Preparation, characteristics and compatibility -Fertilizer Control Order (FCO). Manures- classification, nutrient contents. Composting techniques.

Unit-IV-Application Methods

Methods of fertilizer application - Seed coating, pelletization, seedling dipping - Nutriseed pack - Soil Application - Foliar spray - Fertigation - water soluble fertilizers, fertigation scheduling (Fertilizer- water interaction, fertilizer solubility, comparison of fertilizer application methods)

Unit-V-Nutrient Management

Nutrient management concepts - INM, STCR, IPNS, SSNM and RTNM. Nutrient use efficiencies of major and micronutrients and enhancement techniques (Soil, Cultural and

Fertilizer strategies). Soil health -Quality indices and their management - Organic farming and Precision Farming - Long term effect of fertilization on soil

Practical Syllabus

Soil Nutrient Analysis - Available nutrient status (N, P, K, S and DTPA extractable micronutrients) in soils- Fertilizer Nutrient Analysis- Analysis of nutrient contents in urea, ammonium nitrate, SSP, RP, MOP and SOP- Manure Analysis-Determination of nutrient contents (N, P& K) in FYM/GM - Colloquium on Soil testing laboratories - Soil test based fertilizer prescription - Visit to fertilizer mixing unit.

Theory- Lecture shedule

1. Soil fertility and productivity - essential nutrients- criteria of essentiality - N, P and K nutrients -functions, deficiency and toxicity symptoms

2. Secondary nutrients, micro nutrients and beneficial elements - functions, deficiency and toxicity symptoms

3. Concepts and approaches of soil fertility evaluation - Liebig's Law, Mitscherlich's law and Bray's nutrient mobility concept. Approaches - Deficiency symptoms, tissue analysis, biological tests and chemical tests

4. Techniques/ methods of soil fertility evaluation - Inductive, deductive, 'A' value technique,

   crop logging, critical level, DRIS and agronomic approach

5. Sources, forms, mobility, transformation, fixation, losses and availability of nitrogen in soil

6. Sources, forms, mobility, transformation, fixation, losses and availability of phosphorus in soil

7. Sources, forms, mobility, transformation, fixation, losses and availability of potassium in soil

8. Sources, forms, mobility, transformation, fixation, losses and availability of calcium magnesium and sulphur in soil

9. Sources, forms, mobility, transformation, fixation, losses and availability of micro

   nutrients in soil

10. Nutrient interactions in soil
11. Fertilizers - Definition, classification of N,P and K fertilizers

12. N fertilizers- Urea, ammonium sulphate, ammonium nitrate, CAN, properties and their reactions in soil

13. Manufacture of urea and ammonium sulphate

14. P fertilizers- Rock phosphate, bone meal, basic slag, single super phosphate, diammonium phosphate, triple super phosphate, properties and their reactions in soil

15. Manufacturing of SSP and DAP

16. K fertilizers- MOP and SOP- properties and reactions in soil

17. Mid Semester Examination

18. Synthesis of MOP and SOP

19. Complex fertilizers- definition, manufacture of ammonium phosphate, nitro phosphate and N,P,K complexes

20. Mixed fertilizers-definition, preparation and compatibility

21. Preparation and characteristics and compatibility - Specialty/ Customized fertilizers, Water soluble fertilizers, liquid fertilizers, Micro nutrient mixtures and chelated micronutrients

22. Fertilizer Control Order

23. Organic manures- Definition, classification and sources- Fortified organics

24. Composting techniques- Aerobic and anaerobic (Bangalore & Coimbatore method) enriched FYM and vermicompost. Composting of organic waste-Sugarcane trash and coir waste

25. Methods of fertilizer application for different soil types - Fertigation - Definition - water soluble fertilizers

26. Types of fertigation - Fertilizer schedule

27. Fertilizer application methods - Seed coating, pelletization, seedling dipping - Nutriseed pack - Soil Application - Foliar spray

28. Nutrient management concepts - INM, STCR, IPNS, SSNM and RTNM - Tools - DSSIFER and VDK

29. Nitrogen use efficiency - Slow release N fertilizers - Significance and

enhancement techniques

30. Nutrient use efficiency of P, K and micronutrients and their enhancement techniques

31. Soil health - Definition - Soil Quality Indices - Physical, chemical and Biological indicators-Soil enzymes

32. SOM maintenance - Role of SOM in sustaining soil health

33. Precision farming and organic farming - Concepts and applications

34. Long term effect of fertilization on soil

Practical schedule

1. Estimation of alkaline $KMnO_4$ N in soil
2. Estimation of Olsen P and Bray P in soil
3. Estimation of Neutral Normal NH_4OAc K in soil
4. Estimation of available sulphur in soil by turbidimetry
5. Estimation of DTPA extractable micronutrients in soil
6. Identification of fertilizers - Fertilizer sampling techniques
7. Estimation of N in urea
8. Estimation of ammoniacal and nitrate N in ammonium nitrate
9. Estimation of water soluble P in SSP
10. Estimation of citric acid soluble P in rock phosphate - Pemberton's method
11. Estimation of K in KCI and K_2SO_4
12. Estimation of N in FYM / Compost by Macro Kjeldahl method
13. Preparation of triple acid extract - Estimation of P in FYM / Compost by Vanado molybdate yellow colour method
14. Estimation of K in FYM / Compost by Flame Photometry.
15. Colloquium on establishment of soil testing laboratories -Fertilizer calculations- Soil test based fertilizer prescription
16. Visit to STL and FTL, Visit to fertilizer manufacturing / mixing unit
17. Practical Examination.

Text books

1. John L. Havlin, James D. Beaton, Samuel L. Tisdale and Werner L. Nelson.2011. Soil Fertility and Fertilizers- An Introduction to Nutrient Management. PHL Learning Pvt. Ltd.,New Delhi

2. Gupta, P. K. 2012. A Handbook of Soil, Fertilizer and Manure. Agrobios (India), Jodhpur.

3. Michael, A. M. 2009. Irrigation Theory and Practice. Second Edition. Vikas Publishing House Pvt. Ltd., New Delhi.

4. Ramesh Chandra and S. K. Singh. 2009. Fundamental and Management of soil quality. Westville Publishing House, New Delhi.

References

1. Cooke G.W., 1972. Fertilizers for maximizing yield, Grenada Publishing Ltd, London.

2. Black, C.A. 1965. Agronomy Monograph. Methods of Soil Analysis. Part 1. Physical and Mineralogical properties including Statistics of Measurement and Sampling. Wiley, New York.

3. Das, P.C. 1999. Manures and Fertilizers, Kalyani Publishers, New Delhi.

4. Dilip Kumar Das, 2007. Micronutrients : Their Behvaiour in soils and plants. Kalyani Publishers, New Delhi.

5. Epstein, E. and A.J.Bloom. 2005. Mineral Nutrition of Plants: Principles and perspectives (2nd ed!). Sinauer Associates, Sunderland, MA.

6. FAO, 2000. Manual on integrated soil management and conservation practices. FAO land and water bulletin. No. 8. Food and Agriculture Organization of the United Nations, Rome.

7. Fertilizer Manual. 1998. UN Industrial Development Organization and International Fertilizer Development Center.

8. Horst Marschner. 1995. Mineral Nutrition of Higher Plants, 2nd edition. Academic Press Inc. San Diego, CA.

9. John Havlin, James Beaten, Samuel Tisdale, Werner Nelson, 2006.Soil Fertility and Fertilizers - An Introduction to Nutrient Management. 7th Edition, Prentice Hall. Upper Saddle River, NJ.

10. Kanwar. J.S. 1976. Soil fertility - Theory and Practice. ICAR- New Delhi.

11. Mengel, K., E.A. Kirkby, H.Kosegarten and T.Apple. 2006. Principles of Plant Nutrition, 5th ed. Springer International.

12. Page, A.L, R.H.Miller and D.R.Keeney. 1982. Methods of Soil Analysis. Part 2. Chemical and Microbiological properties. Madison Wiscinsonin, USA.

13. Russell. E.J.1973.Soil conditions and plant growth, Tenth edition English Language Book Society, London.

14. Sree Ramulu, U.S. 2003. Principles in the quantitative analysis of waters, fertilizers, plants and soil. Scientific Publishers, Jodhpur

15. Tandon, H.LS. 1994. Fertilizer, Organic Manures, Recyclable Wastes and Biofertilizers. Fertilizer Development and Consultation Organization, New Delhi

16. Westerman, R.L. (ed.) 1990. Soil Testing and Plant Analysis, 3rd. edition. Soil Science Society of America, Inc., Madison, Wl.

17. Yawalkar, K.S., J.P. Agarwal and S.Bokde.2008. Manures and Fertilizers. Agri - Horticultural Publishing House, Nagpur.

e-references

1. www.fspublishers.org/ijab/past-issues/IJAB Vol_5_No_3/47.pdf

2. www.springerlink.com/index/IQ11256h8t325054.pdf

3. www.ipni.net/ppiweb/bcrops.nsf/$webindex/.../Better_Crops_2009-4 J_.pdf

4. onlinelibrary.wiley.com/doi/10.1002/9780470431771 .index/pdf

5. agtr.ilri.cgiar.org/agtrweb/Documents/Library/docs/.,./Module4.htm

6. www.uoa.edu.er/academics/graduate/.../courses.html -

7. www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm

8. www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm
9.
9. www.uoa.edu.er/academics/graduate/.../courses.html -

10. www.ncpahindia.com/articles/article17.pdf-Similar

11. www.energy.ca.gov/process/agriculture/ag_pubs/fertigation.pdf -

12. www.soilandhealth.org/.../010117attrasoilmanual/010117attra.html

13. goliath.ecnext.com/.../Deficiencies-in-the-soil-quality.html-

18 AEN 301 PESTS OF FIELD CROPS, STORED GRAINS AND THEIR MANAGEMENT - I 3(2+1)

Course outlines

Theory

General account on nature and type of damage by different arthropod 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 practices for other important arthropod pests of various field crops. Mites, birds, nematodes and rodent pests of field crops and their management. Locust management.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 structures 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 different crops and their produce: (a) Field Crops;. Identification of mites, birds and rodent pests of crops. 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. Pesticide application techniques. 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/CWC godowns.

Lecture outlines

Theory

General account on nature and type of damage by different arthropod pests. Scientific name, order, family, host range, distribution, marks of identification, bionomics, nature of damage, and management of major, minor insect pests and other important arthropod pests of various field crops.

1 Introduction of Economic Entomology and Economic Classification of Insect Pests

2 - 5 Rice-Yellow stem borer and other borers, gall midge, brown - planthopper, green leafhopper, hispa, leaf folder, ear head bug, grasshoppers, root weevil, swarming caterpillar, climbing cutworm, case worm, whorl maggot, leaf mite and panicle mite-IPM practices.

6-8 Sorghum and other millets- Sorghum shoot fly, stem borer, pink borer, sorghum midge, ear head bug, red hairy caterpillar, deccan wingless grasshopper, aphids, maize shoot bug, flea beetle, blister beetles, ragi cutworm, ragi root aphid and army worm- IPM practices. Wheat-Ghujia weevil, ragi pink borer and termites- IPM practices.

9-11 Sugarcane- Early shoot borer, internode borer, top shoot borer, scales, leafhoppers, white grub, mealybugs, termites, whiteflies, woolly aphid and yellow mite- IPM Practices.

12-14 Cotton- Spotted bollworm, American bollworm, pink bollworm, tobacco caterpillar, leafhopper, whiteflies, aphid, mites, thrips, red cotton bug, dusky cotton bug, leaf roller, stem weevil, grasshoppers, and mealybug - IPM Practices.
15-16 Jute- Semilooper, stem weevil, stem girdler and Bihar hairy caterpillar. Mesta- Hairy caterpillars, stem weevil, mealybugs, leafhopper and aphid. Sunhemp- Hairy caterpillars, stem borer and flea beetle. IPM Practices.
17-18 Pulses- Gram caterpillar, plume moth, pod fly, stem fly, spotted pod borer, cowpea aphid, cowbug, pod bug, leafhopper, stink bug, green pod boring caterpillar, blue butterflies, leaf webber/borer and redgram mite. Soyabean- Stem fly, stem girdler, ragi cutworm, leaf miner and whitefly- IPM Practices. Pea- pea leaf miner and pea stem fly
19 Castor-Semilooper, shoot and capsule borer, tobacco caterpillar, leafhopper, butterfly, whitefly, thrips, castor slug and mite- IPM Practices.
20 Groundnut - White grub, leaf miner, red hairy caterpillar, tobacco caterpillar, leafhopper, thrips, aphid, pod bug, bud borer, wire worms and jewel beetle- IPM Practices.
21 Sesamum-Leaf and pod borer, gall fly and sphinx caterpillar. Safflower- Aphids and leaf eating caterpillars- IPM Practices.
22 Mustard- Aphid, sawfly, diamondback moth and painted bug. Sunflower- Helicoverpa and Spodoptera, leafhopper, Bihar hairy caterpillar and thrips - IPM Practices.
23 Stored grains Pests- Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain
24-25 Stored grain Insect pests - Rice weevil, lesser grain borer, khapra beetle, pulse beetle, groundnut bruchid, flour beetles, saw-toothed beetle, cigarette beetle, Angoumois grain moth and rice moth
26-27 Stored grains - Non insect Pests- Mites, rodents, birds and microorganisms associated with stored grain - Storage structures and methods of grain storage and fundamental principles of grain store management.
28 Locusts- Locusts and their management
29 Mites- Economically important phytophagous mites of field crops and their management
30 Nematodes-White tip nematode of rice, cyst and gall nematode of wheat, and their management.
31 Rodents- Rodents damaging field crops and stored grains - Keys for identification of rodents and their management.
32 Birds- Various birds infesting crops and their management.
*Important insects and their scientific names may only be chosen for examination purpose.

Practical

1 Typical symptoms of damage by various phytophagous insects.
2 Calculations on the doses of insecticides and their application techniques.
3 Identification of major insect pests of rice and their damage symptoms
4 Identification of major insect and mite pests of sorghum, maize and other millets, and their damage symptoms
5 Identification of insect pests of sugarcane and their damage symptoms
6 Identification of insect pests of cotton, sunhemp and mesta and their damage symptoms
7. Identification of insect pests of pulse crop and their damage symptoms. Identification of insect pests of oil seed crops and their damage symptoms

8 Mite pests of crops and their damage symptoms
9 Nematode pests of crops and their damage symptoms
10 Rodent pests of crops and their nature of damage
11 Bird pests of crops and their damage symptoms
12 Identification of insect and non insect pests (mites, birds and rodents) of stored grain, their nature of damage and their management tactics..
13 Methods of grain sampling under storage condition. Determination of moisture content of grain
14 Methods of detection of infestation by stored grains insect pests in stored grain 15 Assessment of losses in stored grain due to insect pests.
16 Fumigation of grain store / godown. Visit to nearest FCI/CWC/SWC godowns.

References

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

18 PAT 301 DISEASES OF FIELD AND HORTICULTURAL CROPS AND THEIR MANAGEMENT-I (FIELD CROPS) 3(2+1)

Course outlines

Theory

Symptoms, etiology, disease cycle and management of major diseases of following crops: Rice: blast, brown spot, Sheath rot, stem rot, narrow brown leaf spot, sheath blight, false smut, bacterial leaf blight, Bacterial leaf streak, tungro and Khaira; Wheat: rusts, loose smut, karnal bunt, powdery mildew, alternaria blight, and ear cockle; Sorghum: anthracnose, rust, ergot, grain mold , leaf blight, smuts, Charcoal rot, downy mildew, and Striga; Maize: stalk rots, downy mildew, leaf spots, banded leaf and sheath blight and blights; Bajra :downy mildew, ergot, rust and smut; Finger millet: Blast and leaf spot, smut and mosaic; Cotton: anthracnose, vascular wilts, leaf spots, rust and black arm; Sugarcane: red rot, smut, wilt, rust, ring spot, mosaic, grassy shoot, ratoon stunting and Pokkah Boeng; Tobacco: Damping off, frog eye leaf spot, Brown spot, black shank, black root rot and mosaic, leaf curl and Orobanche; Groundnut: early and late leaf spots, Collor rot, pepper leaf spot, Sclerotium wilt, rust, PBND, PSND and Kalahasti malady.
Sesamum: Phyllody, Alternaria leaf spot, Powdery mildew, macrophomina stem rot and bacterial leaf spot; Castor: Phytophthora blight, grey mold, root rot, bacterial leaf spot, seedling blight, rust and wilt;Sunflower: Downy mildew, powdery mildew head rot, rust, mosaic, necrosis, Sclerotinia stem rot and Alternaria blight; Safflower : wilt, Alternaria leaf spot, mosaic and rust; Mustard: Alternaria blight, white rust, downy mildew, powdery mildew and Sclerotinia stem rot; Pigeonpea: Phytophthora blight, wilt and sterility mosaic, bacterial leaf spot; Gram: rust, dry root rot, wilt, grey mould and Ascochyta blight; black & green gram: Cercospora, Corynospora leaf spot, bacterial leaf spot, angular black spot, anthracnose, powdery mildew, rust, web blight ,yellow mosaic, leaf crinckle and cuscuta; Pea: downy mildew, powdery mildew and rust; Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot, rust and mosaic; Lentil: rust and wilt;

Practical

Identification and histopathological studies of selected diseases of field 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**.**

Lecture outlines

Theory

Study of etiology, symptoms, host-parasite relationship and specific management practices of the following diseases.

1. Rice diseases – blast, brown spot.
2. Rice diseases – Sheath rot, Stem rot, narrow brown leaf spot.
3. Rice diseases – sheath blight, False smut, Bacterial leaf blight.
4. Rice diseases – Bacterial leaf streak, Rice Tungro Disease, Khaira.
5. Wheat diseases – Black or stem rust, orange rust, yellow rust.
6. Wheat diseases - loose smut, Karnal bunt.
7. Wheat diseases – Powdery mildew, alternaria blight, Tundu disease.

8. Sorghum diseases – Anthracnose, rust, ergot, headmold, leaf blight.
9. Sorghum diseases - smuts, charcoal rot, downy mildew, *Striga.*
10. Maize diseases - Turcicum leaf blight, post flowering stalk rots, charcoal rot.
11. Maize diseases - Banded leaf and sheath blight, downy mildew.
12. Bajra diseases – Downy mildew/green ear, rust, ergot, smut.
13. Ragi/Fingermillet diseases- blast, smut, mosaic.
14. Cotton diseases– Bacterial blight, Fusarium wilt, Verticillium wilt, root rot.
15. Cotton diseases – grey mildew, anthracnose, Alternaria leaf spot, Cercospora leaf spot, Helminthosporium leaf spot, rust.
16. Sugarcane diseases – red rot, whip smut, wilt, ring spot.
17. Sugarcane diseases – Grassy shoot, mosaic, ratoon stunting, rust, Pokah Boeng.
18. Tobacco diseases –black shank, Damping off, Frog eye spot, brown spot, black root rot.
19. Tobacco diseases – Mosaic, leaf curl, Orobanche.
20. Groundnut diseases – Collar rot, Tikka leaf spots, rust, pepper leaf spot, stem rot.
21. Groundnut diseases – Bud necrosis, Peanut stem necrosis disease, Kalahasti malady.
22. Sesamum diseases – Phyllody, Alternaria leaf spot, powdery mildew, charcoal rot, bacterial leaf spot.
23. Castor diseases – wilt, root rot, grey mold, bacterial leaf spot, seedling blight, rust.
24. Sunflower diseases – leaf blight, rust, powdery mildew, head rot, collar rot, downy mildew, mosaic, sunflower necrosis virus.
25. Safflower diseases – Alternarialeaf blight, wilt, rust, mosaic.
26. Mustard diseases – White rust, downy mildew, powdery mildew, Alternaria leaf spot, Sclerotinia stem rot.
27. Red gram diseases – Phytophthora blight, wilt, sterility mosaic and, bacterial leaf spot and stem canker.
28. Bengal gram diseases – wilt, rust, Ascochyta blight, stem and root rot, grey mold.
29. Black gram and Green gram diseases – Powdery mildew, rust, Cercospora leaf spot, Corynespora leaf spot, Angular black spot, Dry root rot, web blight.
30. Blackgram and Greengram diseases – Bacterial leaf spot, Yellow Mosaic virus, Leaf crinkle, Cuscuta.
31. Soybean diseases – Rhizoctonia blight, seed and seedling rot, rust, Soybean mosaic, Bacterial pustule;Pea diseases - downy mildew, powdery mildew and rust.
32. Cowpea diseases – Cowpea mosaic virus disease.; Lentil diseases - rust and wilt.

PRACTICAL

Study of the symptoms, identification and histopathological studies of the following diseases.
1. Rice diseases
2. Wheat, Sorghum and Bajra diseases
3. Maize and Fingermillet diseases
4. Field visits for the diagnosis of crop diseases.
5. Sugarcane diseases
6. Tobacco diseases
6 Groundnut diseases
7 Field visits for the diagnosis of crop diseases.
8 Sunflower and Safflower diseases

9 Castor and sesamum diseases
10 Mustard diseases
11 Field visits for the diagnosis of crop diseases.
12 Cotton diseases
13 Redgram, greengram and blackgram diseases
14 Bengalgram, cowpea and soybean diseases
15&16 Field visits for the diagnosis of crop diseases

References:

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

18 GPB 301 CROP IMPROVEMENT – I (Kharif Crops) 2 (1+1)

Course outlines

Theory

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

Practical

Emasculation and hybridization techniques in different crop species; cereals, millets, pulses and oilseeds. Maintenance breeding of different crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops.

Lecture outlines

Theory

1 Introduction – General Breeding Objectives – Concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops - Breeding populationsrelevance in crop improvement.

2 Cereals - Rice - Origin – Distribution of species – Wild relatives and forms –Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids-Accomplishments.

3. Cereals - Wheat and Barley - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids – Accomplishments.

4. Millets - Sorghum and Pearlmillet - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties – Seed production technology of varieties and hybrids – Accomplishments.

5 Millets - **F**inger millet, Kodo millet and Proso millet - Origin – Distribution of species – Wild relatives and forms –Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids-Accomplishments.

6 Pulses - Chickpea - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids-Accomplishments.

7 Pulses - Pigeonpea - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids – Accomplishments.

8 Pulses - Urd bean and Mung bean - Origin – Distribution of species – Wild relatives and forms –Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties – Seed production technology of varieties and hybrids - Accomplishments.

9. Pulses - Soybean and Cowpea - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids - Accomplishments.

10 Pulses - Horsegram, Fieldpea and Lentil - Origin – Distribution of species – Wild relatives and forms –Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties-seed production technology of varieties and hybrids –Accomplishments.

11 Oilseeds - Groundnut- Origin – Distribution of species – Wild relatives and forms – breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids- Accomplishments.

12 Oilseeds - Castor and Sesame - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids - Accomplishments.

13 Oilseeds - Sunflower and Safflower - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties – Seed production technology of varieties and hybrids – Accomplishments.

14 Oilseeds - Rapeseed and Mustard - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties – Seed production technology of varieties and hybrids - Accomplishments.

15 Oilseeds - Linseed and Niger - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids – Accomplishments.

16 Oilseeds - Coconut and Oilpalm - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties – Seed production technology of varieties and hybrids – Accomplishments.

Practical

1. Hybridization techniques and precautions to be taken, Floral morphology, selfing, emasculation and crossing techniques in field crops

2. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in rice.

3 Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Wheat and Barley.
4. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Maize and Sorghum.
5. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Pearl millet and Finger millet.
6. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Kodo millet and Proso millet.
7. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Chickpea and Pigeonpea.
8. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Urdbeanand Mungbean.
9. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Soyabeanand Cowpea.
10. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Groundnut and Castor.
11. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in and Sesame and Linseed.
12. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Rapeseed and Mustard.
13. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Sunflower and Safflower.
14. Visit to Agricultural Research stations/AICRP projects of crops.
15 Sources of donors for different characters in various crops &Parentage of released varieties / hybrids of important crops.
16 Study of special quality characters in various crops.

REFERENCES

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

18 AEX 301 ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS COMMUNICATION 2 (1+1)

Course outlines

Theory

Concept of Entrepreneur, Entrepreneurship, Distinction between an Entrepreneur and a Manager ; Management – Levels & Functions of Management - planning- Organizing -Directing – motivation – ordering – leading – supervision-Communication and control; Characteristics of Entrepreneurs; Opportunities for entrepreneurship and rural entrepreneurship. Types of Entrepreneurs, Functions of Entrepreneurship, Agri – Entrepreneurship - Concept, Need and Scope. Assessing overall business environment in Indian economy; Globalization and the emerging business entrepreneurial environment: Entrepreneurship Development Programmes (EDPs) – Objectives, Phases, Problems of EDPs, Entrepreneurial behavior and Role of Achievement Motivation, Factors Affecting Entrepreneurship Development; Generation, Incubation and Commercialization of Business Ideas. Environment scanning and opportunity identification, Rsearching / Managing Competition - Ways to define possible Competitors; Globalization and the emerging business entrepreneurial environment; Role of ED in economic development of a country- Overview of Indian social, political systems and their implications for decision making by individual entrepreneurs SWOT Analysis - Concept, Meaning and Advantages. Government Policies, Incentives, Programmes and Schemes for Entrepreneurship Development; Export and Import Policies relevant to Indian Agriculture Sector. Institutional Support - Financial Institutions and other agencies in entrepreneurship development. Venture capital (VC), contract farming (CF) and joint ventures (JV), Public-private partnerships (PPP); Overview of agricultural Input industry – Seed, Fertilizer, Pesticides, Farm Machinery, Agricultural Food Processing Industry; Steps in establishment of MSME Enterprise - Planning of an enterprise, Project identification, Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution; Project Planning, Formulation and Project Report - Meaning - Importance - Components and Preparation; Supply Chain Management - Meaning, Advantages, Stages and Process and Total quality Management; Definition of business; Stakeholders in business; Stages of Indian business; Importance of agribusiness in Indian economy; Business Communication for Public Relation , Advertisement and crisis communication. Social responsibility of business. Morals and ethics in enterprise management Assessment of Entrepreneurship skills, Business Leadership Skills; Communication Skills for entrepreneurship development, Developing organizational skill, Managerial skills, Problem solving skill and Time management skills.

Practical

Field Visits to study any one Agri - based industries / business – Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis, Constraints in setting up of agro based industries; Formulation of project feasibility reports; industrial and agribusiness houses; Characteristics of Successful Entrepreneurs, Characteristics of Successful Agripreneurs, any one of the Local Financial Institutions to study the MSME Policies, Visit to Entrepreneurial Development Institute to study the Process of Entrepreneurship Development, Local Public - Private

Enterprises to study the Enterprise Establishment and Management Process as well as Assessing entrepreneurial potential problem solving ability, managerial skills and achievement motivation, exercise in Creativity, time audit, preparation of business plan and proposal writing; Carrying out the SWOT Analysis of nearby Successful Enterprises. Visit to nearest Agri - Clinic and Agri - Business Centre's, if any.

Lecture outlines

Theory

1. Concept of entrepreneur, entrepreneurship - Distinction between an entrepreneur and a manager - Management - Management functions – Planning - Organizing - Directing - Motivation - Ordering - Leading – Supervision - Communication and Control.
2. Characteristics of entrepreneurs - Opportunities for entrepreneurship and rural entrepreneurship - Types of entrepreneurs and functions of entrepreneurship.
3. Agri – entrepreneurship - Concept, need and scope - Assessing overall business environment in Indian economy and globalization and the emerging business entrepreneurial environment.
4. Entrepreneurship development programmes (EDPs) – Objectives, phases, problems of EDPs - Entrepreneurial behavior and role of achievement - Motivation, factors affecting entrepreneurship development.
5. Generation, incubation and commercialization of business ideas – Environment scanning and opportunity identification - Researching/ Managing competition - Ways to define possible Competitors.
6. Globalization and the emerging business entrepreneurial environment - Role of ED in economic development of a country - Overview of Indian social, political systems and their implications for decision making by individual entrepreneurs.
7. SWOT Analysis - Concept, meaning and advantages.
8. Government policies, incentives, programmes and schemes for entrepreneurship development - Export and import policies relevant to Indian Agriculture sector.
9. Institutional support - Financial Institutions and other agencies in entrepreneurship development
10. Venture capital (VC), contract farming (CF) and joint ventures (JV) - Public-private partnerships (PPP).
11. Overview of agricultural input industry – Seed, fertilizer, pesticides, farm machinery and agricultural food processing industry.
12. Steps in establishment of MSME Enterprise - Planning of an enterprise - Project identification - Selection of the product/ services - Selection of form of ownership - Registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution.
13. Project planning - Formulation and project report - Meaning - Importance - Components and preparation.
14. Supply chain management - Meaning, advantages, stages and process and total quality management.
15. Marketing management - Market types - Marketing assistance - Market strategies - Definition of business - Stakeholders in business - Stages of Indian business - Importance of agribusiness in Indian economy -Social responsibility of business - Morals and ethics in enterprise management.

16. Assessment of entrepreneurship skills - Business leadership skills - Communication skills for entrepreneurship development – Developing organizational skill - Developing managerial skills - Problem solving skill and time management skills.

Practical

1 Field visits to study any one Agri - based industries/ business – Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis.
2 Field visits to study the constraints in setting up of agro based industries - Formulation of project feasibility reports and industrial and agri-business houses.
3 Field visits to study the formulation of project feasibility reports.
4 Field visits to study the industrial and agri-business houses.
5 Field visits to study the characteristics of successful entrepreneurs.
6 Field visits to study the any one of the Local Financial Institutions to study the MSME Policies.
7 Field visits to study the Entrepreneurial Development Institute to study the Process of Entrepreneurship Development.
8 Field visits to the local Public - Private Enterprises to study the Enterprise Establishment and Management Process.
9 Field visit to the local Public - Private Enterprises to study the Assessing entrepreneurial potential problem solving ability.
10 Field visits to the local Public - Private Enterprises to study the managerial skills and achievement motivation.
11 Practicing exercise in creativity and time audit.
12 Practicing exercise in preparation of business plan and proposal writing.
13 Visit to nearest Agri - Clinic and Agri - Business Centre's if any.
14 Power Point Presentation of Assignments - Session I
15 Power Point Presentation of Assignments - Session II
16 Power Point Presentation of Assignments - Session III

References

1 Anil Kumar, S., Poornima, S. C., Mini, K., Abraham andJayashree, K. 2003. *Entrepreneurship Development*. New Age International Publishers, New Delhi
2 Bhaskaran, S. 2014. *Entrepreneurship Development & Management*. Aman Publishing House, Meerut
3 Gupta, C.B. 2001. *Management: Theory and Practice*. Sultan Chand and Sons, New Delhi
4 Indu Grover 2008. *Handbook on Empowerment and Entrepreneurship*. Agrotech Publishing Academy, Udaipur
5 Khanka, S.S. 1999. *Entrepreneurship Development*. S. Chand and Co., New Delhi
6 Mary Coulter 2008. *Entrepreneurship in Action*. Prentice Hall of India Pvt. Ltd., New Delhi
7 Mohanty, S.K. 2009. *Fundamentals of Entrepreneurship*. Prentice Hall of India Pvt. Ltd., New Delhi
8 Prasad, R. 2003. *Entrepreneurship - Concepts and Cases*. I C F A I Publications, Hyderabad
9 SagarMondal and Ray, G. L. 2003. *Text Book of Entrepreneurship and Rural Development*. Kalyani Publishers,Ludhiana
10 Singh, D. 1995. *Effective Managerial Leadership*. Deep and Deep Publications, New Delhi

11 Vasanta Desai. 1997. *Small Scale Industries and Entrepreneurship*. Himalaya Publishing House, New Delhi
12 Vasanta Desai. 2000. *Dynamics of Entrepreneurial Development and Management*. Himalaya Publishing House, New Delhi

18 AGR 303 RAIN FED AGRICULTURE AND WATERSHED MANAGEMENT
2(1 + 1)

Course outlines

Theory

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

Practical

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

Lecture outlines

Theory

1. Rainfed agriculture – introduction and definition – dimensions of the problem – area and production from dry lands in India and Andhra Pradesh –History of rainfed agriculture and watersheds in India.
2. Problems and prospects of rainfed agriculture in India – climate – rainfall pattern – distribution – variabilities of rainfall – short rainy season – high intensity rainfall
3. Problems and prospects of rainfed agriculture in India - soil characteristics – soil fertility status –soil moisture storage and retention capacity – heavy weed infestation-soil crust and their effect on crop growth and soils-its management.
4. Drought – definition – types of drought – effect of water deficits on physiomorphological characteristics of the plants- mechanism of crop adaptation under moisture deficit condition - management strategies for drought.
5. Tillage for rainfed crops – off-season tillage – primary tillage –secondary tillage – year round tillage – sub soiling – setline cultivation – modern concepts of tillage- minimum tillage and zero tillage.
6. Soil erosion – definition – losses due to erosion – types of water and wind erosion – nature and extent of wind and water erosion – factors affecting erosion – universal soil loss equation

7. Management of crops in rainfed areas - Agronomic measures of soil and water conservation – choice of crop – crop geometry – tillage – contour cultivation – strip cropping – cover cropping – mulching – cropping systems and weed control - Mechanical measures of soil and water management.
8. Watershed – definition – concept— objectives and principles of water shed management components of watershed development programme – factors affecting watershed management.
9. Water harvesting – importance, its techniques- Water harvesting structures – arid region – runoff farming – water spreading – micro catchments – semi arid region – farm ponds, check dams – percolation tank – dug wells – life saving irrigation
10. *In-situ* moisture conservation measures – bund forming – bunding, ridge and furrow system – conservation furrows- inter plot water harvesting, mulching – Broad Bed and Furrow (BBF) and leveling.
11. Fertilizer use in rainfed areas – use of organic manures – introduction of legumes in crop rotation– organic recycling and bio-fertilizer use in rainfed agriculture – time and method of fertilizer application
12. Efficient crops and varieties – cropping systems in rainfed areas – intercropping – advantages – efficient inter cropping systems in different rainfed regions of Andhra Pradesh
13. Contingent crop planning for aberrant weather conditions in red and black soils.
14. Evapotranspiration – measures to reduce evapotranspiration – weeding, use of mulches, chemicals, windbreaks and shelterbelts
15. Land capability classification – alternate land use system
16. Efficient utilization of water through soil and crop management practices - agronomic measures - mechanical measures for soil and water conservation – gully control – bench terraces – contour terracing – graded bund

Practical

1. Climate classification.
2. Rainfall analysis - Mean, standard deviation, variance and CV.
3. Onset and withdrawal of monsoons and determination of length of growing crop season.
4. Study on cropping pattern of different dryland areas.
5. Mapping of dryland areas in India.
6. Interpretation of meteorological data for rainfall variability.
7. Scheduling of supplemental irrigation based on crop ET demand.
8. Critical analysis of rainfall and calculation of wet spells,dry spells ,and length of growing season.
9. Calculation of effective rainfall.
10. Determination of moisture availability index.
11. Study of cultural practices for mitigating moisture stress(mulching, plant density, depth of sowing, thinning and leaf removal).
12. Visit to watershed.
13. Field demonstration on soil & moisture conservation measures.
14. Field demonstration of water harvesting structures.
15. Study of farm ponds as a source of supplemental irrigation.
16. Visit to rainfed research station.

References

1. Reddy, S. R. and Prabhakar Reddy, G. 2015. Dryland Agriculture. Kalyani Publishers.

2. Arnon,I. 1972. Crop Production in Dry Regions (Vol.I), Leonard Hill Pub. Co, London.

3. Dhruva Narayana, V.V., Sastry, G.S. and Patnaiak, V.S. 1999. Watershed Management in India. ICAR, New Delhi.

4. Jeevananda Reddy,S.2002. Dryland Agriculture in India: An agro-climatological and agro-meteorological perspective. B S publications.

18 IPR 301 INTELLECTUAL PROPERTY RIGHTS 1(1+0)

Course outlines

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.

Lecture outlines

Theory

1 Introduction and meaning of intellectual property.
2 Brief introduction to GATT, WTO, TRIPs and WIPO.
3 Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc.
4-6 Types of Intellectual Property and legislations covering IPR in India: Patents and Copyrights, Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets.
7 Patents Act 1970.
8 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
9 Origin and history including a brief introduction to UPOV for protection of plant varieties.
10 Protection of plant varieties under UPOV and PPV&FR Act of India, Plant breeders rights.
11 Registration of plant varieties under PPV&FR Act, 2001.
12 Breeders, researcher and farmers rights.
13 Traditional knowledge-meaning and rights of TK holders.
14 Convention on Biological Diversity.
15 International treaty on plant genetic resources for food and agriculture (ITPGRFA).
16 Indian Biological Diversity Act, 2002 and its salient features, access and benefit sharing.

References

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

18 AGR 301 PRACTICAL CROP PRODUCTION – I (*Kharif crops*) 2(0+2)

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.

- Each student will be allotted a minimum land area of 100/200 m^2 and he / she will do all field operations in the allotted land from field preparation to harvest and processing.

- Under exigencies like water scarcity to raise wetland rice of the crop production programme shall be with two irrigated dry crops, with an area of not less than five cents.

- Irrigated puddled lowland rice / any irrigated dry crop (maize / sorghum / pearl millet / finger millet / cotton / groundnut / sunflower / sesame).

OUTLINE

- Rice *(Transplanted and direct seeded rice)*

- Rice ecosystems - Climate and weather - Seasons and varieties of Tamil Nadu.

- Preparation of nursery - Application of manures to nursery - seed treatment - Forming nursery beds and sowing seeds - Weed management and plant protection to nursery.

- Preparation of main field - Application of organic manures - Green manuring - Bio-fertilizers - Pulling out seedlings and transplanting - Rajarajan 1000 (SRI) - Application of herbicides - Water management - Nutrient management - Plant protection measures - Mechanization in rice cultivation - Recording growth, yield attributes and yield.

- Harvesting, threshing, drying and cleaning the produce - Working out cost of cultivation and economics.

Practical Schedule for Transplanted rice:

18. Study of rice ecosystems, climate, weather, seasons and varieties of Tamil Nadu.

19. Selection of nursery area, preparation of nursery, application of manures and fertilizer to nursery.

20. Acquiring skill in seed treatment, seed soaking and incubation, nursery sowing and management.

21. Study and Practice of main field preparation and puddling operations.

22. Practicing of field preparatory operations - sectioning of field bunds and plastering, leveling and basal application of fertilizers.

23. Practicing transplanting techniques in lowland rice.

24. Estimation of plant population and acquiring skill in gap filling and thinning.

25. Study of weeds and weed management in rice.

26. Study and practice of green manuring and bio-fertilizer application in rice.

27. Acquiring skill in nutrient management and practicing top dressing techniques.

28. Study of water management practices for lowland rice.

29. Observation of insect pests and diseases and their management.

30. Recording growth and other related characters of rice.

31. Estimation of yield and yield parameters in rice.

32. Harvesting, threshing and cleaning of the produce.

33. Working out cost of cultivation and economics.

34. **Practical Examination.**

References:

Ahlawat, I.P.S., Om Prakash and G.S.Saini. 1998. Scientific Crop Production in India. Rama Publishing House, Meerut.

Chidda Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

ICAR 2006. Hand book of Agriculture. Indian Council of Agricuture, New Delhi.

Crop Production Guide. 2005. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.

Rajendra Prasad. 2004. Text Book on Field Crop Production, Indian Council of Agrl. Research, New Delhi.

K Annadurai and B Chandrasekaran. 2009. A Text Book Of Rice Science. Scientific Publishers.

E-References:

www.irri.org
www.crri.nic.in
www.drrindia.org

18 HOR 301 PRODUCTION TECHNOLOGY FOR ORNAMENTAL CROPS MEDICINAL AND AROMATIC PLANTS AND LANDSCAPING 2 (1+1)

Course outlines

Theory

Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping, Landscape uses of trees, shrubs and climbers, Production technology of important cut flowers like rose, gerbera, carnation, lilium and orchids under protected conditions and gladiolus & tuberose, chrysanthemum under open conditions. Package of practices for loose flowers like marigold and jasmine under open conditions. Production technology of important medicinal plants like asparagus, aloe, costus, periwinkle, isabgol and Aromatic plants like mint, lemongrass, citronella, Palmarosa, Ocimum, 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.

Lecture outlines

Theory

1. Importance and scope of ornamental crops and landscaping - Landscape uses of trees, shrubs and climbers.
2. Principles of landscaping - Initial approach – Axis – Focal Point – Mass effect – Unity – Space – Divisional Lines – Proportion and Scale – Texture – Time and Light – Tone and Colour – Mobility – Rhythm – Balance – Contract – Harmony- Vista – Style.
3. Production technology of cut flowers under protected conditions -Rose – Introduction- origin and distribution- Classification- Species and varieties- Climate and soil requirements- Propagation – Rootstocks- Stock scion compatibility- Land preparation- planting- Manures and fertilizers- Cultural operations (pruningpinching and mulching) harvesting- Post harvest management- Yield and rose biproducts.
4. Gerbera - Introduction- Origin and distribution- Classification- Species and varieties- Climate and soil requirements- Propagation- Land preparation- Planting- Manures and fertilizers- Cultural operations - Defoliation- Soil loosening- Shadinguse of growth regulators- Physiological disorders- Harvesting- Post harvest management and yield.
5. Carnation - Introduction- Origin and distribution- Classification- Species and varieties- Climate and soil requirements- Propagation- Land preparation- Planting- Manures and fertilizers- Cultural operations- (Pinching and disbudding) use of growth regulators- Physiological disorders- Harvesting- Post harvest management and yield.
6. Liliumand Orchids - Introduction- Origin and distribution- Classification- Species and varieties- Climate and soil requirements- Propagation- Land preparation- Planting- Manures and fertilizers- Cultural operations- Use of growth regulators- Physiological disorders- Harvesting- Post harvest management and yield.

7. Production technology of cut flowers under open conditions - Gladiolus and Tuberose- Introduction- Origin and distribution- Classification of varieties- Species and varieties- Climate and soil requirements- Propagation- Land preparation- Planting- Manures and fertilizers- Cultural operations- Use of growth regulators- Physiological disorders- Harvesting- Post harvest management and yield.
8. Chrysanthemum - Introduction- Origin and distribution- Classification- Species and varieties- Climate and soil requirements- Propagation- Land preparation- Planting, Manures and fertilizers- Cultural operations- Pinching and disbudding - Use of growth regulators- Harvesting- Post harvest management and yield.
9. Loose flowers - Marigold and Jasmine under open conditions - Introduction- Origin and distribution- Species and varieties- F1 hybrids- Cimate and soil requirements- Propagation- Land preparation- Planting- Manures and fertilizers- Cultural operations- Pinching and disbudding - Use of growth regulators- Harvesting- Post harvest management and yield.
10. Medicinal plants – Scope and Importance – Production technology of Asparagus, Aloe, Costus - Botanical name – Family - Origin - Economic part - Introduction – Climate – Soil - Varieties – Propagation – Planting - Manuring - Irrigation - Intercultural operations - Harvesting - Yield.
11. Periwinkle, Isabgol -Botanical name – Family - Origin - Economic part - Introduction – Climate – Soil - Varieties – Propagation – Planting - Manuring - Irrigation - Intercultural operations - Harvesting - Yield.
12. Aromatic plants – Importance – Essential oil industry in India – Properties of essential oils – Production technology of Mint and Ocimum - Botanical name – Family - Origin - Economic part - Introduction – Climate – Soil - Varieties – Propagation – Planting - Manuring - Irrigation - Intercultural operations - Harvesting - Yield.
13. Lemongrass, Citronella, Palmarosa - Botanical name – Family - Origin – Economic part - Introduction – Climate – Soil - Varieties – Propagation – Planting – Manuring - Irrigation - Intercultural operations - Harvesting - Yield.
14. Geranium and Vettiver - Botanical name – Family - Origin - Economic part - Introduction – Climate – Soil - Varieties – Propagation – Planting - Manuring - Irrigation - Intercultural operations - Harvesting - Yield.
15&16. Processing and value addition in ornamental crops and MAPs produce – Dry flower making - Extraction methods of essential oils.

Practical

1. Identification of ornamental plants.
2. Identification of Medicinal and Aromatic Plants.
3. Nursery bed preparation and flower seed sowing.
4. Training and pruning of roses.
5. Planning and layout of ornamental garden.
6. Bed preparation and planting of Medicinal and Aromatic Plants.
7. Protected structures – Care and maintenance.
8. Intercultural operations in flowers crops.
9. Intercultural operations in Medicinal and Aromatic plants.
10. Harvesting and post harvest handling of cut and loose flowers.
11. Floral preservatives to prolong vase-life of cut flowers.

12. Drying / dehydration techniques for flower drying.
13. Processing of Medicinal and Aromatic Plants.
14. Extraction of essential oils.
15. Visit to commercial flower unit.
16. Visit to commercial MAP unit.

References

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

VI Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 AGR 303	Geoinformatics and Nano-technology and Precision Farming	2(1+1)
2	18 GPB 302	Crop Improvement - II (Rabi Crops)	2(1+1)
3	18 AGR 304	Practical Crop Production - II (Rabi Crops)	2(1+1)
4	18 AGR 305	Principles of Organic Farming	2(1+1)
5	18 AEC 301	Farm Management, Production & Resource Economics	2(1+1)
6	18 AEN 302	Management of Beneficial Insects	2(1+1)
7	18 FSN 301	Principles of Food Science and Nutrition	2(2+0)
8	18 HOR 302	Post-Harvest Management and Value Addition of Fruits and Vegetable	2(1+1)
9	18 PAT 302	Diseases of Field and Horticultural Crops and their Management - II	2(1+1)
10	18 PCA 301	Protected Cultivation and Secondary Agriculture	2(1+1)
11	18 OPT 302	Elective Course	3(2+1)
Total			**23(13+10)**

18AGR 303 GEOINFORMATICS AND NANO TECHNOLOGY FOR PRECISION FARMING 2(1+1)

Course outlines

Theory

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

Practical

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

Lecture outlines

Theory

1. AGRO Precision agriculture: concepts and techniques-Issues and concerns for Indian agriculture
2. AGRO Principles and practices of precision agriculture.
3. AGRO Geo-informatics- definition, concepts, tools and techniques and their use in Precision Agriculture.
4. AGRO Crop discrimination and Yield monitoring techniques
5. AGRO Geodesy and its basic principles
6. AGRO Spatial data and their management in GIS
7. AGRO Global positioning system (GPS) –Components and its application in agriculture
8. AGRO Application of nanotechnology in agriculture - tillage, seed, water, fertilizers, plant protection for scaling-up farm productivity
9. SSAC Cartography, units of cartography, map scale, various symbols used in cartography, Soil mapping techniques

10. SSAC Remote sensing- concepts, Spectral reflectance of various earth features, atmospheric windows
11. SSAC Applications of remote sensing techniques in the field of agriculture and allied sciences including drones.
12. SSAC Spatial variability of soil fertility, its determination, fertilizer recommendation using geospatial technologies in precision farming
13. SSAC Image processing and interpretation - geo referencing - supervised and unsupervised classification of RS images. STCR approach for precision agriculture - principles and computations
14. SSAC Nanotechnology, definition, concepts and techniques – Nano scale – definition – Nano-particles , materials - occurrence – properties
15. SSAC Characterization of nano-materials - structural characterization - Nanosensors
16. SSAC Nano-fertilizers , nano-pesticides - importance and advantages –synthesis – strategies

Practicals

1. SSAC GIS software, spatial data creation and editing.
2. SSAC Image processing software.
3. SSAC Visual and digital interpretation of remote sensing images.
4. SSAC Generation of spectral profiles of different objects.
5. AGRO Supervised and unsupervised classification and acreage estimation.
6. SSAC Multispectral remote sensing for soil mapping.
7. SSAC Creation of thematic layers of soil fertility based on GIS.
8. AGRO Creation of productivity and management zones.
9. AGRO Fertilizers recommendations based of VRT and STCR techniques.
10. AGRO Crop stress (biotic/abiotic) monitoring using geospatial technology. Use of drones for assessing crop damage.
11. AGRO Conduct of agricultural survey using GPS.
12. AGRO Use of GPS for watershed management
13. AGRO Use of GPS for crop yield estimation
14. SSAC Formulation, characterization of nanoparticles
15. SSAC Applications of nanoparticles in agriculture.
16. AGRO Projects formulation and execution related to precision farming.

References

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

18 PAT 302 DISEASES OF FIELD AND HORTICULTURAL CROPS AND THEIR MANAGEMENT-II 2 (1+1)

Course outlines

Theory

Symptoms, etiology, disease cycle and management of following diseases: Citrus: canker, gummosis, felt, tristeza and greening; Mango: anthracnose, malformation,bacterial blight, powdery mildew, sooty mould, red rust and Loranthus; Guava: wilt and anthracnose; Papaya: foot rot, anthracnose, leaf curl and mosaic and powdery mildew,Ber: Powdery mildew; Sapota: Flat limb,;Banana: Panama wilt, bacterial wilt, Erwinia rhizome rot, Sigatoka, bunchy top, banana mosaic and banana bract mosaic; Pomegranate: Anthracnose and bacterial blight; Grape vine: downy mildew, Powdery mildew, anthracnose, alternaria leaf spot and rust; Apple: scab, powdery mildew, fire blight and crown gall; Peach: leaf curl ; Strawberry: leaf spot Chillies: Damping off, anthracnose and fruit rot, wilt, powdery mildew, Choanephora blight cercospora leaf spot, bacterial leaf spot, mosaic complex and leaf curl; Brinjal: Phomopsis blight and fruit rot, bacterial wilt, Sclerotinia blight and little leaf; Okra:Cercospora leaf spot, powdery mildew and Yellow Vein Mosaic; Potato: early and late blight, black scurf, common scab,wart, black leg, brown rot, leaf roll, mosaics, potato spindle tuber; Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl, Septoria leaf spot, bacterial canker, root knot, Tomato spotted wilt and mosaic; Cruciferous vegetables: Club root, white rust, Downy mildew, powdery mildew, Alternaria leaf spot and black rot; Cucurbits: downy mildew, powdery mildew, Cercospora leaf spot, wilt and CMV; Betelvine: Root and stem rot, Sclerotial wilt,Fusarial wilt, Anthracnose; Onion and garlic: Smudge, smut,purple blotch, and Stemphylium blight; Beans: anthracnose, rust, yellow mosaic, Bean common mosaic virus and bacterial blight; Colocasia: Phytophthora blight; Coriander: stem gall; Coconut: Stem bleeding, Ganoderma wilt, bud rot, grey blight and tatipaka; Oilpalm: Bunchrot and spear rot ; Tea: blister blight; Coffee: rust; Turmeric: leaf spot, leaf blotch, rhizome rot; Ginger: rhizome rot/soft rot, leaf spot; Mulberry:powdery mildew; Rose: dieback, powdery mildew and black leaf spot; Marigold: Botrytis blight; Chrysanthemum: wilt, stunt, septoria blotch;.Jasmine: rust; Crossandra : wilt

Practical

Identification and histopathological studies of selected diseases of 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

Lecture outlines

Theory

Study of etiology, symptoms, host-parasite relationship and specific management practices of the following diseases.

1. Citrus diseases - Citrus canker, gummosis (*Phytophthora* and *Diplodia*), felt, tristeza and greening.
2. Mango diseases:anthracnose, malformation, bacterial leaf spot, powdery mildew, sooty mold, red rust and Loranthus.

3. Guava, Papaya, Ber and Sapota diseases –Guava: wilt and anthracnose.Papaya: foot rot, anthracnose, leaf curl and mosaic and powdery mildew.Ber: Powdery mildew. Sapota: Flat limb.
4. Banana and Pomegranate diseases –Banana: Panama wilt, bacterial wilt, Erwinia rhizome rot, Sigatoka,bunchy top, banana mosaic and banana bract mosaic. Pomegranate: Anthracnose and bacterial blight.
5. Grapevine diseases – downy mildew, Powdery mildew, anthracnose, Alternaria leaf spot and rust.
6. Apple and Peach diseases –Apple: scab, powdery mildew, fire blight and crown gall Peach: leaf curl.
7. Chillies diseases - Damping off, die-back and fruit rot, Fusarium wilt, powdery mildew, Choanephora blight,Cercospora leaf spot, bacterial leaf spot, mosaic complex and leaf curl.
8. Brinjal and Okra diseases –Brinjal- Phomopsis blight and fruit rot, bacterial wilt and little leaf. Okra-Cercospora leaf spot, powdery mildew and Yellow Vein Mosaic.
9. Potato diseases - early and late blight, black scurf, common scab, wart, black leg, brown rot, leaf roll, mosaics, potato spindle tuber.
10. Tomato diseases - damping off, Ralstonia wilt, early blight, buck eye rot and leaf curl, Septoria leaf spot, bacterial canker, root knot, Tomato spotted wilt and mosaic.
11. Crucifers and Cucurbits diseases –Cruciferous vegetables- Club root, white rust, Downy mildew, powdery mildew, Alternaria leaf spot and black rot. Cucurbits: downy mildew, powdery mildew, Cercospora leaf spot, Erwinia wilt and CMV.
12. Betelvine, onion and garlic diseases –Betelvine: Phytophthora root and stem rot, Sclerotial wilt, Fusarial wilt, Anthracnose. Onion and garlic: Smudge, smut, purple blotch, and Stemphylium blight.
13. Beans, Colocasia and Coriander diseases –Beans- anthracnose, rust, Bean common mosaic virus and bacterial blight. Colocasia: Phytophthora blight. Coriander- stem gall.
14. Coconut and oil palm diseases –Coconut- Stem bleeding, Ganoderma wilt, bud rot, grey blight and Tatipaka disease.Oil palm- Bunch rot and spear rot. Tea- blister blightCoffee- rust.
15. Turmeric, ginger and mulberry diseases –Turmeric- leaf spot, leaf blotch, rhizome rot Ginger: rhizome rot/soft rot, leaf spot. Mulberry- powdery mildew.
16. Rose- dieback, powdery mildew and black leaf spot. Marigold: Botrytis blight Chrysanthemum- wilt, stunt, Septoria blotch. Jasmine- rust. Crossandra - wilt

Practical

Studies of symptoms, Identification and histopathological studies of the following diseases
1. Citrus diseases.
2. Mango diseases.
3. Ber, guava and sapota diseases.
4. Field visits for the diagnosis of crop diseases.
5. Papaya, banana and pomegranate diseases.
6. Grape and Apple diseases.
7. Chilli, brijnal and Bhendi diseases.
8. Field visits for the diagnosis of crop diseases.
9. Potato and tomato diseases.
10. Crucifers and cucurbits diseases.
11. Betelvine, Onion, Beans, Colocasia and Coriander diseases.

12. Field visits for the diagnosis of crop diseases.
13. Coconut and oilpalm diseases.
14. Tea, Coffee, Turmeric and Ginger diseases.
15. Mulberry, Rose, Jasmine and Chrysanthemum diseases.
16. Field visits for the diagnosis of crop diseases.

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

References

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

18 HOR 302 POST-HARVEST MANAGEMENT AND VALUE ADDITION OF FRUITS AND VEGETABLES 2 (1+1)

Course outlines

Theory

Importance of fruits and vegetables, extent and possible causes of post harvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Role of ethylene; Post harvest disease and disorders; Heat, chilling and freezing injury; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric); Value addition concept; Principles and methods of preservation; Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards; Fermented and nonfermented 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, Preparation of Jelly, Preparation of RTS, Preparation of Nectar, Preparation of 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

Lecture outlines

Theory

1. Scope and Importance of post harvest technology of fruits and vegetables- Extent and possible causes of post harvest losses- Causes of post harvest losses.
2. Pre-harvest factors affecting postharvest quality, maturity, ripening and shelf life of fruits and vegetables – Environmental factors (Temperature, Light, Rainfall, Wind, Relative humidity) – Cultural factors – (Rootstock, Variety, Mineral nutrients, growth regulators, Irrigation, pruning, thinning, girdling) – Maturity – Pest and diseases.
3. Changes occurring during ripening – Ripening definition- Climacteric and nonclimacteric fruits – Metabolic changes - Maturation of seeds – Colour – Texture - Changes in carbohydrates- Changes in aromatic volatiles - Changes in organic acids – Fruit abscission – Changes in respiration rate – Development of surface waxes – Changes in tissue permeability.
4. Causes for deterioration of harvested fruits and Vegetables -Respiration and factors affecting respiration rate – Transpiration and factors affecting transpiration - Ethylene –Mechanical damage – Pest and Diseases.
5. Post harvest diseases and disorders - Heat, chilling and freezing injury.
6. Harvesting and field handling – Methods of harvesting – Post harvest handling – Pre-cooling - Sorting and grading – Disinfestation – Post harvest treatments (Waxing, Wrapping, de-greening, ripening).
7. Storage – Methods of storage – Traditional storages (In-situ, pit storage, high altitude, clamp storage, wind breaks, cellars, barns, Night ventilation, Evaporative cool storage ZECC) -

Improved storage methods (Refrigerated storage, modified atmospheric storage, controlled atmospheric storage, hypobaric storage).

8. Value addition – Concept – Scope and importance of fruit preservation in India –
Status of fruit preservation in India.

9. Principles and methods of preservation – Principles of preservation – Preservation methods – High temperature, low temperature, drying, filtration, chemicals, food additives, fermentation, carbonation, antibiotics, irradiation etc.

10. Intermediate moisture foods - Jam, jelly, marmalade – Problems in Jam makingimportant considerations and problems in Jelly making- Problems in marmalade making.

11. Preserve, candy – Concepts and Standards – Flow chart for manufacturing of preserve and candy – Problems in preservation of preserve and candied fruits – Glazed fruits/vegetables.

12. Fruit beverages –Fermented (Juices, Ready to serve, Nectar, cordial, Squash, crush, Syrup, Fruit Juice concentrate, Fruit Juice, Powder, Carbonated beverages) and non-fermented beverages (Wine, Champagne, Port, Sherry, Tokay, Muscat, Perry, Nira, Feni, Cider) – Preparation and preservation of unfermented fruit beverages.

13. Tomato processing - Concepts and Standards – Tomato juice – Tomato puree and paste – Tomato sauce/ketchup- Tomato chutney/pickle –Tomato cocktail – Tomato soup – Canned tomatoes.

14. Drying/dehydration of fruits and vegetables – Factors affect the rate of drying – Advantages of dehydration over sun drying – Process of drying/dehydration of fruits and vegetables – Spoilage of dried fruits and vegetables - Freezing – Methods of freezing.

15. Canning of fruits and vegetables – Selection of fruits and vegetable - Causes of spoilage of canned foods – Testing for defects - Containers for packing of canned products – Tin containers, glass containers.

16. Packaging of products - Definition – Properties of good packaging material – Different packaging materials for fresh fruits and vegetables for export – Cushioning materials – Purpose – Characteristics of cushioning material.

Practical

1. Applications of different types of packaging containers for shelf life extension.
2. Effect of temperature on shelf life and quality of produce.
3. Demonstration of chilling and freezing injury in vegetables and fruits.
4. Extraction and preservation of pulps and juices.
5. Preparation of jam.
6. Preparation of jelly.
7. Preparation of RTS.
8. Preparation of nectar.
9. Preparation of squash.
10. Preparation of osmotically dried products.
11. Preparation of fruit bar and candy.
12. Preparation of tomato sauce.
13. Preparation of tomato ketchup.
14. Preparation of canned products.
15. Quality evaluation of products - (physic-chemical and sensory).
16. Visit to processing unit/ industry.

References

1. Rathore, N.S., Mathur, G.K., Chasta, S.S. 2012. *Post-harvest Management and Processing of Fruits and Vegetables.* ICAR, New Delhi.

2. Srivastava, R.P. and Sanjeev Kumar. 2002. *Fruit and Vegetable Preservation: Principles and Practices.* International Book Distribution Company, Lucknow.

3. Giridharilal, G.S., Siddappa and Tondon, G.L. 2007. *Preservation of Fruits and Vegetables*. ICAR, New Delhi.

4. Mitra, S.K. 2005. *Post Harvest Physiology and Storage of Tropical and Subtropical Fruits*. CABI Publishers, Kolkatta.

18 AEN 302 PESTS OF HORTICULTURAL CROPS AND THEIR MANAGEMENT & BENEFICIAL INSECTS 3(2+1)

Course outlines

Theory

General account on nature and type of damage by different arthropod pests. Scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific names, order, family, host range, distribution, nature of damage and control practices for other important arthropod pests of various vegetable crops, fruit crops, plantation crops, ornamental crops, narcotics, spices and condiments.

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

Importance of beneficial insects, bee keeping, pollinating plants and their cycle, bee biology, commercial methods of rearing, equipment used and seasonal management. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee. Species of lac insect, morphology, biology, host plant and lac production – Processing of lac - seed lac, button lac, shellac and lac- products.

Identification of major parasitoids and predators commonly used in biological control. Insect orders bearing predators and parasitoids used in pest control and their mass multiplication techniques. Important species of pollinators, weed killers and scavengers and their importance.

Practical

Identification of different types of damage. Identification and study of life cycle and seasonal history of various insect pests attacking horticultural crops - vegetable crops, fruit crops, plantation gardens, narcotics, spices & condiments. Visit to orchards and gardens.

Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves.Types of silkworm, voltinism and biology and rearing of silkworm and equipment. Honey bee species and castes of bees. Beekeeping appliances and seasonal management.Bee enemies and diseases.Bee pasturage, bee foraging and communication.

Species of lacinsect, host plant identification. Identification of other important pollinators, weed killers and scavengers. Visit to research and training institutions devoted to sericulture, beekeeping, lac culture and natural enemies.

Lecture outlines

Theory

General account on nature and type of damage by different arthropod pests. Scientific name, order, family, host range, distribution, marks of identification, bionomics, nature of damage, and management of major, minor insect pests and other important arthropod pests of various vegetable crops, fruit crops, plantation crops, ornamental crops, narcotics, spices and condiments.

1 Brinjal- Epilachna beetle, shoot and fruit borer, stem borer, mealy bug, aphid, leafhopper, lacewing bug, leaf webber and red spider mite- IPM practices.

2 Bhendi- Shoot and fruit borer, leafhopper and whitefly and spider mite - Tomato- Serpentine leaf miner, South American Leaf miner/ Tomato pink worm, fruit borer and whitefly - IPM practices.

3 Cucurbits- Fruit flies, pumpkin beetles, semilooper, serpentine leaf miner and pumpkin leaf eating caterpillar - Coccinia-Coccinia gall fly and aphids - IPM practices.

4 Crucifers- Diamond back moth, cabbage head borer, leaf webber, aphid, painted bug, tobacco caterpillar and cabbage butterfly - IPM practices.

5 Potato- Tuber moth - Sweet potato - Sweet potato weevil, hairy caterpillar, tortoise beetle - Moringa- Hairy caterpillar, budworm, leaf webber and pod fly - Chillies- Thrips, pod borers, aphid, mites, blossom midge - Amaranthus- Leaf eating caterpillar, stem weevil - IPM practices.

6-7 Mango- Leafhoppers, stem borer, nut weevil, fruit fly, shoot borer, fruit borer, mealybug, aphids, leaf webber, termites, thrips, red tree ant, leaf gall midges and red spider mite - IPM practices..

8 Citrus- Butterfly, fruit sucking moths, leaf miner, psylla, rust mite, bark eating caterpillar, black fly and leaf mite.

9 Grapevine- Flea beetle, thrips, mealybug, stem girdler, stem borer, leaf eating caterpillars and root grub - IPM practices.

10 Cashew- Tree borer, shoot and blossom webber, tea mosquito bug, thrips and leaf miner Pomegranate- Butterfly, thrips and fruit sucking moths - IPM practices.

11 Guava- Tea mosquito bug, mealybug, fruit flies and spiralling whitefly - Sapota- Leaf webber, parijatha hairy caterpillar, mealybugs - Ber- Fruit fly, fruit borer and fruit weevil.

12 Banana- Rhizome weevil, skipper, aphid and pseudostem weevil - Papayawhiteflies, mealybugs and thrips - Apple - Woolly aphid and Codling moth – Custard apple- Mealybug - IPM practices

13 Coconut- Black headed caterpillar, rhinoceros beetle, red palm weevil, slug, termites, scale and mite - Oil palm- Black headed caterpillar, rhinoceros beetle and red palm weevil - IPM practices.

14 Arecanut- Scales - Cocoa - Scales - Cardamom- Thrips - Pepper- Pollu beetle and shoot borer - Eucalyptus - Gall wasp - Neem - Tea mosquito bug and white grub - IPM practices.

15 Turmeric and ginger- Rhizome fly and Lace wing bug - Betelvine- Shoot bug and tobacco caterpillar - Onion- Thrips and *Spodoptera exigua* - Coriander- Aphids and leaf eating caterpillar - Rose- Thrips, scales, leaf eating caterpillars and chafer beetles - Jasmine- Stink bug, bud worm and gall mite - Chrysanthemum- Aphid- IPM practices - Tobacco-Tobacco caterpillar, aphid, whitefly and stem borer - Coffee- White borer, red borer and green scale; Tea- Tea mosquito bug, thrips, red spider mite, pink mite, purple mite and scarlet mite- IPM practices.

16 Economically important mite, nematode (vegetables, citrus, banana and coconut), rodent (coconut) and bird pests of horticultural crops and their management. 17 Beneficial insects – Importance of silkworm, honeybee, lac insects, predators, parasitoids, pollinators, weed killers and scavengers.

18 Species of Silkworms - Characteristic features of Mulberry Silkworm, Tasar Silkworm, Eri Silkworm and Muga Silkworm and their hosts- Biology – Voltinism - Ahimsa silk.

19 Establishment of mulberry garden – Planting season and land preparation, preparation of planting material - Irrigation- spacing, varieties, planting inter cultivation, fertilization, irrigation, leaf harvest and leaf yield - Mulberry Planting under rainfed and irrigated conditions - Spacing and preparation of pits, planting, fertilization, inter-cultivation, maintenance, soil moisture

conservation and leaf harvest - Pests and diseases of mulberry plants and their management – Rearing house, rearing equipment and appliances-rearing stand, chawki rearing trays, late age rearing trays, paraffin wax coated paper, bird feathers, bed cleaning nets, chop sticks, rubber foam, ant well, mountages, chopping knife, chopping board, feeding basins, disinfection and hygiene in rearing house.

20 Mulberry silkworm races - Grainage centres, brushing of silkworm larvae, young age and late age silkworm rearing - Effect of temperature, humidity, air current and photoperiod - Leaf quality and leaf maturity on larval growth and survival – Feeding of late instars, bed cleaning and bed spacing for IV and V instars 21 Mounting- mountages, mounting density, harvesting and assessment of cocoon yield and cocoon characters for marketing - Defective cocoons.

22 Silk worm diseases- Pebrine- Symptoms, mode of transmission, stages of contamination and intensity, detection and control - Viral diseases- Nucleo polyhedron Virus and Cytoplasmic Polyhedro Virus - Symptoms, prevention and control. Grasserie - Symptoms, source of contamination, prevention and control - Infectious Flacherie - Symptoms, prevention and control - Fungal Diseases- White muscardine- Source of infection, symptoms, prevention and control - Uzi fly – Biology, nature of damage and symptoms and management.

23 Beekeeping- Importance and multiple source of income - Species of Honey bees- Rock bee, Little bee, Indian honey bee, European bee and Dammar bee - Bee biology- Life cycle - Caste determination in honey bees- Structural adaptations of honeybees.

24 Commercial methods of rearing, – Different types of the hive- Equipment - Smoker, bee veil, gloves, honey extractor, queen gate, queen excluder sheet, drone extruder, drone trap, comb foundation sheet, dummy division board, swarm trap, bee brush, feeder, queen cage and queen cell protector - Colony management in different seasons, winter, summer and rainy seasons.

25 Bee pasturage – Different species of pollen and nectar yielding plants- Honey flow season and dearth period – Communication in bees – Round dance and wag tail dance- Management of bees for crop pollination – Queen bee substance –Honey extraction, testing of honey, honey composition and value, bee wax, pollen, royal jelly, propolis, venom and its uses.

26 Enemies of bees and bee brood - Nature of damage and management of Greater wax moth, lesser wax moth, wax beetle, wasps, black ants, birds *etc*., - Nature of damage and management of honey bee - *mites, Acarapis woodi*, *Varroa jacobsoni* and *Tropilaelaps clareae.*

27 Bee diseases – Nature of damage and management of American foul brood disease, European foul brood disease, Sac brood disease, Thai sac brood disease, Chalk brood, stone brood disease, Nosema and Amoeba disease - Colony collapse disorder in bees.

28 Lac insect- Different species, morphology, behaviour, host plants, inoculation methods, natural enemies of lac insect and their management - Lac production – Processing, different forms of lac- raw lac, seed lac, shellac and lac by - products. Recent applications of lac.

29 Identification of biological control agents - Insect predators and parasitoids, pathogens, entomopathogenic nematodes.

30 Insect orders bearing predators and parasitoids used in pest control and their key identification characters (Dictyoptera: Mantidae; Hemiptera: Reduviidae, Anthocoridae, Lygaeidae, Pentatomidae; Neuroptera: Chrysopidae, Myrmeleontidae, Hemerobiidae; Coleoptera: Carabidae, Cicindelidae, Coccinellidae; Diptera: Asilidae, Tachinidae, Syrphidae; Lepidoptera: Noctuidae, Lycaenidae, Epipyropidae, Pyralidae; Hymenoptera: Vespidae, Braconidae, Ichneumonidae, Chalcididae, Trichogrammatidae, Platygasteridae, Elasmidae, Eulophidae, Scelionidae and Strepsiptera).

31 Mass production/multiplication methods of predators (Cheilomenes and Chrysoperla) parasitoids (Goniozus nephantidis).
32 Important species of pollinators, weed killers, and scavengers and their significance.

Practical

1 Identification of insect pests of Solanaceous and Malvaceous vegetables and their damage symptoms
2 Identification of insect pests of Cruciferous and Cucurbitacious vegetables and their damage symptoms
3 Identification of insect pests of leafy vegetables, potato, sweet potato, moringa and chilli and their damage symptoms (Potato and Chillies are Solanaceous crops).
4 Identification of insect pests of mango, cashew, citrus & banana and their damage symptoms.
5 Identification of insect pests of grapevine, pomegranate, sapota, papaya, apple, custard apple, ber and guava and their damage symptoms.
6 Identification of insect pests of coconut, arecanut, cocoa, cardamom, pepper, date palm & oil palm, eucalyptus and neem and their damage symptoms.
7 Identification of insect pests of spices, narcotics (turmeric, betel vine, onion, tobacco & ginger) and ornamental plants (jasmine, rose, chrysanthemum) and their damage symptoms.
8 Identification of economically important mite, nematode (vegetables, citrus, banana and coconut), rodent (coconut) and bird pests of horticultural crops and their management.
9 Acquaintance with silkworm species and small scale rearing of mulberry silkworm.
10 Acquaintance with different appliances of silkworm rearing, model rearing house and methods of disinfection.
11 Acquaintance with handling of chawki and late age silkworm rearing - Feed change and spacing techniques.
12 Dissection of silkworm larval mouthparts and salivary glands.
13 Acquaintance with important species of honey bees, caste system, structural adaptations, beekeeping appliances and different beehives.
14 Seasonal management of honey bees and their enemies and diseases.
15 Visit to nearby silkworm rearing and bee keeping centres.
16 Identification of various lac products.

References

1. Vasantharaj David, B. and V.V. Rama Murthy (2016). *Elements of Economic Entomology*, Popular Book Depot, Coimbatore.
2. Butani, D.K. and Jotwani, M.G. 1984. *Insects in Vegetables.* Periodical Export Book Agency, New Delhi.
3. Butani, D. K. 1984. *Insects and Fruits.* Periodical Export Book Agency, New Delhi.
4. Ganga , G and Sulochana Chetty, 1997. *Introduction to Sericulture,* Oxford and IBH publishing Co. Pvt. Ltd., New Delhi
5. Hisao Aragu 1994. *Principles of Sericulture,* Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.
6. Singh, S.1975. *Bee Keeping in India - Indian Council of Agriculture research,* New Delhi.
7. Mishra, R.C. 1995. *Honey Bees and Their Management in India* – Indian Council of Agricultural Research, New Delhi.

8. Glover, P.M.1937. *Lac cultivation in India.* The Indian Lac research Institute, Ranchi
9. Abrol, D.P. 2010. *Beekeeping: A Comprehensive Guide on Bees and Beekeeping.* Scientific publishers, Jodhpur
10. Nair, MRGk. 1990. *Monograph on Crop Pests of Kerala and their Control.* Trissur Directorate of extension, Kerala agricultural University.

18 GPB 302 CROP IMPROVEMENT-II (*Rabi Crops*) 2 (1+1)

Course outlines

Theory

Centers of origin, distribution of species, wild relatives in different fibres, sugars, starches, narcotics, vegetables, fruits and flower crops. Plant genetic resources, its utilization and conservation; Floral biology; study of genetics of qualitative and quantitative characters; Important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Ideotype concept and climate resilient crop varieties for future.

Practical

Emasculation and hybridization techniques in fibres, sugars, starches, narcotics, vegetables, fruits and flower crops;maintenance breeding of different crops,Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of quality characters, study of donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops.

Lecture outlines

Theory

1 Introduction – General breeding objectives – Concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops - Breeding populationsrelevance in crop improvement.

2 Fibres - Cotton and Jute- Origin – Distribution of species – Wild relatives and forms –Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids - Accomplishments.

3. Sugars and starches – Sugarcane - Origin – Distribution of species – Wild relatives and forms –Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties – Seed production technology of varieties and hybrids – Accomplishments.

4. Sugars and starches – Potato and sweet potato - Origin – Distribution of species – wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids - Accomplishments.

5 Narcotics - Tobacco- Origin – Distribution of species – Wild relatives and forms – breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids – Accomplishments.

6 Vegetables - Tomato andBrinjal - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties – Seed production technology of varieties and hybrids – Accomplishments.

7 Vegetables - Chilli and Okra - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids – Accomplishments.

8 Vegetables-Cucumber , Cabbage and cauliflower - Origin – Distribution of species – wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids – Accomplishments.

9. Vegetables - Garlic and Onion - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids - Accomplishments.

10 Vegetables - Gourds and Melons- Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties – Seed production technology of varieties and hybrids - Accomplishments.

11 Fruit crops - Banana and Guava - Origin – Distribution of species – Wild relatives and forms –Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids - Accomplishments.

12 Fruit crops-Mango and Papaya - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures(conventional and moderninnovative approaches) for development of hybrids / varieties-seed production technology of varieties and hybrids-Accomplishments.

13 Fruit crops - Lime , Lemons and Apple - Origin – Distribution of species – Wild relatives and forms –Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties – Seed production technology of varieties and hybrids - Accomplishments.

14 Fruit crops - Pomegranate andSapota - Origin – Distribution of species – Wild relatives and forms –Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties – Seed production technology of varieties and hybrids – Accomplishments.

15 Flower crops - Rose and Jasmine - Origin – Distribution of species – Wild relatives and forms – Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties – Seed production technology of varieties and hybrids - Accomplishments.

16 Flower crops - Chrysanthemum and Marigold - Origin – Distribution of species – wild relatives and forms –Breeding objectives – Major breeding procedures (conventional and modern innovative approaches) for development of hybrids / varieties - Seed production technology of varieties and hybrids - Accomplishments.

Practical

1. Hybridization techniques and precautions to be taken - Floral morphology, selfing, emasculation and crossing techniques in field crops.
2. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Cotton and Jute.
3. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Sugarcane and Tobacco.
4. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Tomato and Brinjal.
5. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Chilli and Okra.
6. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in and Cucumber, Cabbage and Cauliflower.
7. Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Garlic and Onion.
8 Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Bitter gourd and Water melon.
9 Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Bananaand Mango.
10 Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Papaya and Guava.
11 Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Lime and Lemon.
12 Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Rose and Jasmine.
13 Floral biology, anthesis, pollination, selfing, emasculation and crossing techniques in Marigold and Chrysanthemum.
14 Visit to Agricultural Research stations/AICRP Centres of crops.
15 Sources of donors for different characters in various crops & Parentage of released varieties / hybrids of important crops.
16 Study of special quality characters in various crops.

References

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

18 AGR 304 PRACTICAL CROP PRODUCTION – II (*Rabi Crops*) 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.

Any irrigated dry crop (maize / sorghum / pearl millet / finger millet / cotton / groundnut / sunflower / sesame)

Practical Schedule for Irrigated dry crop (Eg. Maize):

- Ecosystem - Climate and weather - Seasons and varieties of Tamil Nadu
- Selection of field - Main field preparation - seed treatment - Application of manures and fertilizers - Sowing - Weed management and practicing pre- emergence application of herbicides - Thinning and gap filling - Estimation of plant population - Top dressing - Weed management - Water management - Pest management - Observation on nutrient and weeds - Recording growth, yield attributes and yield
- Harvesting, threshing and cleaning the produce - Cost of cultivation and economics

Practical Schedule:

1. Study of ecosystems, climate, weather, seasons and varieties of Tamil Nadu
2. Selection of field for maize cultivation
3. Acquiring skill in seed treatment practices
4. Study and Practice of main field preparation for maize
5. Practicing of application of manures and fertilizers for maize
6. Practicing sowing of maize
7. Acquiring skill in pre-emergence application of herbicides
8. Estimation of plant population and acquiring skill in gap filling and thinning
9. Observation on nutritional deficiency symptoms and corrective measures

10. Study of weeds and weed management in maize

11. Recording growth parameters and assessing dry matter production

12. Study of water management practices for maize

13. Observation of insect pests and diseases and their management

14. Estimation of yield and yield parameters in maize

15. Harvesting, threshing and cleaning of the produce

16. Working out cost of cultivation and economics

17. **Practical Examination**

References:

Ahlawat, I.P.S., Om Prakash and G.S.Saini.2010. Scientific Crop Production in India. Rama Publishing House, Meerut.

Crop Production Guide. 2012. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.

Rajendra Prasad. 2012. Text Book on Field Crop Production, Indian Council of Agrl. Research, New Delhi.

E-References:

www.cimmyt.org

18 AGR 305 PRINCIPLES OF ORGANIC FARMING 2(1+1)

Theory:

Unit - I: Components and Principles of Organic Cotton

Organic farming: Definition - Scope - principles and concepts - history of organic farming - global scenario - biodiversity: importance and measure to preserve biodiversity - pre requisites for Organic farming:- Soil organic carbon: status and improvement strategies.

Unit - II: Organic sources of Nutrients

Organic sources of nutrients - manures and other inputs - on farm and off farm sources - organic waste recycling - methods - Soil and crop management - inter cropping, crop rotation, green manures, cover crops, mulching - bio fertilizers.

Unit - III: Non - Chemical weed and Pest disease management

Non-chemical weed management methods: preventive, physical, cultural, mechanical and biological measures - Bio-intensive pest and disease management.

Unit - IV: Indigenous Technical Knowledge (ITK)

Indigenous Technical Knowledge (ITK) in organic agriculture - scientific rationale - soil, nutrient, weed, water, management - prospects and problems in organic farming. **Unit -**

V: Certification of label

Organic certification - NPOP guidelines - Certification agencies in India - crop production standards - Quality considerations - labeling and accreditation process - marketing and export opportunities.

Practical:

Experiencing organic farming practices - soil, seed, nutrient, weed, water, pest and diseases, post - harvest management - hands on experience on bio composting, vermicomposting, ITK based biological preparations, bio - inoculants - quality aspects of inputs and products - grading, packaging - visit to organic farms, market outlets and organic certification (TNOCD).

Theory - Lecture Schedule:

1. Organic farming; definition - prospects - principles and concepts - History and genesis of organic farming in World and India: Present status in World, India and Tamil Nadu.

2. Introduction to bio - diversity; importance and measures to preserve bio - diversity.

3. Pre-requisites and basic steps for organic farming; conversation to organic farming - planning and processes in practices - IFS approach - Integration of animal components.

4. Organic carbon; status and improvement strategies - conservative tillage systems.

5. Sources of organic manures - plant, animal and microbial origin - on - farm resources; FYM, green manures, crop residues, poultry manure, sheep and goat manures, biogas slurry and vermicompost.

6. Off-farm resources; coir pith, press mud, oilcakes, flyash, bio compost, minerals, bone meal, bio fertilizers, traditional preparations.

7. Organic waste recycling methods and techniques - composting, vermicomposting, *in situ* composting - system approach.

8. **Mid-Semester Examination.**

9. Soil and crop management in organic farming; Inter cropping and companion planting, crop rotation , green manures and cover crops, mulching.

10. Weeds - Ecology - habitat management of weeds - Non - chemical weed management methods; preventive, physical, cultural, use of tools and implements and biological measures - good crop husbandry practices.

11. Integrated pest and diseases management - bio control agents, bio rational pesticides; minerals, botanicals, soaps, trap crops, bird perches, and traditional preparations - sanitation.

12. Organic certification - procedures - certification agencies in India - labeling and accreditation processes.

13. Crop production standards - NPOP guidelines - principles, recommendations and

standards - Quality considerations - assessment methods - premium and export

opportunities.

14. Indigenous technical knowledge (ITK) in organic agriculture - rationale and principles - general, indigenous practices for soil, nutrient, weed, water pest and disease management in farming - ITK‘s in farmers practice.

15. Benefits and problems in organic farming.

16. Organic farming; Promotional activities; role of government and NGO‘s - action plan - policy considerations.

17. Economic evaluation of organic production systems - cost - benefit analysis and comparison with conventional systems.

Practical:

1. Resource inventory of organic farm- Soil sampling and analysis for organic carbon and pesticide residues / contaminants.

2. Raising of green manures (Sunnhemp / Daincha / Fodder cowpea).

3. Incorporation of green manure - seed treatment and raising of field crop (Rice / Maize / Cowpea / Cotton / Gingelly).

4. Hands on practice on preparatory cultivation; soil and water conservation methods.

5. Hands on experience on recycling techniques; bio-composting and vermicomposting.

6. Quantification of nutrients from organic sources and application of manures and bio-fertilizers.

7. Exposure visit to an organic farm to learn ITK based preparations.

8. Organic crop production and weed management.

9. Exposure visit to bio-pesticide and pheromone manufacturing units.

10. Organic crop production and pest management.

11. Exposure visit to bio-control agent (*Pseudomonas, Trichoderma* etc.,) production units.

12. Organic crop production and diseases management.

13. Exposure on macro quality aspects of crop produces in laboratories.

14. Hands on training on grading, packaging and post-harvest management.

15. Exposure visit to organic market out lets.

16. Exposure visit to organic certification agencies / Directorate of Organic Certification, Tamil Nadu.

17. Practical Examination

References:

Dahama, A.K.2009. Organic farming for sustainable agriculture, Agrobros publishers.

SP. Palaniappan and K Annadurai. 2008. Organic Farming: Theory and Practice. 2008. Scientific Publishers.

E:References:

www.ifoam.org
www.apeda.org
www.cowindia.org
www.ncof.org
www.earthfooda.co.uk
www.newfarm.org/training

18 AEC 301 FARM MANAGEMENT, PRODUCTION AND RESOURCE ECONOMICS 2 (1+1)

Course outlines

Theory

Meaning and concept of farm management, definitions, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, changing structure of land holdings in India and characteristics of small and marginal farm holdings. Farm management problems in India.

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, time comparision principle.

Meaning and concept of cost, types of costs and their interrelationship, cost function /cost-output relationship, importance of costs in managing farm business and Cost Principle.

Farm inventory, appraisal and valuation of farm resources and products, Meaning and importance of farm planning and budgeting, Partial budget, enterprise budget and complete budgeting, steps in farm planning and budgeting-linear programming, Concept of risk and uncertainty 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 Natural 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

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

Lecture outlines

Theory

1. Meaning and concept of farm management, definitions, objectives and relationship with other sciences - Importance of study of farm management - Farm management problems in India.
2. Meaning and definitions of types and systems of farming and their characteristics - Changing structure of land holdings in India - Characteristics of small, marginal and tenant farm holdings.
3. Concept of production function and its types, use of production function in decision -Making on a farm - Seven principles of farm management.

4. Factor - Product relationship – Law of variable proportions – Definition, graphical and arithmetical explanation with the help of an example.
5. Determination of optimum input and optimum output and decision rules.
6. Factor-Factor relationship, resources and types - Substitutes and complements, variable and fixed resources - Iso-quants - Iso-cost lines - Meaning and characteristics - Principle of least cost combination/ Principle of factor substitution – Explanation and decision rules.
7. Product-Product relationship - Iso- product curves and Iso-revenue lines – Meaning and characteristics - Principle of optimum product combination - Law of equimarginal returns/ principles of opportunity cost, decision rules.
8. Types of enterprises and their characteristics - Principle of comparative advantage.
9. Meaning and concept of cost, cost function /cost-output relationship - Types of production costs and their interrelationship - Importance of costs in managing farm business - Minimum loss principle (Cost Principle) and decision rules – Time comparison principle – compounding and discounting.
10. Farm inventory - Meaning and importance of taking inventory on farm business - Different methods of appraisal and valuation of farm resources and products.
11. Farm planning and budgeting - Meaning and importance, partial budgeting, enterprise budgeting and complete budgeting, steps in farm planning and budgeting.
12. Linear programming-Meaning - Definition, LP mathematical model specification, importance in farm decision making, basic assumptions, limitations.
13. Concepts of risk and uncertainty in agriculture production, nature and sources of risks and uncertainty and management strategies.
14. Economy and environmental linkages - How economic activity affects life on a planet with limited resources and a fragile environment - Concepts of natural resource economics - Ecological equilibrium, direct use value and indirect use value, willingness to accept and willingness to pay, contingent valuation, opportunity cost, discounting, societal cost - benefit analysis, consumer surplus, carbon sequestration - Unique properties of natural resources.
15. Environmental costs of economic growth - Sustainable development - Positive and negative externalities in agriculture - Inefficiency and welfare loss, solutions.
16. Important issues in economics and management of common property resources of land, water, pasture and forest resources etc. - India’s environmental policy.

Practical

1 & 2. Different methods Computation of depreciation cost of farm assets.
3. Determination of most profitable level of inputs use and output in farm production process.
4. Determination of least cost combination of inputs
5. Application of equi-marginal returns/opportunity cost principle in allocation of farm resources.
6. Selection of most profitable enterprise combination.
7 & 8. Farm holding surveys.
9.& 10. Application of cost principles - CACP concepts in the estimation of cost of mono cropping and poly cropping and livestock enterprises.
11. Farm business analysis - Estimation of different farm income measures, technical and economic efficiency measures and breakeven analysis.
12. Preparation of partial budgets and enterprise budgets.

13. Visit to college farm and study different farm records and accounts and prepare profit and loss account.

14 -16. Collection and analysis of data on various natural resources in India - Land - Changes in land use pattern, forests – Water - Changes in ground water and surface water resources - Changes in labour resources - Agricultural workers - Pollution and green gas emissions - Biodiversity, etc.

References

1 Bishop, C.E. and W. D. Tousaint. 1958. *Introduction to Agricultural Economic Analysis*. John Wiley and Sons, London.

2 Heady, Earl O. 1964. *Economics of Agricultural Production and Resource Use*. Prentice Hall of India, Private Limited, New Delhi

3 S.S. Johl, J.R. Kapur. 2006. *Fundamentals of Farm Business Management*.

4 Kalyani Publishers, New Delhi.

5 Kahlon, A.S. and Karam Singh. 1965. *Principles of Farm Business Management*. Kalyani Publishers, New Delhi.

6 Raju, V.T. and D.V.S. Rao. 2006. *Economics of Farm Production and Management*. Oxford & IBH Publishing Co. Pvt. Limited, New Delhi

7 www.core_economics.org

18 FSN 301 PRINCIPLES OF FOOD SCIENCE AND NUTRITION 2 (2+0)

Course outlines

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.

Lecture outlines

1 Concepts of food science - Definitions of food, specific nutrients in foods and their functions - Physical characterstics of foods - Importance

2 Food physical characteristics - Density - Phase change, pH, osmosis, surface tension, colloidal systems.

3 Food composition - Food chemistry - Water, solutions, water balances in body, clinical signs of water depletion, excessive water intake, recommended requirements

4 Carbohydrates - Structure, properties of sugars, starches, cellulose and hemicelluloses, pectin, gums.

5 Proteins - Structure, amino-acids, properties.

6 Fats and oils - Structure, functional aspects.

7 Vitamins - Retinol, vitamin D, vitamin E, vitamin K, ascorbic acid, B-complex group

8 Minerals, pigments, colours, flavours

9 Natural emulsifiers.

10 Organic acids.

11 Oxidants and antioxidants.

12 Enzymes.

13 Food microbiology - Morphology and fine structure of bacteria - Cultivation of bacteria, nutritional requirements -Nutritional classification of bacteria.

14 Introduction to yeast, algae and protozoa and virus, general characteristics

15 Microbial spoilage of foods - Factors affecting kinds, numbers, growth and survival of microorganisms in foods.

16 Production of fermented foods - Production, purification and estimation of beer/ ethanol.

17 Preservation by heat treatment - Principle and equipment for blanching.

18 Preservation by heat treatment - Canning, pasteurization, sterilization.

19 Preservation by use of low temperature - Principle, methods, equipment

20 Preservation by chemicals - Antioxidants, mould inhibitors, antibodies, acidulants, etc.

21 Preservation by irradiation - Principle, methods, equipment.

22 Preservation by fermentation - Principles, methods, equipment

23 Preservation by drying, dehydration and concentration - Principle, methods, equipment.

24 Food and nutrition - History of diet around the world - European diet.

25 Malnutrition (over and under nutrition), body cell, digestion and absorption, energy and calories, obesity and weight control.
26 Nutritional disorders that can compromise health.
27 Energy metabolism - Carbohydrates, individual sugars, sugars and diabetes mellitus, glycemic response, dietary carbohydrates
28 Energy metabolism - Fat, synthesis, control, biosynthesis, cellular degradation, peroxidation.
29 Energy metabolism - Proteins, synthesis, catabolism, ammonia and urea.
30 Balanced/modified diets, diet selection.
31 Menu planning.
32 New trends in food science and nutrition.

References

1. Sumati R. Mudambi, Shalini M. Rao and M.V. Rajagopal. 2006. *Food Science,* 2nd Ed. New Age International (P) Limited, New Delhi.
2. Martin Eastwood. 2003. *Principles of Human Nutrition.* Blackwell Science Ltd., Oxford.
3. Norman N. Potter. 1998. *Food Science,* 5th Ed. Springer Science+ Business Media, New York.
4. Michael J. Pelczar Jr., E.C.S. Chan and Noel R. Krieg. 1998. *Microbiology,* 5th Ed. Tata McGraw-Hill Education, New Delhi.
5. William C. Frazier and & Dennis C. Westfoff. 1987. *Food Microbiology,* 4th Ed. Tata McGraw-Hill Education, New Delhi.
6. L.E. Casida Jr. 1968. *Industrial Microbiology.* New Age International Publishers, New Delhi.
7. P. Fellows. 2000. *Food Processing Technology: Principles and Practice,* 2nd Ed. CRC Press, Boca Raton, FL, USA.
8. Marcus Karel and Darvl B. Lund.2003. *Physical Principles of Food Preservation,* 2nd Ed. Marcel Dekker, Inc., NY, USA.
9. Gerald Wiseman. 2002. *Nutrition and Health.* Taylor & Francis, London.
10. *An Introduction to Nutrition*, v. 1.0

18 PCA 301 PROTECTED CULTIVATION AND SECONDARY AGRICULTURE 2(1+1)

Course outlines

Theory

Greenhouse technology – Introduction - Types of greenhouses - Plant response to greenhouse 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 greenhouse - Hot air greenhouse heating systems - Greenhouse drying - Cost estimation and economic analysis.

Important engineering properties such as physical - Thermal and aerodynamic properties of cereals - Pulses and oilseeds - Their application in PHT equipment design and operation - Drying and dehydration - Moisture measurement – EMC - Drying theory - Various drying methods - Commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, re-circulatory dryer and solar dryer) - Material handling equipment - Screw conveyer and bucket elevator - Their principle - Working and Selection - Primary processing of cereals, pulses and oilseed, like cleaning, grading, packaging etc.

Practical

Study of different type of greenhouses based on shape - Determine the rate of air exchange in an active summer winter cooling system - Determination of drying rate of agricultural products inside greenhouse - Study of greenhouse equipment - 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 - Exposure to primary processing equipment like dalmills, graders, cold storages etc. - Field visit to seed processing plant.

Lecture outlines

Theory

1. Introduction to green houses - History, definition, greenhouse effect, advantages of green houses.
2. Brief description of types of green houses - Greenhouses based on shape, utility, construction, covering materials and cost, shade nets.
3. Plant response to greenhouse environments - Light, temperature, relative humidity, ventilation and carbon dioxide and environmental requirement of agriculture and horticulture crops inside green houses.
4. Equipment required for controlling green house environment – Summer cooling and winter cooling, natural ventilation, forced ventilation and computers.
5. Planning of green house facility - Site selection and orientation, structural design and covering materials.
6. Materials for construction of green houses - Wood, galvanized iron, glass, polyethylene film, poly vinyl chloride film, Tefzel T2 film, fiberglass reinforced plastic rigid panel and acrylic and polycarbonate rigid panel.

7. Design criteria and constructional details of greenhouses - Construction of pipe framed greenhouses, material requirement, preparation of materials and procedure of erection.
8. Greenhouse heating and distribution systems - Greenhouse utilization - Off-season drying of agricultural produce - Economic analysis of greenhouse production - Capital requirement, economics of production and conditions influencing returns.
9. Irrigation system used in greenhouses - Rules of watering, hand watering, perimeter watering, overhead sprinklers, boom watering and drip irrigation.
10. Important engineering properties such as physical, thermal and aero-dynamic properties of cereals, pulses and oil-seeds.
11. Designing post harvest equipment based on physical and thermal properties.
12. Winnowing - Manual and power operated winnowers, care and maintenance - Groundnut decorticators - Hand and power operated decorticators, principle of working, care and maintenance.
13. Moisture measurement - Equilibrium moisture content (EMC) – importance - Drying theory - Drying and dehydration.
14. Commercial grain dryers - Deep bed, flat bed, tray, fluidised bed, recirculated and solar dryers.
15. Material handling equipment - Bucket elevator and screw conveyer and their selection.
16. Primary processing of cereals, pulses and oilseeds - Cleaning, grading and packaging.

Practical

1. Study of different types of green houses based on shape, etc.
2. Computing the rate of air exchange in an active summer and winter cooling systems.
3. Feasibility study on drying of agricultural products inside a greenhouse and its calculation.
4. Visit to post harvest technology units and laboratories.
5. Determination of moisture content of various grains by oven drying and infrared methods.
6. Determination of size, space, porosity, bulk density, etc., of grains.
7. Determination of aerodynamic properties of grains.
8. Cleaning and grading of grains, pulses and oilseeds.
9. Drying and dehydration of vegetables (cauliflower).
10. Visit to rice mill.
11. Study of LSU dryer.
12. Study of Bucket elevator and screw conveyor.
13. Visit to dhal mill
14. Visit to oil seed processing plant.
15. Visit to cold storage
16. Practical final examination

References

1. Radha Manohar, K and Igathinathane. C. *Greenhouse Technology and Management*, 2nd Edition, BS Publications.
2. Tiwari, G.N. *Greenhouse Technology for Controlled Environment*. Narosa Publishing house Pvt.Ltd.
3. Singh Brahma and Balraj Singh., 2014. *Advances in Protected Cultivation*, New India Publishing Company.

4. Sahay, K.M. and Singh, K.K. 1994. *Unit operations of Agricultural Processing*. Vikas Publishing house Pvt. Ltd. New Delhi.
5. Chakraverty, A. *Post Harvest Technology of cereals, pulses and oilseeds*. Oxford & IBH publishing Co. Ltd., New Delhi.
6. Ojha, T.P and Michael, A.M. *Principles of Agricultural Engineering*, Vol. I, Jain Brothers, Karol Bag, New Delhi.

VII Semester				
No.	**Course Code**	**Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & ALA)**		
		Activites	**No. of weeks**	**Credit Hours**
1	18 AEX 401	General orientation & On campus training by different faculties	1	14
		Village attachment	8	
		Unit attachment in Univ./ College. KVK/ Research Station Attachment	5	
		Plant clinic	2	02
		Agro-Industrial Attachment	3	04
		Project Report Preparation, Presentation and Evaluation	1	
		Total weeks for RAWE & ALA	**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
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, Post harvest-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.**

VIII Semester

S. No.	Course Code	Course Title	Credit Hours
1	18 EXP 401	Experiential Learning - Module I	0+10
2	18 EXP 402	Experiential Learning - Module II	0+10

Sl. No.	Title of the module	Credit Hours
1	Production Technology for Bioagents and Biofertilizer	0+10
2	Seed Production and Technology	0+10
3	Mushroom Cultivatiuon 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
9	Food Processing	0+10
10	Agriculture Waste Management	0+10
11	Organic Production Technology	0+10
12	Commercial Sericulture	0+10

*Experiential Learning

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

S. No.	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 Issues	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)

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

Practical

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

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 potassiumchloride, 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 insecticides to be used. To study and identify various formulations of insecticide available kin market. Estimation of nitrogen in Urea. Estimation of water soluble P2O5 and citrate soluble P2O5 in single super phosphate. Estimation of potassium in Muraite 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, FSSA. Global Scenario CAC. Other laws and standards related to food. Recent concerns- New and Emerging Pathogens. Packaging, Product labeling and Nutritional labeling. Genetically modified foods\ transgenics. Organic foods. Newer approaches to food safety. Recent Outbreaks. Indian and International Standards for food products.

Practical

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

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 biorationales. Botanicals and their uses. Mass production technology of bio-pesticides. Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes. Methods of application of biopesticides. Methods of quality control and Techniques of biopesticides. Impediments and limitation in production and use of biopesticide. Biofertilizers - Introduction, status and scope. Structure and characteristic features of bacterial biofertilizers- Azospirillum, Azotobacter,

Bacillus, Pseudomonas, Rhizobium and Frankia; Cynobacterial biofertilizers- Anabaena, Nostoc, Hapalosiphon and fungal biofertilizers- AM mycorrhiza and ectomycorhiza. 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 biofertiizers. 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, Metarhyzium 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 Cultivation 3(2+1)

Theory

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

Practical

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

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 agrochemicals 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, Crop models, concepts & techniques, types of crop models, data requirements, relational diagrams. 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 agroadvisory.

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 outing.

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.

Experiential Courses: A student can select three elective courses out of the following and offer during 8th semester.

Sl. No.	Title of the module	Credit Hours
1	Production Technology for Bioagents and Biofertilizer	0+10
2	Seed Production and Technology	0+10
3	Mushroom Cultivatiuon 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
9	Food Processing	0+10
10	Agriculture Waste Management	0+10
11	Organic Production Technology	0+10
12	Commercial Sericulture	0+10

18 EXP 401 & 402 Organic Production Technology (0 +10)

Organic nutrient and weed management

Quantification of cow dung and cow urine recovery per animal - analysis their nutrients constituents-Methods of storing of cow dung - analysis of temperature, nutrients and microbial load in different layers of manure pit -Quantification of yield and nutrient content of fodder crops grown organically-Quantification of biomass for different green manures and green leaf manures grown organically-Experiencing mulching and other techniques in weed management.

Biofertilizers preparation

Introduction to biofertilizers and equipments – Isolation of bacterial biofertilizers – Method of application of biofertilizers – Arbuscular Mycorrhizal Fungi – Production and Assessment of infective propagules – Cyanobacterial biofertilizer – PPFM and liquid bioinoculants

Organic manure preparation

Biological wastes, farm wastes: collection, segregation, pre digestion of wastes, Biocompost preparation in pit method and vermicompost bed formation - Preparation of Panchagavya, Jeevamruth and EM and characterization – Harvest of biocompost and vermicompost – Compost maturity indices – FAO standard – Enriched compost preparation – Preparation of bankable project on establishment of organic input production unit.

Eco-friendly Pest Management

Establishment of model pest repellants cafeteria - Preparation and application of herbal leaf extracts in pest management - Monitoring of insect pests through traps and lures - Fruit fly trapping survey in horticultural crops - Case study on Agro-Eco System Analysis (AESA) - Push and Pull Strategies in organic crop protection.

Non chemical diseases management

Diagnosis of disease symptoms and pathogens ,Preparation of enriched farm yard manure and methods of application of bio control agents - Cultural methods of disease management- Disease assessment and scoring - Removal of pathogens like ergot by mechanical methods- Preparation and foliar spraying of Arappu butter milk extract - Preparation and foliar spraying of pseudomonas butter milk extract- Preparation and foliar spraying of garlic vasambu extracts - Preparation and foliar spraying of cowdung 20% extract for BLB management- Preparation and foliar spraying of anti viral principles - Role of milk, curd and buttermilk in disease management.

Organic Certification and Preparation of Bankable Projects

Organic certification – Importance and scope – Procedure for obtaining certification — Post harvest management and value addition, supply chain management -Preparation of bankable projects – Visit to Tamil Nadu Organic Certification Department and organic outlets – Visit to Nationalized Banks to learn about funding for projects.

Experiential Learning –18 EXP 401 & 402 Organic Production Technology (0 +10)

Class Schedule

1 week	Quantification of cow dung and cow urine recovery per animal and analysis their nutrients constituent. Methods of storing of cow dung and analysis of temperature, nutrients and microbial load in different layers
2 week	Quantification of yield and nutrient content of fodder crops grown organically. Quantification of biomass for different green manures and green leaf manures grown organically.
3 week	Experiencing mulching techniques in weed management
4 week	Introduction to biofertilizers, equipments and Good Laboratory practices Preparation of culture media for biofertilizers Isolation of *Rhizobium* from root nodules of leguminous plants Isolation of *Azospirillum* from roots of cereal crops/ grasses Isolation of phosphobacteria from soil Microscopic observation of biofertilizer cultures
5 week	Population assessment of bacterial biofertilizers Method of application of bacterial biofertilizers Mass production of Arbuscular Mycorrhizal Fungi Identification of AM propagules in roots and soil Mass production of *Azolla* and method of application PPFM and Liquid bioinoculants
6 week	Collection, segregation, shredding and quantification of biological wastes/ farm wastes for biocompost and vermicompost preparation and initiating the pre digestion process (15 days)
7 week	Procuring inputs for preparing the formulations of *Panchagavya*, Jeevamruth and Effective Microorganisms (EM) -EM to be prepared from mother culture obtained from progressive organic farmers for multiplication Formation of beds and digging of compost pit of required size based on the availability of the farm wastes. Filling the pit and bed for biocompost
8 week	Vermicompost process respectively. Release of earthworms onto the compost bed Monitoring the composting process for moisture and temperature for efficient composting. Sampling of partially decomposed material for determining the nutritive value especially carbon build up

9 week	Harvest of matured composts, quantification and assessment of compost maturity indices and comparing with FAO standards for marketability. Characterization of Panchagavya, Jeevamruth and EM formulations Preparation of enriched biocompost, vermicompost and FYM using *Azospirillum* and *Azotobacter* or Azophos
10 week	Establishment of model pest repellants cafeteria. Preparation and application of herbal leaf extracts in pest management.
11 week	Monitoring of insect pests through traps and lures. Fruit fly trapping survey in horticultural crops.

12 week	Case study on Agro-Eco System Analysis (AESA). Push and Pull Strategies in organic crop protection.
13 week	Preparation of a bankable project on Establishment of a pilot scale organic manure production unit for obtaining bank loans Diagnosis of disease symptoms and pathogens and cultural methods of disease management Disease assessment and scoring.
14 week	Removal of pathogens like ergot by mechanical methods. Preparation and foliar spraying of Arappu butter milk extract and fliar spraying of pseudomonas butter milk extract Preparation and foliar spraying of garlic vasambu extracts Preparation and foliar spraying of cowdung 20% extract for BLB management
15 week	Organic certification – Importance and scope Procedure for obtaining certification Post harvest management and value addition
16 week	Supply chain management in Organic Farming Exposure visit to Tamil Nadu Organic Certification Directorate and organic outlets
17 week	Preparation of bankable projects Evaluation of individual and group assignments and report submission Visit to Nationalized Banks to learn about funding for projects. **Final Practical Examination**

18 EXP 401 & 402 Soil, Plant, Water and Seed Testing(0+10)

Practical Schedule /week

1. Identification and Selection of farm holdings growing different crops
2. Studying the land features and collection of soil samples
3. Assessment of soil physical and chemical quality indices of collected soil samples
4. Assessment of soil biological quality indices and interpretation (Dept. of Agrl. Microbiology)
5. Interpretation of analytical results of collected soil samples for their quality
6. Identifying soil constraints - Interpretation of results (Soil physics)
7. Problem solving management techniques, Calculation of ameliorants.
8. Assessing the Land suitability for agricultural, horticultural and tree crops (Dept.of RS&GIS)
9. Water sample collection, quality assessment
10. Assessing the land suitability for irrigation
11. Fertilizer prescription calculations for important crops - Nutrient equivalent basis -Soil Test Crop Response based recommendation for targeted yields
12. Deriving the nutrient requirement using DSSIFER soft ware for different crops (STCR)
13. Issue of Soil Health Card and Fertilizer prescription using DSSIFER software
14. Diagnosis of nutrient deficiencies using VDK software and corrective measures
15. Formulating the plan for the selected farm holding for the existing crops
16. Formulating the most viable farm plan for the selected farm holding and Development of Soil Constraint Management Package (SCMP)
17. Recap and Practical examination

References

1. BaruahJ.C and D.K.Patgiri. 1996. Physics and Chemistry of Soils, New Age International Publications
2. Garison Sposito, 2008. The Chemistry of Soils. Oxford University Press, USA
3. Black, C.A. 1965. Agronomy Monograph. Methods of Soil Analysis. Part 1. Physical and Mineralogical properties including Statistics of Measurement and Sampling. Wiley, New York.
4. Hessee, P.R. 1971. A Text book of Soil Chemical Analysis. John Murray (Publishers) Ltd. London
5. Indian Society of Soil Science 1991. Soil related constraints in crop production Bulletin No.15.lSSS, New Delhi.

   6. Indian Society of Soil Science 1996. Soil management irelation to land degradation and environment. Bulletin No.17.ISSS, New Delhi.
7. Jackson, ML. 1973. Soil Chemical Analysis. Prentice Hall Pvt.Ltd
8. Mani.A.K., R.Santhi, K.M.Sellamuthu. 2007. A handbook of Laboratory Analysis.A.E.Publications, Coimbatore
9. Motsara.M.R and R.N.Roy.2008.Guide to laboratory establishment for plant nutrient analysis. Food and Agriculture organization of the United Nations.Rome.pp.220 (also available online <ftp: /ftp.fao. org/agl/ agll/docs /fpnb 19. pdf>)
10. Piper, C.S 1942. Soil and plant analysis: Inter science *Publishers*, New York.
11. Sehgal,J.2005. A text book of Pedology- Concepts and applications. Kalyani Publishers, Ludhiana, New Delhi.
12. Subramanian,S.S, G.V.Kothandaraman, S.Natarajan and P.P.Ramaswami. ed. 1987. Soil survey and land use planning for watershed management. Directorate of Soil and Crop Management Studies, TNAU, Coimbatore
13. Tandon, HLS.1994. Fertilizers, organic manures, recyclable wastes and
14. biofertilizers. Fertilizer Development and Consultant Organization, New Delhi

15. USDA 1954. Diagnosis and Improvements of Saline and Alkali Soils. (Ed) L.A.Richards. Handbook No.60. USDA Washington DC.
16. Werner Bergmann.Ed.1992.Nutritional Disorders of Plants - Development, Visual and analytical Diagnosis. Gustav Fischer Verlag Jena.Stuttgart. NewYork

E-References

1. ftp:/ftp.fao.org/agl/agll/docs/fpnb19.pdf
2. http://www.agric.gov.mt/soil-and-irrigation-water-lab
3. www.soiltesting.okstate.edu/
4. www.texasplantandsoillab.com/
5. www.ulm.edu/spal/
6. soilhealth.cals.cornell.edu/extension/.../managing_constraints.pdf
7. cnal.cals.cornell.edu/
8. http://agritech.tnau.ac.in/agriculture/agri_reosurcemgt_soil_soilcontraints.html
9. http://edis.ifas.ufl.edu/topicjertilization

18 EXP 401 & 402 Seed production and Technology (0+10)

CONTENT

Unit I - Introduction to quality seed production, principles and practices

Scope and importance of seed industry and seed production - principles and practices of seed production - generation system of seed multiplication - pollination behaviour - tools employed in hybrid seed production - study of morphological characters of varieties, parental line and hybrids - designing of planting ratio and border rows - physical and genetic contaminants - isolation distance.

Unit II - Seed production planning and pre sowing seed treatments

Planning of seed production - season and land selection - assessment of seed source and seed selection - pre sowing seed invigouration treatments - dormancy breaking treatments - seed priming - pelleting - polymer coating. Practicing nursery and main field preparation - practicing the sowing of seeds in the nursery - protray nursery - sowing - nursery management.

Unit III - Seed crop management and hybrid seed production techniques

Main field preparation - layout - formation of beds - transplanting - fertilizer and nutrient management - weed management - irrigation management - special cultural practices - pest and disease management - identification and removal of off-types and volunteer plants - practicing hybridization techniques (emasculation and pollination and detasseling) - identification of physiological disorders and management - exposure visit to seed certification department - seed certification procedures - registration and sowing report - field inspection – field counting - visit to seed production plots.

Unit IV - Pre and post harvest operations

Pre-harvest sanitation spray - identification of physiological and harvestable maturity indices - harvesting methods - post harvest verification - kapas sorting, cob sorting and pod verification - threshing / extraction of seeds - processing sequence - seed drying - seed cleaning - grading - pre-storage seed treatment - seed packing - seed storage -visit to seed processing unit and seed storage godown and learning sanitation measures. Eeconomics of variety and hybrid seed production (cost benefit ratio) - visit to private seed industry.

Unit V - Seed testing and marketing

Seed sampling procedure and submission of samples - seed testing procedure - estimation of seed moisture - physical purity analysis - germination test - visit to grow out test field and DNA finger printing laboratory for genetic purity assessment - visit to seed retail shop - seed marketing - project preparation.

Crops

Cereals, pulses, oilseeds, cotton and commercially important vegetable crops.

Deliverables:

Students who complete this course will gain enough confidence to establish seed industry as a successful business vent

Reference

4. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.
5. Bhaskaran, M. A.Bharathi, K.Vanangamudi, N.Natarajan, P.Natesan, R.Jerlin and K.Prabakar. 2003. Principles of seed production. Kaisher Graphics, Coimbatore.
6. Copeland LO & McDonald MB. 2001. Principles of Seed Science and Technology. 4th Ed. Chapman & Hall.
7. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers, New Delhi.

8. Vanangamudi, K. 2014. Seed Science and Technology. An Illustrated Text Book. New India Publishing Agency, New Delhi

E References

1. Seednet.gov.in
2. www.iar.org.in/Directorate1.htm
3. www.apsa.org
4. www.seedassociationofindia.com
5. www.apaseed.com
6. www.apaseed.org

Schedule of Activities

Week	Classes
1.	Scope and importance of seed industry and seed production - principles and practices of seed production - generation system of seed multiplication.
2.	Pollination behaviour - tools employed in hybrid seed production - study of morphological characters of varieties, parental line and hybrids.
3.	Designing of planting ratio and border rows - physical and genetic contaminants - isolation distance.
4.	Planning of seed production - season and land selection - assessment of seed source and seed selection.
5.	Pre sowing seed invigouration treatments - dormancy breaking treatments - seed priming - pelleting - polymer coating.
6.	Practicing nursery and main field preparation - practicing the sowing of seeds in the nursery - protray nursery - sowing - nursery management.
7.	Main field preparation - layout - formation of beds - transplanting - fertilizer and nutrient management.
8.	Weed management - irrigation management - special cultural practices - pest and disease management.
9.	Identification and removal of off-types and volunteer plants - practicing hybridization techniques (emasculation and pollination and detasseling) - identification of physiological disorders and management.
10.	Exposure visit to seed certification department - seed certification procedures - registration and sowing report - field inspection - field counting - visit to seed production plots - project preparation.
11.	Pre-harvest sanitation spray - identification of physiological and harvestable maturity indices - harvesting methods - project preparation.
12.	Post harvest verification - kapas sorting, cob sorting and pod verification - threshing / extraction of seeds - processing sequence - seed drying - seed cleaning - grading - pre-storage seed treatment - seed packing - seed storage.
13.	Visit to seed processing unit and seed storage godown and learning sanitation measures - project preparation.
14.	Economics of variety and hybrid seed production (cost benefit ratio) - visit to private seed industry.
15.	Seed sampling procedure and submission of samples - project preparation.
16.	Seed testing procedure - estimation of seed moisture - physical purity analysis - germination test - visit to grow out test field and DNA finger printing laboratory for genetic purity assessment.
17.	Visit to seed retail shop - seed marketing - project preparation and submission.

18 EXP 401 & 402 Agriculture Waste Management (0+10)

Activities

Collection and characterization of solid-wastes – analyzing physical and chemical properties – site selection for composting – infrastructure required for compost making – processing of solid waste for composting – carbon : nitrogen ratio maintenance – selection of microbial inoculum for composting - compost bed formation – windrow method – heap method – application of microbial inoculum – recording compost heap temperature- thermophilic phase and mesophilic phase – turning of compost pile for uniform composting – moisture maintenance in compost pile – assessing reduction in carbon and nitrogen ratio – compost maturity assessment – curing of compost material – value addition through beneficial microbes - Assessing nutritive value of compost – national and international standards for compost quality parameters – project preparation for compost making facility – Marketing of compost products – working out cost benefit ratio for compost production – Record maintenance in compost making.

Deliverables/Out come

The students who are undergoing this experiential learning will have independent skill to manage large quantity of solid waste through composting technology. They know how to prepare a project on solid waste management and it will create a self enterprising activity for them.

References:

1.Kelly Smith. 2012. How to build, maintain and use a compost system. Atlantic publishers, Florida.

1 John Berry. 2014. How to make compost? A quick and easy guide. Hewel Trading, USA

2 Roland Ulrich. 2014. Creating humus on farm – The controller heat method of composting. Outskirts press

3 Augustine Afuilio, 2014. Integrated solid waste management. Hand book for Beginners, Planners, Environmentalists, Students and policy makers. Warmra Twechoprise, Nairobi, Kenya.

E -References:

1. http.//www.eartheasy.com
2. http.//www.composting council.org
3. http.//www.Epa.gov/compost
4. http.//www.Compost.css.cornnell.ed

18 EXP 401 & 402 Commercial Horticulture (0+10)

Students who undergo this course will gain practical knowledge and hands on experience in different aspects of a commercial fruit nursery.

Students' attitude in leadership quality, managerial skill and professionalism will be enriched.

References

1. Sadhu, M.K. 1989. Plant Propagation. Wiley Eastern Ltd., New Delhi
2. Bose, T.K., S.K. Mitra, M. K. Sadhu and B. Mitra. 1991. Propagation of Tropical and Subtropical Horticultural crops. Naya Prakash Publishers, Culcutta, India.
3. Hartmann, H.T., D. E. Kester, F.T. davies and R. L. Grene. 2010. Plant Propagation – Principles and Practices. Prentice Hall of India Private Ltd., New Delhi.
4. Nanda, K. K and V. K. Kochhar. 1995. Vegetative Propagation of Plants. Kalyani Publishers, Ludhiana.

References

1. http://www.oer.nios.ac.in
2. http://www.sas.upenn.edu
3. http://www.tmnehs.gov.in

18 EXP 401 & 402 Floriculture and Landscaping (0+10)

Activities

Understanding the concept of experiential learning and identifying the broad area for experiential learning project activity in commercial Landscape Gardening - Fixing the area of interest for individual or group experiential learning project activity in commercial Landscape Gardening (Green consultancy, Green wall fixtures, Green showcases, Green wall hangings, Green furniture, Cacti buckets and flower bouquets, Green glasses, Trees indoor, Smart garden *etc*.,) - Rationale for selecting the activity in commercial Landscape Gardening and formulating the anticipated methodology for execution - Preparation of the project with budget for execution and marketing - Nurturing the students potential and innovativeness in their area of interest and facilitating the project activity (planning, development and execution) - Concept of advertising the product and developing market strategies for efficient selling - Working out the cost economics / balance sheet involved in the project - Generating a reflective report about the project and the student's potential in academic and personal development.

Deliverables

1 Entrepreneurship skill and buoyancy in handling commercial ventures in the domain of landscape gardening is assured

2 Student's attitude in leadership quality, managerial skill and professionalism will be enriched

18 EXP 401 & 402 Production Technology for Bioagents and Biofertilizer (0+10)
Team teaching by Entomologists, Pathologists and Economists)

Reference

1. Kennedy, J.S and Zadda Kavitha. 2006. Manual on commercial Production of biocontrol agents. Department of Agricultural Entomology, TNAU, Coimbatore. 156p
2. Gautam, R.D. 1994. Biological Pest Suppression. Westville Publishing House, New Delhi. 221 p

3. Course plan: TB: Text Book

Units / Practicals	Topics to be covered	Chapter#
1st week	Establishment of a biocontrol unit, Mass production of *Corcyra cephalonica* and *Maconellicoccus hirsutus*	Chap#1,2,3,6 (TB1)
2nd week	Mass production of parasitoids *viz.*,*Trichogramma* sp., *Chelonus blackburnii, Bracon sp*	Chap#7,8,10 (TB1)
3rd week	Mass production of parasitoids *viz.*, *Goniozus nephanitis* and *Nesolynx thymus*	Chap#11 (TB1)
4th week	Mass production of predators *viz*., *Cryptolaemus montrouzieri* and *Chrysoperla carnea*.	Chap#13,14 (TB1)
5th week	Rearing of host insects *viz*., *Helicoverpa armigera* and *Spodoptera litura*	Chap#4,5 (TB1)
6th week	Mass production of nuclear polyhedrosis virus of *Helicoverpa armigera* and *Spodoptera litura*	Chap#15,16 (TB1)
7th week	Mass production of entomopathogenic fungi *viz. Metarhizium anisopliae, Beauveria bassiana* and *Verticillium lecanii*	Chap#18,19,20 (TB1)
8th week	Processing and standardization of microbial pathogens	Chap#21 (TB1)

References

http://www. mycologia. Org
http://www.nysaes. cornell.edu
http://www. Eduwebs.org/bugs/mealybug_destroyers.htm
http:// plant disease.ippc.orst.adv/articles
http:// www.nbaii.res.in

PRACTICAL SYLLABUS

Unit 3:

Importance of biological control in plant disease management – Handling of equipments – sterilization techniques –Preparation of media

Collection of soil sample and Isolation of antagonists - *Trichoderma, Chaetomium, Beauveria, Pseudomonas fluorescens,* and *Bacillus subtilis* - Maintenance of pure cultures - Morphological and molecular characterization of antagonists

Unit 4

Keys for the identification of lab contaminants - Assessing the efficacy *in vitro* - mode of action of antagonists - Fermentation systems and different kinds of formulations - Mass multiplication

Methods of delivery of biocontrol agents - Bio efficacy against plant diseases – Container content compatibility - packaging methods and shelf life studies of bio control agents -Guidelines and requirements to establish a commercial bio control lab - energy requirements to establish a commercial bio control lab

Unit 5

Legal issues involved in the establishment of commercial bio control lab and registration (Small scale and large scale) - Cost Analysis and project preparation - Principles of enterprise management. Exposure visit to commercial bio control units

PRACTICAL SCHEDULE

9 week

1. Bio-control agents and their significance in plant disease management
2. Safety procedures for handling of equipments (Autoclave, Laminar Air Flow Chamber, Hot air oven, pH meter)
3. Safety procedures for handling of equipments (Electronic balance, Fermentor, Distillation unit, Spectrophotometer, Microscopes and Spiral Kneader)
4. Good laboratory practices of a bio control lab
5. Sterilization techniques

10 week

1. Preparation of PDA and Rose Bengal agar medium
2. Preparation of *Trichoderma* selective medium,
3. Preparation of Kings B medium and Nutrient Agar medium
4. Preparation of Actinomycetes and *Chaetomium* selective medium.

Collection of soil samples and isolation of *Trichoderma, Beauveria* and *Chaetomium*

11 week

1. Collection of soil samples and isolation of *Pseudomonas fluorescens* and *Bacillus subtilis* and maintenance of pure cultures of biocontrol agents
2. Morphological and molecular characterization of *Trichoderma*
3. Morphological and molecular characterization of *Pseudomonas fluorescens*
4. Morphological and molecular characterization of *Bacillus subtilis*

12 week

1. Keys for the identification of lab contaminants (*Salmonella, Shigella, Vibrio, Aspergillus, Penicillium, Rhizopus* etc.,)
2. Assessing the efficacy of *Trichoderma* under *in vitro* condition.
3. Assessing the efficacy of *Pseudomonas and Bacillus* under *in vitro* condition.
4. Studies on the mode of action of *Trichoderma* against soil-borne, foliar and Post harvest pathogens

5. Studies on mode of action of *Pseudomonas and Bacillus* against soil-borne, foliar and Post harvest pathogens

13 week

1. Fermentation systems
2. Different kinds of formulations- solid , liquid oil invert formulation etc.
3. Mass multiplication of *Trichoderma*
4. Mass multiplication of *Trichoderma*
5. Quality analysis of *Trichoderma*

14 week

1. Mass multiplication of *Pseudomonas*
2. Mass multiplication of Bacillus
3. Quality analysis of *Pseudomonas and Bacillus*
4. Methods of delivery of bio control agents - *Trichoderma*
5. Methods of delivery of bio control agents - *Pseudomonas and Bacillus*

15 week

1. Bioefficacy of *Trichoderma* against plant diseases
2. Bioefficacy of *Pseudomonas and Bacillus* against plant diseases
3. Biocontrol agents in pipeline –*Chaetomium*
4. Biocontrol agents- *Beauveria*
5. Container content compatibility, packaging methods and shelf life studies of bio control agents.
6. Guidelines and requirements to establish a commercial bio control lab

16 week

1. Studies on energy requirements to establish a commercial bio control lab
2. Legal issues involved in the establishment of commercial bio control lab and registration (Small scale and large scale).
3. Legal issues involved in the establishment of commercial bio control lab and registration (Small scale and large scale).
4. Exposure visit to commercial bio control units
5. Exposure visit to commercial bio control units

17 week

1. Cost Analysis and project preparation: Principles of enterprise management.
2. Financial management – Agricultural Finance – Source of finance– Acquisition – Ratio analysis.

Economics of Mass Production of Biocontrol agents

Mass Production of *Trichoderma viride* talc formulation (500kg for 30 students)

S. No.	**Particulars**	**Quantity**	**Amount (Rs.)**
I.Non-Recurring or Capital Investment *			
1.	Fermentor – 100 lit	1	,00,000
2.	Autoclave	1	40,000
3.	Hot air Oven	1	25,000
4.	Laminar Air flow Chamber-2'/3'/4'	1	60,000
5.	Electronic Balance	1	10,000

6.	Racks and Cabinet	1	15,000
7.	Plastic tray and glasswares	1	20,000
8.	Sealing machine	1	3000
9.	Refrigerator	1	20,000
10.	Gas connection, Cooker and burner	1	5,000
		Total	**,98,000**

S. No.	**Particulars**	**Quantity**	**Amount (Rs.)**
II. Recurring or Working Expenditure			
1.	Talc Powder	500kgs	7500
2.	Chemicals		2500
3.	Polybags		750
4.	Electricity and gas refilling		1000
5.	Labour charges		5000
6.	Miscellaneous expenditures		2000
		Total	**8,750.00**

III. Income		
1.	500 kgs of product @Rs. 75/-	37,500.00
2.	Total Expenditure	18,750.00
	Net Profit Rs.	**18,750.00**

* **Non-Recurring:** One time investment

Mass Production of *Pseudomonas fluorescens* talc formulation (1000kg for 30 students)

S. No.	**Particulars**	**Quantity**	**Amount (Rs.)**
I.Non-Recurring or Capital Investment			
1.	Fermentor		,00,000
2.	Autoclave		0,000
3.	Hot air Oven		5,000
4.	Laminar Air flow Chamber		0,000
5.	Electronic Balance		0,000
6.	Racks and Cabinet		5,000
7.	Plastic tray and glasswares		0,000
8.	Sealing machine		000
9.	Refrigerator		0,000
10.	Gas connection, Cooker and burner		,000
		Total	**,98,000**

S. No.	**Particulars**	**Quantity**	**Amount (Rs.)**
II. Recurring or Working Expenditure			
1.	Talc Powder	000kgs	5000
2.	Chemicals		000
3.	Polybags		500

4.	Electricity and gas refilling		000
5.	Labour charges		0000
6.	Miscellaneous expenditures		000
		Total	**8,500.00**

III. Income		
.	1000 kgs of product @Rs. 75/-	5,000.00
.	Total Expenditure	8,500.00
	Net Profit Rs.	**6,500.00**

* **Non-Recurring:** One time investment

REFERENCE

1. Baker, K.F. and Cook, R.J. 1974. Biological control of plant pathogens. W.H. Freeman and Co. San Francisco, U.S.A.
2. Chet, I. 1987. Innovative approaches to plant disease control, John wiley and Sons, New York.
3. Dinakaran, D, G.Arjunan & G.Karthikeyan 2003. Biological control of crop diseases.
4. Papavizas, G.C. 1985. *Trichoderma* and *Gliocladium* : biology, ecology and potential for biocontrol. Annu. Rev. Phytopathol. 23 : 23-54.
5. Maheswari ,D.K and R.C Dubey 2008 .Potential micro organisms for sustainable agriculture. I.K International Publishing House Pvt. Lts , New Delhi
6. Prakasam, V., Raguchander, T. and Prabakar, K. 1998. Plant Disease Management. AE Publications, Coimbatore, India.
7. Ahamed S and Narain U 2007 . Eco friendly management of plant diseases. Daya Publishing house , New Delhi
8. Utkhede, R.S. and Gupta, V.K. 1996. Management of soil borne diseases. Kalyani Publishers, New Delhi.

18 EXP 401 & 402 Mushroom Cultivation Technology(0+10)
(Team Teaching)

Unit 1 : Different types of mushroom , Morphology - **Edible and poisonous type - edible mushrooms-*Pleurotus, Agaricus, Volvariella* and *Calocybe* –** nutritional values - and pharmacological values-**preparation of** culture media- pure culture techniques- **sterilizing techniques-media - glassware - maintenance of culture**

Unit 2: Mother spawn **production-type of spawn-Multiplication of bed spawn –** Substrates for mushroom cultivation **and their preparation -mushroom cultivation techniques for *Agaricus, Pleurotus, Calocybe and Volvariella*- maintenance of spawn running and cropping room-harvest-packing and storage of *Pleurotus, Agaricus* and *Calocybe.***

Unit 3 : Problems in cultivation **of *Agaricus, Pleurotus, Calocybe and Volvariella* – pests, diseases and weed moulds, abiotic disorders – management strategies –- Biodegradation of coir pith - cost estimation**

Unit 4 : Post harvest technology **of *Agaricus, Pleurotus, Calocybe and Volvariella* – methods of preservation –Drying: solar, cabinet, fluidized bed and freeze drying – Packing methods and storage - Controlled atmospheric storage- modified atmospheric storage and canning – Cost analysis.**

Unit 5 : Mushroom recipes of ***Agaricus, Pleurotus, Calocybe and Volvariella* - Cooking methods-value added products – instant food mixes –Cost analysis. Project preparation- principles of mushroom farm enterprise management – cost estimation**

Practical schedule

1 week

Studying the general characters of mushrooms
Different types of mushrooms and their morphology
Identification of edible and poisonous mushrooms
Morphological characters of *Pleurotus, Agaricus, Volvariella and Calocybe*
Equipments required for culture media preparation and tissue culture - their operation

2 week

Equipments required for spawn preparation - their operation
Equipments required for substrate sterilization - their operation
Preparation of different types of culture media- Potato Dextrose Agar (PDA) , Oats meal agar (OMA), Malt extract Agar medium (MEA)
Pure culture technique –Tissue isolation methodology
Pure culture technique **–Tissue isolation in PDA, OMA and MEA medium 3 week**
Sub culturing of fungal cultures and maintenance.
Spawn preparation- laboratory requirements, essentials required for mother spawn and bed spawn preparation and their usage.
Oyster mushroom: mother spawn preparation – Cooking of cholam grains , packing in polybags and autoclaving
Oyster mushroom: mother spawn preparation - inoculation
Oyster mushroom: first generation bed spawn preparation - Cooking of cholam, packing in polybags and autoclaving

4 week

Oyster mushroom: first generation bed spawn preparation - inoculation
Observe the spawn contaminants.
Oyster mushroom: second generation bed spawn preparation – Cooking of cholam, packing in polybags and autoclaving

Oyster mushroom: second generation bed spawn preparation - inoculation
Management of contaminants in mother spawn and bed spawn

5 week

Oyster mushroom cultivation – essentials required, cropping room requirement
Oyster mushroom: preparation of substrates for bed preparation
Oyster mushroom – Bed preparation
Oyster mushroom – Maintenance of beds, harvest and storing
Oyster mushroom – pest and their management

6 week

Oyster mushroom – moulds and disease management
Visit to oyster mushroom farm (spawn lab and mushroom farm)
Visit to ulavar sandai markets (Farmers' Market) and observing the marketing pattern of oyster mushroom
Milky mushroom: mother spawn preparation – Cooking of cholam grains, packing in polybags and autoclaving
Milky mushroom: mother spawn preparation **- inoculation**

7 week

Milky mushroom: first generation bed spawn preparation – Cooking of cholam, packing in polybags and autoclaving
Observing the spawn contaminants, their management
Milky mushroom: first generation bed spawn preparation - inoculation
Milky mushroom: second generation bed spawn preparation – Cooking of cholam, packing in polybags and autoclaving
Milky mushroom: second generation bed spawn preparation - inoculation

8 week

Milky mushroom cultivation – essentials required, cropping room requirement
Milky mushroom:– substrates for bed preparation
Milky mushroom – Bed preparation
Milky mushroom- casing
Milky mushroom – Maintenance of beds, harvest and storing

9 week

Milky mushroom – pest and their management Milky mushroom – moulds and disease management
Visit to Milky mushroom farm (spawn lab and mushroom farm)
Visit to ulavar sandai, markets and observing the marketing pattern of milky mushroom Button mushroom: visiting units and learning – tissue isolation, spawn preparation

10 week

Button mushroom: visiting units and learning compost preparation
Button mushroom: visiting units and learning: cropping, harvest and storage
Visit to ulavar sandai, markets and observing the marketing pattern of button mushroom
Paddy straw mushroom: tissue isolation
Paddy straw mushroom**: spawn preparation**

11 week

Paddy straw mushroom: Substrate preparation for beds
Paddy straw mushroom: bed preparation
Paddy straw mushroom cultivation – cropping room requirement, Maintenance of beds, harvest and storing

Paddy straw mushroom – pest and disease management
Abiotic disorders and their management

12 week

Integrated pest and disease management in Mushrooms Biodegradation of agrowastes using mushroom spawn Biodegradation of agrowastes using mushroom spawn- continuation Mushroom as a component in Integrated Farming System Interaction with successful spawn producers – TNAU community radio

13 week

Interaction with successful mushroom producers- TNAU community radio Short term post harvest processing of oyster mushroom

Long term post harvest processing of oyster mushroom
Packing methods of oyster mushrooms

Short term post harvest processing of milky mushroom

14 week

Long term post harvest processing of milky mushroom
Packing methods of milky mushrooms
Short term post harvest processing of button mushroom
Long term post harvest processing of button mushroom
Packing methods of button mushrooms

15 week

Canning of button mushroom
Recipe and value added products from oyster mushroom
Recipe and value added products from oyster mushroom continued
Recipe and value added products from milky mushroom
Recipe and value added products from milky mushroom continued

16 week

Recipe and value added products from button mushroom
Recipe and value added products from button mushroom continued
Recipe and value added products from paddy straw mushroom
Project preparation on oyster -spawn production and economics
Project preparation on oyster mushroom production and cost estimation

17 week

Project preparation on milky spawn production and cost estimation
Project preparation on milky mushroom production and cost estimation
Project preparation on button -spawn production and cost estimation
Project preparation on button - mushroom production and cost estimation
Practical examination

BUDGET

Economics of Spawn Production (100 spawn bags per day) for oyster and milky mushroom mother spawn and bed spawn

Total working days for spawn: 25

Sl.No.	Item	Quantity	Rate (Rs.)	Total (Rs.)
	Recurring cost (100 spawn x 25 days)			
1.	Polypropylene bags	18 kg	120/kg	14,400

2.	**Cholam grain**	**700 Kg**	**30/kg**	**21,000**
3.	**Calcium carbonate (commercial grade)**	**50**	**25/kg**	**1,250**
4.	**Non-absorbent cotton (400 g rolls)**	**100**	**80/roll**	**8,000**
5.	**Fungicides & Fumigants**	**--**	**--**	**3,000**
6.	**Electricity & Fuel**	**--**	**--**	**20,000**
7.	**Labour @ 2 women per day for 25 days**	**2 nos**	**190/person**	**9,500**
8.	**Glass wares and chemicals for preparing mother spawn**	**--**	**5,000**	**5,000**
9.	**Miscellaneous**	**--**	**--**	**2,000**
	Total			84,150
	Overall total			84,150

Economics of Oyster mushroom production and milky mushroom (each 5 Kg/day)

Total working days: 10

Sl.No.	Item	Quantity	Rate (Rs.)	Total (Rs.)
	Recurring Cost			
1.	**Paddy straw**	**100 kg**	**5/kg**	**5,000**
2.	**Spawn**	**-**	**-**	**-**
3.	**Polythene bags for bed & packing**	**2 kg**	**120/kg**	**240**
4.	**Fungicides, Fumigants & Chemicals**	**--**	**--**	**5000**
5.	**Labour @ 2 Per day**	**2**	**190 /day**	**3,800**
6.	**Miscellaneous (gunny bags, rope,racks)**	**--**		**6000**

II.	**Non recurring-Oyster Mushroom Shed**	**800 sq.ft.**	**75,000**	**75,000**
			Total (Rs.)	95,040

REFERENCES

Agarwal, R.K. and C.L.Jandaik.1986. Mushroom cultivation in India. Indian Mushroom Growers Association, Solan, Himachal Pradesh.p-83.

Bahl, N.1988. Hand book of Mushroom II Edn. Oxford & IBM Publishing Co. New Delhi. **Reference books- further reading**

Marimuthu, T., A.S Krishnamoorthy, K.Sivaprakasam and R.Jeyarajan, 1989. Oyster Mushroom Production. The Vijay Books. Sivakasi, India.P.57.

A.S Krishnamoorthy, Marimuthu, T., and S. Nakkeran . 2005 . Mushroom Biotechnology ,The Vijay Books. Sivakasi, India., Pub.ODL, TNAU, Cbe-3

Pathak,V.N. Nagendra Yadav and Maneeskas Gaur.2000.Mushroom production and processing Technology. Agribios (India) Ltd., New Delhi

E-REFERENCES

1. www.mushroomcouncil.com/grow /grow.html
2. www.krishiworld.com/html/mushroom.html
3. www.gmushrooms.com /pots.html.
4. www.mushworld.com /home/
5. www.mushroomcouncil.org

18 EXP 401 & 402 Poultry Production Technology (0+10)

	Unit – I - Introduction
	Poultry Industry in India - Current status of broiler and layer industry – Scope of broiler and layer production in India - Introduction to Broilers and Layers – Commercial strains of broilers and layers.
	Unit – II – Housing Management
	Housing management – Location and layout of commercial broiler and layer farm – Preparation of poultry house - Equipments used in broiler and layer farm - Different system of Management - Deep litter system, Cage system of management, Raised housing - Litter management - Preparation of brooder house – Brooder Management –Chick management – Grower management – Layer management -Summer management of broiler -Winter management of broiler – Lighting management – Common procedures followed in broiler and layer farm.
	Unit – III – Feeding Management
	Water – Requirement, quality analysis and its maintenance - Feeding Management of broilers and layers – Types of feed – Feed ingredients – Quality assessment of feed ingredients and feed – Additive and supplementation of additives - Storage of feed-Feeding Methods – Nutrient requirement of different stages of broilers and layers – Various standards for broilers and layers - Feed formulation – Least cost formulation –Preparation of compound feed –Components in feed mill –Feed mill operations - Hatchery Management – Hatchery layout and design – Hatcher and Setter – Collection and handling of egg – Setting and hatching of eggs and chicks quality assessment.
	Unit – IV – Flock Health Management
	Common disease of broilers and layers – Control and Prevention - Medication and Vaccination in broilers and layers – Different vaccination methods – Cold chain for vaccine – Vaccination schedule for broilers and layers -Postmortem inspection –Waste management -Disposal of dead birds and Manure management - Biosecurity measures.
	Unit – V – Processing and Marketing
	Processing of broilers - Slaughtering of broilers and cut up parts of broilers – Evaluation of egg for its quality - Record maintenance- Marketing Channels in broilers and layers - Export of egg and poultry meat - Integration method of broilers marketing–Team teaching along with Department of Economics on Economics of broiler and layers farming and Project preparation for broiler and layer farm unit for bank loan–Role of NECC and BCC in marketing of poultry and its products - Visit to commercial broiler farm, layer farm, feed plant, hatchery unit and processing plant.

Practical schedule

Week	Topic to be covered
1	Current status of broiler and layer industry Scope of broiler and layer production in India Commercial strains of broilers and layers Location and layout of commercial broiler and layer farm Preparation of poultry house

2	Equipments used in broiler and layer farm Different system of Management Deep litter system Cage system of management, Raised housing Litter management
3	Preparation of brooder house Brooder Management, Grower management and Layer management Summer management of broiler and layer Winter management of broiler and layer Lighting management
4	Common procedures followed in broiler and layer farm. Water – Requirement Quality analysis and its maintenance Feeding Management of broilers and layers Types of feed
5	Feed ingredients Quality assessment of feed ingredients and feed Additive and supplementation of additives Storage of feed-Feeding Methods Nutrient requirement of different stages of broilers and layers
6	Various standards for broilers and layers Feed formulation Least cost formulation Preparation of compound feed Components in feed mill
7	Feed mill operations Hatchery Management Hatchery layout and design Hatcher and Setter Collection and handling of egg
8	Setting and hatching of eggs and chicks quality assessment Common disease of broilers and layers Control and Prevention Medication and Vaccination in broilers and layers Different vaccination methods
9	Cold chain for vaccine Vaccination schedule for broilers and layers Postmortem inspection Disposal of waste -dead birds and manure
10	Biosecurity measures.
11	Processing of broilers Slaughtering of broilers and cut up parts of broilers

12	Evaluation of egg for its quality Record maintenance Marketing Channels in broilers and layers
13	Export of egg and poultry meat Integration method of broilers marketing
14	Team teaching along with Department of Economics on Economics of broiler and layers farming and Project preparation for broiler and layer farm unit for bank loan
15	Role of NECC and BCC in marketing of poultry and its products
16	Visit to commercial broiler farm, layer farm, feed plant, hatchery unit and processing plant
17	Examination

18 EXP 401 & 402 Commercial Beekeeping (0+10)

Activities

Honey bee species, castes, social biology and communication in honey bees - Bee pasturage and preparation of bee floral calendar - Honey bees for crop pollination and seed production. - Stingless bees, little bees, rock bees conservation and honey harvest - Beehives, beekeeping equipments specification and uses, visit to manufacturing unit - Hiving feral Indian bee colony, site selection for apiary, visit to migratory bee keeping sites, visit to commercial cerana bee farm, - Honey extraction, processing, purity testing and value addition, visit to honey processing unit - Hive inspection, maintenance of hive records, management in nectar flow season, dearth period, management of swarming, absconding and laying workers - Dividing, uniting bee colonies, artificial feeding, protecting bees from pesticides - Insect, mite and bird enemies of honeybees, brood and adult diseases - Mass queen rearing and production of mating nucleus, visit to beekeeping society - Methods of collection of bees wax, bee pollen, propolis, bee venom, royal jelly - Visit to commercial mellifera bee farm - Marketing and economics of honey and bee products, preparation of bee keeping projects for bank funding

Reference

1. Atwal, A.S. 2013. Mellifera Bee Keeping and Pollination. *Kalyani Publishers, Ludhiana*. 394 p.
2. Ted Hooper, 1991. Guide to Bees and Honey (Thrid Edition), *BAS printers ltd. Over Wallop, Hampshire* 271 p.
3. Roger A. Morse, 1994. The new complete guide to beekeeping. *The Countryman Press, Woodstock, Vermont*. 207p.
4. Thomas D. Seeley. 1995. The Wisdom of the Hive, Harvard University Press, Cambridge, 295p.

Sl. No.	Practical classes	Activity	Ref Book
1.	1-10	Honey bee species, castes, social biology and communication in honey bees	Chapters 3,5,6 and 10 of TB Chapters 2 to 5 of RB 1 Chapter 2,10 of RB 4
2.	11-20	Bee pasturage and preparation of bee floral calendar	Chapter 11 of TB Chapter 12 of RB 1 Chapter 10 of RB 2
3.	21-30	Honey bees for crop pollination and seed production.	Chapter 17 and 18 of TB Chapter 15 of RB 1
4.	31-40	Stingless bees, little bees, rock bees conservation and honey harvest	Chapter 5 of TB Chapter 2 of RB 1
5.	41-50	Beehives, beekeeping equipments specification and uses, visit to manufacturing unit	Chapter 9 of TB Chapter 1 of RB 1 Chapter 4 of RB 2 Chapter 1 of RB 3 Chapter 4 of RB 4
6.	51-70	Hiving feral Indian bee colony, site selection for apiary, visit to migratory bee keeping sites, visit to commercial cerana bee farm	Chapter 8 of TB Chapter 1 and 8 of RB 1 Chapter 2 of RB 3
7.	71-80	Honey extraction, processing, purity testing and value addition, visit to honey processing unit	Chapter 12, 20, 29 of TB Chapter 10 of RB 1 Chapter 11 of RB 2 Chapter 5 of RB 3
8.	81-100	Hive inspection, maintenance of hive records, management in nectar flow season, dearth period, management of swarming, absconding and laying workers	Chapter 12 of TB Chapter 6, 9 of RB 1 Chapter 7 of RB 2 Chapter 3 to 7 of RB 3
9.	101-120	Dividing, uniting bee colonies, artificial feeding, protecting bees from pesticides	Chapter 12, 14, 25 of TB Chapter 9 of RB 1
10.	121-130	Insect, mite and bird enemies of honeybees, brood and adult diseases	Chapter 21 of TB Chapter 13 of RB 1 Chapter 8 of RB 3 Chapter 9 of RB 2
11.	131-140	Mass queen rearing and production of mating nucleus, visit to beekeeping society	Chapter 16, 22 of TB Chapter 10 of RB 1 Chapter 8 of RB 2
12.	141-150	Methods of collection of bees wax, bee pollen, propolis, bee venom, royal jelly - Visit to commercial mellifera bee farm	Chapter 19 of TB Chapter 14 of RB 1

13.	151-170	Marketing and economics of honey and bee products, preparation of bee keeping projects for bank funding	Chapter 28, 29 of TB Chapter 14 of RB 1

E- Reference

i. http://agritech.tnau.ac.in/farm_enterprises/fe_apiculture_home.html http://agdev.anr.udel.edu/maarec/ http://www.aragriculture.org/insects/beekeeping.htm http://tiwanabeefarm.com/
ii. http://beekeeping.com/
iii. http://www.apimondia.com/

18 EXP 401 & 402 Commercial Sericulture (0+10)

UNIT I : MULBERRY PRODUCTION AND MANAGEMENT

- Area and distribution of mulberry –Popular Varieties – climatic requirements and soils
- Propagation of nursery - Selection of planting material - Nursery bed Preparation - planting - management – Economics.
- Main field preparation - manuring – planting - Irrigation –Weeding- fertilizers – Intercropping – Training and pruning. Shoot harvest - Transporting - preservation – Economics - project preparation.
- Pruning methods –farm machinery implements.
- Insect pests and diseases of mulberry –management.

UNIT II: SILKWORM REARING AND MANAGEMENT

- Authorized Silkworm Races – crossbreed and bivoltine. Rearing houses – plan and maintenance. Rearing appliances - disinfection.
- Agencies involved in egg production - procurement - transportation - preservation– incubation - black boxing – hatching. Brushing of eggs – rearing of chawki worms – leaf selection – feeding – moulting - bed cleaning - bed disinfectants.
- Chawki Garden – maintenance and management
- Estimation of population of chawki - establishing Chawki Rearing Centres - Record maintenance

  – Transport - Fixation of rate. Visit to Chawki Rearing Centre.
- Late age rearing – tray and shoot rearing methods - leaf selection – feeding - spacing - bed cleaning
- Moulting care - bed disinfectants. Mounting and mountages. Spinning care and Harvesting.
- Calculation of Effective rate of rearing - Transporting and marketing of cocoons- Economics of rearing silkworms.
- Project preparation for establishing Late age rearing centres. Large scale sericulture farming and contract farming.

Unit III: Silk Reeling

- Physical and commercial properties of cocoons and silk. Cocoon sorting - defective cocoons - cocoon drying - stifling – cooking - brushing - reeling machines - parts and their functions.
- Study of silk reeling - re-reeling - Skein preparation – packing.
- Eri silk spinning – spinning - methods.
- Sampling and testing procedure for winding, size, strength test, condition cohesion and seriplane test. Standards for grading raw silk. Economics of establishing reeling units. Visit to silk reeling units automatic silk reeling units.

PRACTICAL SCHEDULE (WEEKLY)

Week	Syllabus to be covered and Expected Learning experience
1	Area and distribution of mulberry – Popular Varieties – climatic requirements and soil requirement. Preparation of nursery - planting material - manure application.
2	Nursery management – irrigation, weeding, fertilizer application and plant protection. Economics of nursery management.
3	Main field preparation, manuring - Planting methods - Irrigation – Weeding – Intercropping

4	Training and pruning the mulberry crop. Chawki rearing garden - Pruning methods – schedule of operations. Visit to Chawki rearing garden.
5	Late age silkworm rearing - Harvest of leaf and shoot- methods of harvest. Transporting – preservation of leaves and shoots – methods. Visit to Late age silkworm rearing garden - Calculation of brushing capacity.
6.	Farm machinery implements – mulberry pruner, stem cutter and power weeder.
	Insect pests and diseases of mulberry –natural enemies- IPM. Economics of Mulberry leaf production. Preparation of project proposals.
7.	Authorized Silkworm Races –crossbreed and bivoltine silkworm rearing. Requisites, inspection and selection of site for rearing house.
8.	Rearing houses – plan and maintenance. Rearing appliances – Disinfection. Agencies involved in egg production - procurement of eggs. Transportation – preservation of eggs – incubation.
9.	Black boxing of eggs. - hatching - estimation of hatching percentage. Brushing of eggs – practicing brushing. Rearing of chawki worms – methods. Leaf selection and feeding for young age silkworms.
10.	Moulting, Bed cleaning and bed disinfectants for chawki worms. Estimation of population of chawki worms. Establishing Chawki Rearing Centres. Record maintenance and logistics at Chawki Rearing Centres. Transport of Chawki worms. Visit to Chawki Rearing Centre.
11.	Late age rearing – tray and shoot rearing methods. Leaf selection and feeding for late age silkworms. Spacing of late age worms and bed cleaning.
12.	Moulting care, application of bed disinfectants and its importance. Mounting of worms and mountages. Spinning care and Harvesting.
13.	Calculation of Effective rate of rearing. Maintenance of rearing records, rearing environment for successful rearing. Transporting and marketing of cocoons. Economics of rearing silkworms and maintenance of rearing records.
14	Project preparation for establishing Late age rearing centres. Large scale sericulture farming and contract farming. Visit to Chawki Rearing Centre and late age rearing centres.

15 Physical and commercial properties of cocoons and silk. Study of cocoon sorting – defective cocoons - drying - stifling - cooking – brushing. Study of reeling machines parts and their functions.

Study of silk reeling - re-reeling - Skein preparation - packing.

16 Study of tasar and muga cocoons – characteristics - cooking and reeling. Study of eri silk spinning - methods of spinning.

Sampling and testing procedure for winding, size, strength test. Sampling and testing procedures for condition cohesion and seriplane test.

17 Standards for grading raw silk. Economics of establishing reeling units. Visit to cocoon market and silk reeling units.

References

- Dandin S.B. Jayant Jayswal and K. Giridhar. 2003. Hand book of Sericulture Technologies. Central Silk Board, Bangalore.
- Krishnaswami,S., M.N. Narasimhanna, S.K Suryanarayan and S.Kumararaj. 1978. Sericulture Manual 2 – Silkworm Rearing . FAO Agricultural Services Bulletin 15/2. Food and Agriculture Organisation of the United Nations, Rome, 131 p.
- Somashekar, T.H. and K. Kawakami. 2003. Manual on Bivoltine Silk Reeling Technology. Central Silk Board, Bangalore. 122 p.

E- References

1. www.silkbase.org
2. www.papilo.ab.a.u.tokyo.ac.jp