UTTARANCHAL UNIVERSITY

UTTARANCHALUNIVERSITY

ArcadiaGrant,P.O.Chandanwari,Premnagar,Dehradun, Uttarakhand-248007,INDIA

Detailed Course Structure & Syllabus

of

Bachelor of Science- B.Sc. Hons. (Agriculture)

Applicable for Batch: 2018-22

Under Choice Based Credit System (CBCS)

Course Structure & Syllabus of Bachelor of Science- B.Sc. Hons. (Agriculture)
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EVALUATION SCHEME
BACHELOR OF SCIENCE- B.SC. HONS. (AGRICULTURE)
4 Years
Under Choice Based Credit System (CBCS)

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Detail syllabus of Study and Evaluation Scheme
Discipline-wise Courses:

Discipline/Course title	Credit Hrs
Agronomy	
Fundamentals of Agronomy	4(3+1)
Introductory Agro-meteorology & Climate Change	2(1+1)
Crop Production Technology – I (*Kharif* crops)	2(1+1)
Crop Production Technology – II (*Rabi* crops)	2(1+1)
Farming System & Sustainable Agriculture	1(1+0)
Practical Crop Production - I *(Kharif* crops*)*	2(0+2)
Practical Crop Production - II *(Rabi* crops*)*	2(0+2)
Principles of Organic Farming	2(1+1)
Geoinformatics and Nanotechnology for Precision Farming	2(1+1)
Rainfed Agriculture & Watershed Management	2(1+1)
Fundamentals of Agronomy	4(3+1)
Introductory Agro-meteorology & Climate Change	
Fundamentals of Genetics	3(2+1)
Principles of Seed Technology	2(1+1)
Fundamentals of Plant Breeding	3(2+1)
Crop Improvement-I (*Kharif* crops)	2(1+1)
Crop Improvement-II (*Rabi* crops)	2(1+1)
Total	**12(7+5)**
Soil Science & Agricultural Chemistry	
Fundamentals of Soil Science	3(2+1)
Manures, Fertilizers and Soil Fertility Management	3(2+1)
Problematic soils and their Management	2(2+0)
Total	**8(6+2)**
Entomology	
Fundamentals of Entomology	3(2+1)
Pests of Crops and Stored Grain and their Management	3(2+1)
Management of Beneficial Insects	2(1+1)
Total	**8(5+3)**
Agricultural Economics	
Fundamentals of Agricultural Economics	2(2+0)
Agricultural Finance and Co-Operation	3(2+1)
Agricultural Marketing Trade & Prices	3(2+1)
Farm Management, Production & Resource Economics	2(1+1)
Total	**10(7+3)**
Agricultural Engineering	
Introductory Soil and Water Conservation Engineering	2(1+1)
Farm Machinery and Power	2(1+1)
Renewable Energy and Green Technology	2(1+1)

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Protected Cultivation and Secondary Agriculture	2(1+1)
Total	**8(4+4)**
Plant Pathology	
Fundamentals of Plant Pathology	3(2+1)
Diseases of Field and Horticultural Crops and their Management-I	3(2+1)
Diseases of Field and Horticultural Crops and their Management-II	3(2+1)
Principles of Integrated Pest and Disease Management	3(2+1)
Total	**12(8+4)**
Horticulture	
Fundamentals of Horticulture	2(1+1)
Production Technology for Fruit and Plantation Crops	2(1+1)
Production Technology for Vegetables and Spices	2(1+1)
Production Technology for Ornamental Crops, MAP and Landscaping	2(1+1)
Post-harvest Management and Value Addition of Fruits and Vegetables	2(1+1)
Total	**10(5+5)**
Food Science	
Principles of Food Science & Nutrition	2(2+0)
Total	**2(2+0)**
Agricultural Extension	
Fundamentals of Agricultural Extension Education	3(2+1)
Rural Sociology & Educational Psychology	2(2+0)
Entrepreneurship Development and Business Communication	2(1+1)
Communication Skills and Personality Development	2(1+1)
Total	**9(6+3)**
Biochemistry / Physiology / Microbiology/ Environmental Sciences	
Fundamentals of Plant Biochemistry and Biotechnology	2(1+1)
Fundamentals of Crop Physiology	2(1+1)
Agricultural Microbiology	2(1+1)
Environmental Studies & Disaster Management	3(2+1)
Introduction to Forestry	2(1+1)
Total	**11(6+5)**
Statistics, Computer Application and I.P.R.	
Fundamentals of Statistics	2(1+1)
Agriculture Informatics	2(1+1)
Intellectual Property Rights	1(1+0)
Total	**5(3+2)**
Animal Production	
Livestock and poultry Management	3(2+1)
Total	**3(2+1)**
Language	
Comprehension & Communication Skills in English (Gradial course)	2(1+1)
Total	**2(1+1)**
Remedial Courses	
Agriculture Heritage	1(1+0)
Introductory Biology	2(1+1)

Elementary Mathematics	1(1+0)
Total	**4(3+1)**
Non-Gradial Courses	
NSS/NCC/Physical Education & Yoga Practices	2(0+2)
Human Values & Ethics	1(1+0)
Educational Tour	2(0+2)
Total	**5(1+4)**

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I Semester		
1.	Fundamentals of Statistics	3(2+1)
2.	Fundamentals of Soil Science	3(2+1)
3.	Fundamentals of Agronomy	4(3+1)
4.	Comprehension & Communication Skills in English	2(1+1)
5.	Environmental Studies and Disaster Management	3(2+1)
6.	Fundamentals of Agricultural Economics	2(2+0)
7.	Rural Sociology & Educational Psychology	2(2+0)
8.	Agriculture Informatics	2(1+1)
9.	Agriculture Heritage*	1(1+0)
10.	Elementary Mathematics* or Introductory Biology*	1(1+0) or 2(1+1)
TOTAL ***R: Remedial course**		**21 +2* or +3***
II Semester		
1.	Fundamentals of Horticulture	2(1+1)
2.	Fundamentals of Plant Biochemistry and Biotechnology	2(1+1)
3.	Agricultural Microbiology	2(1+1)
4.	Introduction to Forestry	2(1+1)
5.	Communication Skills and Personality Development	2(1+1)
6.	Fundamentals of Genetics	3(2+1)
7.	Introductory Soil and Water Conservation Engineering	2(1+1)
8.	Fundamentals of Plant Pathology	3(2+1)
9.	Fundamentals of Entomology	3(2+1)
10.	NSS/NCC/Physical Education & Yoga Practices	2(0+2)
Total ****NC: Non-gradial courses**		**21 +2****
III Semester		
1.	Fundamentals of Agricultural Extension Education	3(2+1)
2.	Fundamentals of Crop Physiology	2(1+1)
3.	Crop Production Technology – I (Kharif Crops)	2(1+1)
4.	Fundamentals of Plant Breeding	3(2+1)
5.	Agricultural Finance and Cooperation	3(2+1)
6.	Farm Machinery and Power	2(1+1)
7.	Production Technology for Vegetables and Spices	2(1+1)
8.	Introductory Agro-meteorology & Climate Change	2(1+1)
9.	Human Values & Ethics (NC)**	1(1+0)
Total ****NC: Non-gradial courses**		**19 +1***

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IV Semester		
1.	Crop Production Technology –II (Rabi Crops)	2(1+1)
2.	Production Technology for Ornamental Crops, MAP and Landscaping	2(1+1)
3.	Renewable Energy and Green Technology	2(1+1)
4.	Problematic Soils and their Management	2(2+0)
5.	Production Technology for Fruit and Plantation Crops	2(1+1)
6.	Principles of Seed Technology	2(1+1)
7.	Farming System & Sustainable Agriculture	1(1+0)
8.	Agricultural Marketing Trade & Prices	3(2+1)
9.	Livestock and Poultry Management	3(2+1)
10.	Elective Course	3(2+1)
Total		**22**
V Semester		
1.	Principles of Integrated Pest and Disease Management	3(2+1)
2.	Manures, Fertilizers and Soil Fertility Management	3(2+1)
3.	Pests of Crops and Stored Grain and their Management	3(2+1)
4.	Diseases of Field and Horticultural Crops and their Management -I	3(2+1)
5.	Crop Improvement-I (Kharif Crops)	2(1+1)
6.	Entrepreneurship Development and Business Communication	2(1+1)
7.	Geoinformatics and Nano-technology for Precision Farming	2(1+1)
8.	Intellectual Property Rights	1(1+0)
9.	Elective Course	3(2+1)
10.	Practical Crop Production – I (Kharif crops)	2(0+2)
Total		**24**
VI Semester		
1.	Rainfed Agriculture & Watershed Management	2(1+1)
2.	Protected Cultivation and Secondary Agriculture	2(1+1)
3.	Diseases of Field and Horticultural Crops and their Management-II	3(2+1)
4.	Post-harvest Management and Value Addition of Fruits and Vegetables	2(1+1)
5.	Management of Beneficial Insects	2(1+1)
6.	Crop Improvement-II (Rabi crops)	2(1+1)
7.	Principles of Organic Farming	2(1+1)
8.	Farm Management, Production & Resource Economics	2(1+1)
9.	Principles of Food Science and Nutrition	2(2+0)
10.	Elective Course	3(2+1)
11.	Practical Crop Production –II (Rabi crops)	2(0+2)
12.	Educational Tour	2(0+2)
Total		**26**

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VII Semester			
S. No.	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE &AIA)		
	Activities	No. of weeks	Credit Hours
1.	General orientation & On campus training by different faculties	1	14
2.	Village attachment/ Unit attachment in Univ./ College. KVK/ Res. Stn.	8	
3.	Agro-Industrial Attachment	10	06
4.	Project Report Preparation, Presentation and Evaluation	1	
Total weeks for RAWE & AIA		20	20

Agro- Industrial Attachment: The students would be attached with the agro-industries for a period of 10 weeks to get an experience of the industrial environment and working**.**

RAWE Component-I
Village Attachment Training Programme

S. 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.	Animal Production Interventions	1 week
7.	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 10 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

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Performance evaluation, appraisal and ranking of students

Evaluation of RAWE Programme
Attendance: Minimum attendance - 85%.
Records: Students would complete the record work/ report writing/ presentations, etc. based on daily field observations recorded in notebooks and weekly diaries maintained by them.
Evaluation Procedure: Students shall be evaluated component-wise under village attachment and agro-industrial attachment. The respective component In-Charge Instructor(s), agro-industrial official and Course Coordinator will evaluate the students as under:

ACTIVITY		**Max. Marks**
1. **Village attachment training**		
a.	KVK/ARS/NGO scientist	50
b.	Report Preparation	10
c.	University Committee (Presentation & Viva-voce)	40
2. Industrial attachment training		
a.	Industry officials	50
b.	Report Preparation	10
c.	University Committee (Presentation & Viva-voce)	40

Assessment Parameters (RAWE & AIA):

	Parameters	**Marks (%)**
A	Village Attachment	
	Regularity	10
	Initiative & creativity	10
	General conduct & discipline	10
	Work performance	20
B.	Industrial Attachment	
	Initiative & compliance	10
	General conduct and discipline	10
	Project planning & implementation	10
	Work performance	20

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VIII Semester (Experiential Learning Programme/HOT)		
	Module	Credit Hr.
1.	Module-I	0+10
2.	Module-II	0+10
	Total	**20 (0+20)**

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.

S. No.	Title of the module	Credits
1.	Bioagents and Biofertilizer production	0+10
2.	Seed Production and Technology	0+10
3.	Mushroom Cultivation	0+10
4.	Soil, plant , water and seed Testing services	0+10
5.	Beekeeping	0+10
6.	Poultry Production	0+10
7.	Applied Hi-Tech Horticulture	0+10
8.	Agri-business management	0+10
9.	Hybrid Seed Production Technologies	0+10
10.	Floriculture and Landscaping	0+10
11.	Food Processing and Food safety standards	0+10
12.	Commercial vegetable production	0+10
13.	Tissue-culture Technologies	0+10
14.	Agriculture Waste Management	0+10
15.	Organic Production Technology	0+10
16.	Agro-advisory Services	0+10
17.	Nursery Management	0+10
18.	Sericulture	0+10
19.	Practicing Protected Horticulture	0+10

Evaluation of Experiential Learning Programme/ HOT

S. No.	Parameters	Max. Marks
1.	Project Planning and Writing	10
2.	Presentation	10
3.	Regularity	10
4.	Monthly Assessment	10
5.	Output delivery	10
6.	Technical Skill Development	10

7.	Entrepreneurship Skills	10
8.	Business networking skills	10
9.	Report Writing Skills	10
10.	Final Presentation	10
	Total	**100**

Discipline-wise summary of credit hours

S.N.	Group	Credit Hours
1.	Agronomy	21(10+11)
2.	Genetics & Plant Breeding	12(7+5)
3.	Soil Science & Agricultural Chemistry	8(6+2)
4.	Entomology	8(5+3)
5.	Agricultural Economics	10(7+3)
6.	Agricultural Engineering	8(4+4)
7.	Plant Pathology	12(8+4)
8.	Horticulture	10(5+5)
9.	Food Science	2(2+0)
10.	Agricultural Extension	9(6+3)
11.	Biochemistry / Physiology / Microbiology/ Environmental Sciences	11(6+5)
12.	Statistics, Computer Application and I.P.R.	5(3+2)
13.	Animal Production	4(3+1)
14.	English	2 (1+1)
15.	Remedial Courses	03 (Biol/ Math)
16.	NSS/NCC/Physical Education & Yoga Practices	2(0+2)
17.	Human Values and Ethics	1(1+0)
18.	Educational Tour	2(0+2)
Total		122 + 2/1 (for Bio / Math)/ + 5 NC 122+2/1+5=129/130 (For Bio/ Math/) + 9 credits elective
RAWE ELP		20 +20
Grand Total		138/139+20+20=178/179

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

S.N.	Courses	Credit Hours
1.	Agribusiness Management	3(2+1)
2.	Agrochemicals	3(2+1)
3.	Commercial Plant Breeding	3(1+2)
4.	Soil, Plant, Water and Seed Testing	3(1+2)
5.	Landscaping	3(2+1)
6.	Agricultural Waste Management	3(2+1)
7.	Food Safety Issues	3(2+1)
8.	Biopesticides & Biofertilizers	3(2+1)
9.	Protected Cultivation	3(2+1)
10.	Micro propagation Technologies	3(1+2)
11.	Hi-tech. Horticulture	3(2+1)
12.	Weed Management	3(2+1)

Examination and Evaluation System

Fifth Deans' Committee of ICAR had deliberated on the examination and evaluation system being followed by different universities. The Committee recommends Uniform Grading system to be followed with uniform OGPA requirements for award of degrees at all levels and uniform conversion formulae to be followed for declaration of I, II and III divisions, distinctions etc. Declaration of division in the degree certificate to be made compulsory. by all universities:

Examination

External theory (50%)

Internal Theory + Practical (50%)

- Courses with theory and practical

Mid-term Exam (30%) + Assignment (5%) in practical oriented courses + Practical (15%)

- Courses with only theory

Mid-term Exam (40%) + Assignment (10%)

- Courses with only practical:

(100%) Internal

Paper to be set by external: HOD shall ensure the coverage of syllabus. If needed moderation can be done.

Evaluation to be done **i**nternally by the faculty other than the Course Instructor. Syllabus of the concerned course shall be sent to the external examiner, who shall prepare the question papers. For practical, it is recommended that examination shall be conducted by course instructor(s) and one teacher nominated by HOD.

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(Established vide Uttaranchal University Act, 2012)
(Uttarakhand Act No. 11 of 2013)
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SYLLABUS
of
BACHELOR OF SCIENCE- B.SC. HONS.
AGRICULTURE

SEMESTER –I

BSAG-101: Fundamentals of Statistics (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

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

Practical

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

Suggested Readings:

1. Biostatistics. P.N. Arora and P.K. Malhan. Himalaya Publishing House.
2. Fundamentals of mathematical statistics. S.C. Gupta and V.K. Kapoor. S. Chand

BSAG-102: **Fundamentals of Soil Science** (**L-T-P: 2-0-2**) **Credit: 3(2+1)**

Theory

Soil as a natural body, Pedological and edaphological concepts of soil; Soil genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation; Soil Profile, components of soil; Soil physical properties: soil-texture, structure, density and porosity, soil colour, consistence and plasticity; Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; soil air, composition, gaseous exchange, problem and plant growth; 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. Study of soil forming rocks and minerals. Determination of soil density, moisture content and porosity. Determination of soil texture by feel and Bouyoucos Methods. Studies of capillary rise phenomenon of water in soil column and water movement in soil. Determination of soil pH and electrical conductivity. Determination of cation exchange capacity of soil. Study of soil map. Determination of soil colour. Demonstration of heat transfer in soil. Estimation of organic matter content of soil.

Suggested Readings:

1. Soil Fertility and Fertilizers. Tisdale and Nelson.
2. Soil fertility and Nutrient management. S.S. Singh
3. Introductory Soil Science. Dilip Kumar Das.
4. Nature and Properties of Soils. N.C. Brady

BSAG-103: Fundamentals of Agronomy (L-T-P: 3-0-2) Credit: 4(3+1)

Theory

Indian agriculture: importance, present status, scope and future prospect. Cropping seasons of India. Soil: their formation, classification, physical, chemical properties, prevention and formation of acidic and alkali soils. Essential nutrients, uptake of N, P and K by plants. Manures and fertilizers: methods of application, composition of bulky organic manures, concentrated organic manures, green manures and various types of inorganic fertilizers. Irrigation: importance of water, quality of irrigation water and source. Disadvantages of excessive soil moisture, necessity and methods of drainage. Acquaintance of important crops: wheat, rice, cotton, sorghum, maize, mustard, chickpea, pigeon pea, groundnut, sugarcane, potato. Acquaintance with horticultural crops such as cabbage, cauliflower, onion, tomato, brinjal, cucurbits, root crops, peas, banana, apple, mango, litchi, citrus, guava. Tillage, types of plough, their management and different methods of ploughing. Water lifting devices. Types of iron and steels and used in agricultural. Place of agriculture in five year plans.

Practical:

Identification of important crops and crop seeds; Acquaintance with fertilizers and agricultural chemicals; Identification of crop weeds; Identification of farm implements; Acquaintance with vegetable and horticulture crops; Practical Knowledge of seed bed preparation; Visit to agricultural institutes and meteorological observatory.

Reference Book:

1. Fundamentals of Agriculture. Vol.-1 Arun Katyayan
2. A hand book of Agriculture. ICAR
3. History of Agriculture in India, Vol.I-IV –(Ed.)M.S.Randhawa
4. Rainfed Agriculture in India:Research and development Scenario. J. Venkataswarelu
5. Concise History of Science in India, Agriculture - S.P. Rayachaudhury, D.M. Bose, S.N. Sen and B.V.A. Subbarayappa

BSAG-104: Comprehension & Communication Skills in English (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested Readings:

Suggested Books:

1. Basic Technical Communication, Raj K. Dhar, Pearson, New Delhi
2. Effective Technical Communication, Rizvi,TMH, New Delhi
3. Improve your Writing, Arora & Chandra,OUP, New Delhi
4. Guide to Patterns & Usage in English; Hornby A.S, OUP, New Delhi

BSAG-105: Environmental Studies and Disaster Management (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

Multidisciplinary nature of environmental studies Definition, scope and importance.

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

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

Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-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.

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

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

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

DISASTER MANAGEMENT

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

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

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

Practical

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

Suggested Readings:

- Environmental science. Anubha Kaushik. New Age Publication . New Delhi
- Environmental Studies. R. Rajgopalan. Oxford Univ. Press, New Delhi.

BSAG-106: Fundamentals of Agricultural Economics (L-T-P: 2-0-0) Credit: 2(2+0)

Theory

Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macroeconomics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country. *Demand:* meaning, law of demand, demand schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Production: process, creation of utility, factors of production, input output relationship. *Laws of returns*: Law of variable proportions and law of returns to scale. *Cost:* Cost concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply. Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points. Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit. *National income:* Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control. Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation. Banking: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy. Agricultural and public finance: meaning, micro v/s macro finance, need for agricultural finance, public revenue and public expenditure. *Tax:* meaning, direct and indirect taxes, agricultural taxation, VAT. *Economic systems:* Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.

Suggested Readings:

- Myneni S.R : Principles of Economics.
- Seth M.L : Principles of economics
- Desai Pranav K.: Agriculture Economics,Daya publishing house.
- Reddy Subba : Agricultural Economics
- Penson John, Capps Oral, C.Rosson, Woodward Richard: Introduction to Agricultural Economics

BSAG-107: Rural Sociology & Educational Psychology (L-T-P: 2-0-0) Credit: 2(2+0)

Theory

Sociology and Rural sociology: Definition and scope, its significance in agriculture extension, Rural society, Social Groups, Social Stratification, Culture concept, Social Institution, Social Change & Development. Educational psychology: Meaning & its importance in agriculture extension. Behavior: Cognitive, affective, psychomotor domain, Personality, Learning, Motivation, Theories of Motivation, Intelligence.

Suggested Readings:

- Dr. Hans Raj, Rural Sociology, Surjeet Publications.
- Mangal, S.K, Advanced Educational Psychology, PHI Publications

BSAG-108: Agriculture Informatics (L-T-P: 1-0-2) Credit: 2(1+1)

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 and components.

Computer Programming, General Concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc, concepts and standard input/output operations. e-Agriculture, concepts, design and development. Application of innovative ways to use information and communication technologies (IT) in Agriculture. 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, concepts, components and applications in Agriculture, Agriculture 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, practice of important DOS Commands. Introduction of different operating systems such as windows, Unix/ Linux, Creating, Files & Folders, File Management. Use of MS-WORD and MS Power-point for creating, editing and presenting a scientific Document. MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros. MS-ACCESS: Creating Database, preparing queries and reports, demonstration of Agri-information system. Introduction to World Wide Web (WWW) and its components. Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++. Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/CropSyst/ Wofost. 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, for generating information important for Agriculture. Hands on practice on preparation of Decision Support System. Preparation of contingent crop planning.

Suggested Readings:

- V. Rajaram. Fundamentals of Computers. Pentice Hall Pvt. Ltd.
- Ron Mansfield, The Compact Guide to Microsoft Office
- Chris Lewis, Essential Tips: Using the Internet
- Gene Weisskopf, ABCs of Excel 97.

RBSAG-101: Agriculture Heritage* (L-T-P: 1-0-0) Credit: 1(1+0)

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.

Suggested Readings:

- Fundamentals of Agriculture. Vol.-1 Arun Katyayan
- A hand book of Agriculture. ICAR
- History of Agriculture in India, Vol.I-IV –(Ed.)M.S.Randhawa
- Rainfed Agriculture in India:Research and development Scenario. J. Venkataswarelu
- Concise History of Science in India, Agriculture - S.P. Rayachaudhury, D.M. Bose, S.N. Sen and B.V.A. Subbarayappa

RBSAG-102: Elementary Mathematics (L-T-P: 1-0-0) Credit: 1(1+0)**

Theory

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

Suggested Readings:

- Biostatistics. P.N. Arora and P.K. Malhan. Himalaya Publishing House.
- Fundamentals of mathematical statistics. S.C. Gupta and V.K. Kapoor. S. Chand Publication
- Fundamentals of mathematical statistics. S.C. Gupta and V.K. Kapoor. S. Chand Publication
- Narayan Shanti. 2004. Mathematics for degree student. S. Chand and Co. Ltd. New Delhi.

RBSAG-102: Introductory Biology (L-T-P: 1-0-2) Credit: 2(1+1)**

Theory

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

Practical

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

Suggested Readings:

Textbook of Structural & Physiological Botany. Otto W. Thome. Longman Green & Company.
Biology Botany. Tamil Nadu Textbook Corporation, College Road, Chennai.
Elements of Botany. Asa Gray, 1887. Ivison, Blakeman, And Company
C. Dutta. (1998). *Botany for Degree Students*. (1998). Oxford University Press. India
Ashok Bendre and Ashok Kumar. (1984). *Textbook of Practical Botany*. Vol. I and II. Rastogi Publications. Meerut. India. (Also available on Flipkart and Amazonbooks. Com)
Ashok Bendre and P. C. Pande. (1996). *Introductory Botany*. Rastogi Publications. Meerut. India.
P. Pandey. (2012). *Taxonomy of Angiosperms*. S. Chand and Company Ltd. New Delhi.
Gurucharan Singh. (2000). *Plant Systematics*. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

SEMESTER –II

BSAG- 109: Fundamentals of Horticulture (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested Readings:

- Hand Book of Horticulture. K.L. Chaddha. ICAR
- Fundamentals of Horticulture. Kunte and Yawalkar. Agri-Horticultural Publishing House
- Basic Horticulture. Jitendra Kumar
- Fruit Growing in India. A.S. Salaria

BSAG-110: Fundamentals of Plant Biochemistry and Biotechnology (L-T-P:1-0-2) Credit: 2(1+1)

Theory

Importance of Biochemistry. Properties of Water, pH and Buffer. Carbohydrate: Importance and classification. Structures of Monosaccharides, Reducing and oxidizing properties of Monosaccharides, Mutarotation; Structure of Disaccharides and 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; Classification; Mechanism of action; Michaelis & Menten and Line Weaver Burk equation & plots; Introduction to allosteric enzymes. Nucleic acids: Importance and classification; Structure of Nucleotides, A, B & Z DNA; RNA: Types and Secondary & Tertiary structure. Metabolism of carbohydrates: Glycolysis, TCA cycle, Glyoxylate cycle, Electron transport chain. Metabolism of lipids: Beta oxidation, Biosynthesis of fatty acids.

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

Practical

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

Suggested Readings:

- Biochemistry by U. Satynarayan
- Biochemistry by Lehringer
- Fundamentals of Biotechnology. Dr J.L. Jain *et al*. S. Chand Publication
- Plant Biochemistry. Arun Kumar et al. APH Publication

BSAG-111: Agricultural Microbiology (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

Introduction of microorganisms, Prokaryotic and eukaryotic microbes. Bacteria: cell structure, standard growth curve, factors affecting microbial growth. Preparation and preservation, of pure culture, microbial association, role of microorganisms in biotechnology and genetics.

Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and sulphur cycles.

Biological nitrogen fixation- symbiotic, associative and aysmbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere.

Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation.

Practical

Introduction to microbiology laboratory and its equipments
Microscope- parts, principles of microscopy, resolving power and numerical aperture
Methods of sterilization
Nutritional media and their preparations
Enumeration of microbial population in soil-bacteria, fungi, actinomycetes
Methods of isolation and purification of microbial cultures
Isolation of nitrogen fixing bacteria
Staining and microscopic examination of microbes

Suggested Readings:

1. Microbiology. Harish Chandra, Ravi Kant Agarwal & Jatin Sriwastva. John Publishers, New Delhi.
2. Microbiology. R.P. Singh. 2014. Kalyani Pub. Ludhiyana, India.
3. A text Book of Microbiology. 2014. R.C. Dubey & D.K. Maheshwari. S. Chand and Company Pvt. Ltd., New Delhi, India.
4. Experiments in Microbiology, Plant Pathology and Bitechnology. K.R. Aneja. 2014. New Age International Publications, New Delhi. p. 607.

BSAG-112: Introduction to Forestry (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested Readings:

Beazley, M. 1981. The International Book of Forest. London
Champion and Seth. 1968. Forest types of India.
Grebner, D.L., Bettinger, P.and Siry, J.P. 2012. Introduction to Forestry and Natural Resources.
Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, New Delhi.
Mitchell Beazly.1981. The International Book of the Forest. Mitchell Beazly Publishers, London.
Mather, A.S. 1990. Global forest resources. Belhaven, London
Persson, R. 1992. World forest resources. Periodical experts, New Delhi.
Westoby, J. 1991. Introduction to World Forestry. Wiley, 240p.

BSAG-113: Communication Skills and Personality Development (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and non-verbal 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, precis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

Practical

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

Suggested Readings:

1. Balasubramanian T. 1989. A Text book of Phonetics for Indian Students. Orient Longman, New Delhi.
2. Balasubrmanyam M. 1985. Business Communication. Vani Educational Books, New Delhi.
3. Naterop, Jean, B. and Rod Revell. 1997. Telephoning in English. Cambridge University Press, Cambridge.
4. Mohan Krishna and Meera Banerjee. 1990. Developing Communication Skills. Macmillan India Ltd. New Delhi.
5. Krishnaswamy,. N and Sriraman, T. 1995. Current English for Colleges. Macmillan India Ltd. Madras.
6. Narayanaswamy V R. 1979. Strengthen your writing. Orient Longman, New Delhi.
7. Sharma R C and Krishna Mohan. 1978. Business Correspondence. Tata Mc Graw Hill publishing Company, New Delhi.

BSAG-114: Fundamentals of Genetics (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity, Cell division – mitosis, meiosis, Probability and Chi-square. Dominance relationships, gene interaction.
Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanisms, chromosome mapping. Structural changes in chromosome, Mutation, classification, Methods of inducing mutation & CIB technique, mutagenic agents and induction of mutation. Qualitative & Quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Epistatic interactions with examples. Cytoplasmic inheritance. Genetic disorders,. Nature, structure & replication of genetic material. Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operons.

Practical

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

Suggested Readings:

Fletcher, H. and Hickey, I. (2012). Genetics. Garland Science, 392p.
Garner, E. J., Simmons, M. J. and Sunstad, P. D. (2008). Principles of Genetics (8th edn.). Wiley India (P.) Ltd., Daryaganj, New Delhi.
Gupta P. K. (1999). Cytogenetics Rastogi Publishers, Meerut
Strickberger, M.W. (1996). Genetics (3rd edn.). Mac Millan Publishing Co., New Delhi
Tamarin, R. (2002). Principles of Genetic (7th Ed). Tata McGraw-Hill Education.
White, T.L., Adams, W.T., and Neale, D.B. (2007). Forest Genetics. CABI

BSAG-115: Introductory Soil and Water Conservation Engineering (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested Readings:

- Soil and water Conservation Engineering. Dr R. Suresh
- Principles of Agronomy - T.Y. Reddy and G. H. SankarReddi
- Principles of Agronomy - S. R. Reddy
- Soil Erosion and Conservation – R.P. Tripathy and H.P. Singh

BSAG-116: Fundamentals of Plant Pathology (L-T-P: 2-0-2) **Credit : 3(2+1)**

Theory

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

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

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

Viruses: nature, architecture, multiplication and transmission.

Study of phanerogamic plant parasites.

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

Principles and methods of plant disease management.

Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.

Practical

Acquaintance with various laboratory equipments and microscopy; Preparation of media, isolation and Koch's postulates; General study of different structures of fungi. Study of symptoms of various plant diseases. Study of representative fungal genera; Staining and identification of plant pathogenic bacteria; Transmission of plant viruses; Study of phanerogamic plant parasites; Study of morphological features and identification of plant parasitic nematodes. Extraction of nematodes from soil; Study of fungicides and their formulations. Methods of pesticide application and their safe use; Calculation of fungicide sprays concentrations**.**

Suggested Readings:

- Plant Diseases. R.S. Singh
- Plant Pathology. G.N. Agrios

BSAG-117: Fundamentals of Entomology (L-T-P: 2-0-2) Credit : 3(2+1)

Part - I

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 molting. Body segmentation. Structure of Head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. Structure of male and female genital organ. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs like simple and compound eyes, chemoreceptor.

Part-II

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

Part III

Pest surveillance and pest forecasting. Categories of pests. Host plant resistance, Cultural, Mechanical, Physical. Legislative. Biological (parasites, predators & transgenic plant pathogens such as bacteria, fungi and viruses) methods of control. Chemical control-importance, hazards and limitations. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Recent methods of pest control, repellents, antifeedants, hormones, attractants, gamma radiation and genetic control. Practices, scope and limitations of IPM. Insecticides Act 1968-Important provisions. Application techniques of spray fluids. Phytotoxicity of insecticides. Symptoms of poisoning, first aid and antidotes. Beneficial insects: parasites and predators used in pest control and their mass multiplication techniques. Important groups of microorganisms, bacteria, viruses and fungi used in pest control and their mass multiplication techniques. Important species of pollinators, weed killers and scavengers, their importance.

Part – IV

Systematics: Taxonomy –importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta upto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae,Muscidae, Tephritidae.

Practical

Methods of collection and preservation of insects 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.

Suggested Readings:

- Manual on Insect pest of crops and their management. Rajendra Singh, S.S. Dhaka and C.S. Prasad.
- T A text book of Entomology. Mathur and Upadhyayay.
- A text book of Applied Entomology. K.P. Srivastava
- Elements of Economic Entomology. B.V. David and T. Kumarswami
- Agricultural pests of India and South-east Asia. A.S. Atwal

NCBSAG-101: NSS/NCC/Physical Education & Yoga Practices (L-T-P: 0-0-0) Credit: 2(0+2)

Theory

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

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

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

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

lectures and practical works.Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction.

SYLLABUS

Semester I
Course Title: National Service Scheme I
Introduction and basic components of NSS:

Orientation: history, objectives, principles, symbol, badge; regular programmes under NSS, organizational structure of NSS, code of conduct for NSS volunteers, points to be considered by NSS volunteers awareness about health

NSS programmes and activities

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

Understanding youth

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

Community mobilisation

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

Social harmony and national integration

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

Volunteerism and shramdan

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

Citizenship, constitution and human rights

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

Family and society

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

Semester II
Course Title: National Service Scheme II
Importance and role of youth leadership

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

Life competencies

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

Youth development programmes

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

Health, hygiene and sanitation
Definition needs and scope of health education; role of food, nutrition, safe drinking water, water born diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programmes and reproductive health.
Youth health, lifestyle, HIV AIDS and first aid
Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid
Youth and yoga
History, philosophy, concept, myths and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method

Semester III
Course Title: National Service Scheme III
Vocational skill development

To enhance the employment potential and to set up small business enterprises skills of volunteers, a list of 12 to 15 vocational skills will be drawn up based on the local conditions and opportunities. Each volunteer will have the option to select two skill-areas out of this list
Issues related environment
Environmental conservation, enrichment and sustainability, climatic change, natural resource management (rain water harvesting, energy conservation, forestation, waste land development and soil conservations) and waste management
Disaster management
Introduction and classification of disaster, rehabilitation and management after disaster; role of NSS volunteers in disaster management.
Entrepreneurship development
Definition, meaning and quality of entrepreneur; steps in opening of an enterprise and role of financial and support service institution.
Formulation of production-oriented project
Planning, implementation, management and impact assessment of project
Documentation and data reporting
Collection and analysis of data, documentation and dissemination of project reports

Semester IV
Course Title: National Service Scheme IV
Youth and crime
Sociological and psychological factors influencing youth crime, cyber crime, pear mentoring in preventing crime and awareness for juvenile justice
Civil/self defence
Civil defence services, aims and objectives of civil defence; needs and training of self defence
Resource mobilisation
Writing a project proposal of self fund units (SFUs) and its establishment
Additional life skills
Positive thinking, self confidence and esteem, setting life goals and working to achieve them, management of stress including time management.

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SEMESTER –III

BSAG-201: Fundamentals of Agricultural Extension Education (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

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

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

Practical

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

Suggested Readings:

- Agricultural Extension- A.W. Van Den Ban & H.S. Hawkins
- Rural Extension Hand book- V. Singh & M.S. Vasistha
- New Dimension and Approaches in Extension – J. Vasanthakumar

BSAG-202: Fundamentals of Crop Physiology (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

Study of plant cells, structure and distribution of stomata, imbibitions, osmosis, plasmolysis, measurement of root pressure, rate of transpiration, Separation of photosynthetic pigments through paper chromatography, Rate of transpiration, photosynthesis, respiration, tissue test for mineral nutrients, estimation of relative water content, Measurement of photosynthetic CO_2 assimilation by Infra Red Gas Analyser (IRGA).

Suggested readings:

- Plant Physiology. S.N. Pandey and B.K. Singh
- Plant physiology - R.G.S. Bidwell
- A text book of plant physiology - C.P.Mallick and A.K.Srivastav
- Plant physiology - R.K.Shinha
- Plant Physiology -K.N.Vatia and A.N.Parasar

BSAG-203: Crop Production Technology – I (Kharif Crops) (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested readings:

- Modern Techniques of Raising crops: Chidda Singh, Prem singh, Rajbir singh.
- Scientific crop production in India: I P S Ahlawat, Om prakash, G.S. Saini.
- Modern Techniques of raising field crops - Chida Singh
- Crop management under rainfed and irrigated condition - S.S.Singh
- Agronomy of field crops - S.R.Reddy
- Text book of field crop production - Edited by R. Prasad (ICAR)

BSAG-204: Fundamentals of Plant Breeding (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self – incompatibility and male sterility- genetic consequences, cultivar options. Domestication, Acclimatization, introduction; Centre of origin/diversity, component of Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self- pollinated crops-mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept. Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross pollinated crops, modes of selection; 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; Intellectual Property Rights, Patenting, Plant Breeders and & Farmer's Rights.

Practical

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

Suggested readings:

- Principles of Plant Breeding - R.W. Allard
- Plant Breeding Principles and Methods - B. D. Singh
- Plant Breeding - (Ed.) V. L. Chopra
- Plant Breeding. Analysis and Exploitation of Variation - D. Roy

BSAG-205: Agricultural Finance and Cooperation (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4 R's, and 3C's of credits. Sources of agricultural finance: institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks, Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent development in agricultural credit. Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis.
Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED.

Practical

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

Suggested readings

- Reddy,S., and Ram,P.R. Agricultural Finance and Management. Oxford and IBH, New Delhi
- Berry ,Peter ,Ellinger Paul: Financial Management in Agriculture
- Jha Sadanadn : Agriculture Finance and Commercial Bank
- Anand Jaya S :Cooperative Agriculture Rural Development Bank
- Kulshrestha R.K., Markande, R.K , Agriculture Economics

BSAG-206: Farm Machinery and Power (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested Books:

- Principles of Farm Machinery – Roy Bainer, R.A. Kepner, E.L. Barger
- Farm Machinery and Equipment – C.P. Nakra
- Elements of Farm Machinery – J. Sahay

BSAG-207: Production Technology for Vegetables and Spices (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested readings:

- A text book of pomology Vol-I (Tropical fruits) - T.K.Chattopadhaya
- A text book of pomology Vol-II (Sub- tropical fruits) - T.K. Chattopadhaya
- Fruits Physiology and production – A. Singh

BSAG-208: Introductory Agro-meteorology & Climate Change (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical:

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

Suggested readings:

- A text book of Agrometeorology. N.S. Varshneya and P.Pillai. ICAR
- Hand book of Agrometeorology. O.P. Meena *et al*. Agrotech Publication.
- Agrometeorology and remote sensing - D.D. Sahu
- Introduction to Agrometeorology - H.S.Mavi
- Crops and Weather – S. Venkataraman and A. Krishnan (ICAR)

NCBSAG-103: Human Values & Ethics (L-T-P: 1-0-0) Credit: 1(1+0)

Theory

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

Suggested Readings:

1. Gaur R.R, Sangal R & Bagaria GP. 2011. A *Foundation Course in Human Values and Professional Ethics.* Excel Books.
2. Sharma RP & Sharma M. 2011. *Value Education and Professional Ethics.* Kanishka Publishers.
3. Srivastava S. 2011. *Human Values and Professional Ethics.* S K Kataria & Sons.

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SEMESTER –IV

BSAG-209: Crop Production Technology –II (Rabi Crops) (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops; cereals –wheat and barley, pulses-chickpea, lentil, peas, oilseeds-rapeseed, mustard and sunflower; sugar crops-sugarcane; other crops- potato, Forage crops-berseem, lucerne and oat.

Practical

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

Suggested readings:

- Modern Techniques of raising field crops - Chida Singh
- Crop management under rainfed and irrigated condition - S.S.Singh
- Agronomy of field crops - S.R.Reddy
- Text book of field crop production - Edited by R. Prasad (ICAR)

BSAG-210: Production Technology for Ornamental Crops, MAP and Landscaping (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested readings:

- Modern Techniques of raising field crops - Chida Singh
- Crop management under rainfed and irrigated condition - S.S.Singh
- Agronomy of field crops - S.R.Reddy
- Text book of field crop production - Edited by R. Prasad (ICAR)

BSAG-211: Renewable Energy and Green Technology (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested readings:

- Environmental science. Anubha Kaushik. New Age Publication . New Delhi
- Environmental Studies. R. Rajgopalan. Oxford Univ. Press, New Delhi.

BSAG-212: Problematic Soils and their Management (L-T-P: 2-0-0) Credit: 2(2+0)

Theory

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

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

Multipurpose tree species, bio remediation through MPTs of soils, land capability and classification, land suitability classification. Problematic soils under different Agroeco systems.

Suggested readings:

- Soil and water Conservation Engineering. Dr R. Suresh
- Principles of Agronomy - T.Y. Reddy and G. H. SankarReddi
- Principles of Agronomy - S. R. Reddy
- Soil Erosion and Conservation – R.P. Tripathy and H.P. Singh

BSAG-213: Production Technology for Fruit and Plantation Crops (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested readings

- Cultivation of Tropical, Subtropical Vegetables, Spices, Medicinal and Aromatic Plants : National Institute of Industrial Research, 2004.
- Hand Book of Horticulture. K.L. Chaddha. ICAR
- Fundamentals of Horticulture. Kunte and Yawalkar. Agri-Horticultural Publishing House
- Basic Horticulture. Jitendra Kumar
- Fruit Growing in India. A.S. Salaria

BSAG-214: Principles of Seed Technology (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

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

Practical

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

Suggested readings:

- Seed Technology – R.L. Agrawal
- Principles of Seed Technology – G.M. Kulkarni
- Structure Development and Reproduction in Angiosperms – V. Singh, P.C. Pande and D.K.Jain
- Principles of Seed Science & Technology – L.O. Copeland & M.B. KcDonald

BSAG-215: Farming System & Sustainable Agriculture (L-T-P: 1-0-0) Credit: 2(1+0)

Theory

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

Suggested readings:

- Fundamentals of Agriculture. Vol.-1 Arun Katyayan
- A hand book of Agriculture. ICAR
- History of Agriculture in India, Vol.I-IV –(Ed.)M.S. Randhawa
- Rainfed Agriculture in India:Research and development Scenario. J. Venkataswarelu
- Concise History of Science in India, Agriculture - S.P. Rayachaudhury, D.M. Bose, S.N. Sen and B.V.A. Subbarayappa
- Principles of Agronomy - T.Y. Reddy and G. H. SankarReddi
- Principles of Agronomy - S. R. Reddy

BSAG-216: Agricultural Marketing Trade & Prices (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

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

Practical

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

Suggested readings:

- Acharya, S.S., Agarwal, N.L.1987. Agricultural Marketing in India. Oxford and IBH, New Delhi.
- Acharya, S.S., Agarwal, N.L.1994. Agricultural Prices and Policy Oxford and IBH, New Delhi.
- Philip, K.2004. Principles of Marketing Prentice Hall, New Delhi.

BSAG-217: Livestock and Poultry Management (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

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

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

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

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

Practical

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

Suggested readings

- Livestock Production. Khalid Javed
- Livestock production management. Thomas, Shastri and Singh
- A Textbook of Animal Husbandry – G.C. Benerjee
- Livestock Production and Management – N.S.R. Sastri, C.K. Thomas, R.A. Singh
- Essentials of Animal Production and Management – R. Singh

A Handbook of Animal Husbandry – ICAR

BSAG-218: Elective Course (L-T-P: 2-0-2 or 1-0-4) Credit: 3(2+1) or 3(1+2) – details given separately.

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SEMESTER –V

BSAG-301: Principles of Integrated Pest and Disease Management (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

Categories of insect pests and diseases, IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of insect pests, diseases and pest risk analysis. Methods of detection and diagnosis of insect pest and diseases. Calculation and dynamics of economic injury level and importance of Economic threshold level. Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment. Introduction to conventional pesticides for the insect pests and disease management. Surveysurveillance 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, Pseudomona*s, *Trichogramma*, NPV etc. Identification and nature of damage of important insect pests and diseases and their management. Crop (agro-ecosystem) dynamics of a selected insect pest and diseases. Plan & assess preventive strategies (IPM module) and decision making. crop monitoring attacked by insect, pest and diseases . Awareness campaign at farmers fields.

Suggested readings:

- M.K. Gupta, Handbook of Organic Farming and Biofertilizers. ABD Publishers, 2007
- Organic Farming. By A.K. Dahama
- Manual on Insect pest of crops and their management. Rajendra Singh, S.S. Dhaka and C.S. Prasad.
- T A text book of Entomology. Mathur and Upadhyayay.
- Elements of Economic Entomology. B.V. David and T. Kumarswami
- Agricultural pests of India and South-east Asia. A.S. Atwal

BSAG-302: Manures, Fertilizers and Soil Fertility Management (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

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

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

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

Practical

Introduction of analytical instruments and their principles, calibration and applications, Colorimetry and flame photometry. Estimation of available N in soils. Estimation of available P in soils. Estimation of available K. Estimation of available S in soils. Estimation of available Ca and Mg in soils. Estimation of available Zn in soils. Estimation of N in plants. Estimation of P in plants. Estimation of K in plants. Estimation of S in plants.

Suggested readings

- Principles of Agronomy - T.Y. Reddy and G. H. SankarReddi
- Principles of Agronomy - S. R. Reddy
- The Nature and Properties of Soil - N.C.Brady and Ray R. Weil
- Manures and Fertilizers - K. S. Yawalkar, J.P. Agrawal and S. Bokde

BSAG-303: Pests of Crops and Stored Grain and their Management (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

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

Practical

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

Suggested readings:

- Manual on Insect pest of crops and their management. Rajendra Singh, S.S. Dhaka and C.S. Prasad.
- T A text book of Entomology. Mathur and Upadhyayay.
- A text book of Applied Entomology. K.P. Srivastava
- Elements of Economic Entomology. B.V. David and T. Kumarswami
- Agricultural pests of India and South-east Asia. A.S. Atwal

BSAG-304: Diseases of Field and Horticultural Crops and their Management -I (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

Symptoms, etiology, disease cycle and management of major diseases of following crops:
Field Crops: Rice: blast, brown spot, bacterial blight, sheath blight, false smut, khaira and tungro;Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra :downy mildew and ergot; Groundnut: early and late leaf spots, wilt
Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; Pigeonpea: Phytophthora blight, wilt and sterility mosaic;Finger millet: Blast and leaf spot; black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic; Castor: Phytophthora blight;Tobacco: black shank, black root rot and mosaic. Horticultural Crops: Guava: wilt and anthracnose;Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top;Papaya: foot rot, leaf curl and mosaic,Pomegranate: bacterial blight;Cruciferous vegetables: Alternaria leaf spot and black rot;Brinjal: Phomopsis blight and fruit rot and Sclerotinia blight;Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic; Okra:Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot; Colocasia: Phytophthora blight; Coconut: wilt and bud rot;Tea: blister blight;Coffee: rust

Practical

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

Suggested readings:

- Mehrotra, R.S. and Aneja, K.R. 1990. *An Introduction to Mycology.* New Age International (P) Ltd, New Delhi.
- Singh, R.S. 1982. *Plant Pathogens - The Fungi. Oxford* & IBM Publishing Co. Pvt. Ltd., New Delhi.
- Singh, R.S. 1989. *Plant Pathogens - The Prokaryotes.* Oxford & IBM Publishing Co. Pvt. Ltd., New Delhi.

BSAG-305: Crop Improvement-I (Kharif Crops) (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation 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); Seed production technology in self pollinated, cross pollinated and vegetatively propagated crops. Hybrid seed production technology in Maize, Rice, Sorghum, Pearl millet and Pigeonpea, etc. Ideotype concept and climate resilient crop varieties for future.

Practical

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

Suggested readings:

- Principles of Plant Breeding - R.W. Allard
- Plant Breeding Principles and Methods - B. D. Singh
- Plant Breeding - (Ed.) V. L. Chopra
- Plant Breeding. Analysis and Exploitation of Variation - D. Roy

BSAG-306: Entrepreneurship Development and Business Communication (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs; Assessment of entrepreneurship skills, SWOT Analysis & achievement motivation, Entrepreneurial behavior, Government policy and programs and institutions for entrepreneurship development, Entrepreneurial Development Process; Business Leadership Skills; Communication skills for entrepreneurship development, Developing organizational skill , Developing Managerial skills, Problem solving skill, Achievement motivation; time management; Supply chain management and Total quality management, Project Planning Formulation and report preparation; Opportunities for entrepreneurship and rural entrepreneurship.

Practical

Assessing entrepreneurial potential, problem solving ability, managerial skills and achievement motivation, exercise in creativity, time audit, preparation of business plan and proposal writing, visit to entrepreneurship development institute and entrepreneurs.

Suggested readings:

- Downey,W.D., Troche, J. K.1981.Agribusiness Management. Mc Graw Hill Inc.,New Delhi
- Gittinger,J.P.1982. Economic Analysis of Agricultural Projects. The Johns Hopkins University Press, Baltimore
- Alagumani ,T., Chinnaiyan, P.,Elangovan, S.1998. Agricultural Management Publishers K9 International, Madurai.
- Philip,K. 2004. Marketing Management. Prentice Hall, New Delhi

BSAG-307: Geoinformatics and Nano-technology for Precision Farming (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture; Geo-informatics- definition, concepts, tool and techniques; their use in Precision Agriculture. Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Spatial data and their management in GIS; 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.

Suggested readings:

- Fundamentals of Biotechnology. Dr J.L. Jain *et al*. S. Chand Publication
- Plant Breeding Principles and Methods - B. D. Singh

BSAG-308: Intellectual Property Rights (L-T-P: 1-0-0) Credit: 1(1+0)

Theory

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

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

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

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

Suggested reading:

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

http://patentoffice.nic.in

www.wipo.org

www.dbtindia.nic.in

www.dbtbiosafety.nic.in

BSAG-309: Elective Course (L-T-P: 2-0-2) Credit: 3(2+1)- details given separately.

BSAG-310: Practical Crop Production – I (Kharif crops) (L-T-P: 0-0-4) Credit: 2(0+2)

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed treatment, nursery raising, sowing, nutrient management, water management, weed management and management of insect pests and diseases of crops harvesting, threshing, drying, winnowing, storage and marketing of produce. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of a group of students.

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SEMESTER –VI

BSAG-311: Rainfed Agriculture & Watershed Management (L-T-P: 1-0-2) Credit: 2(1+1)

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**.**

Suggested readings:

- Rainfed Agriculture in India. Eds Surjit Singh and Rathore
- Principles of Agronomy - T.Y. Reddy and G. H. SankarReddi
- Principles of Agronomy - S. R. Reddy
- Rainfed Agriculture in India:Research and development Scenario. J. Venkataswarelu
- Dry farming in India - U.S.SreeRamulu
- Dry land Agriculture – G. Subbareddy
- Watershed Management - V.V. Narayan, G. Shastry and U.S. Pattanaik
- Soil Erosion and conservation - R.P. Tripathi and H.P. Singh
- Watershed Management for dryland agriculture – M.C. Oswal

BSAG-312: Protected Cultivation and Secondary Agriculture (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

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

Practical

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

Suggested readings:

- Principles of Agronomy - T.Y. Reddy and G. H. SankarReddi
- Principles of Agronomy - S. R. Reddy

BSAG-313: Diseases of Field and Horticultural Crops and their Management-II (L-T-P: 2-0-2) Credit: 3(2+1)

Theory

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

Field Crops:

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

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

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

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

Strawberry: leaf spot Potato: early and late blight, black scurf, leaf roll, and mosaic;
Cucurbits: downy mildew, powdery mildew, wilt;Onion and garlic: purple blotch, and Stemphylium blight;Chillies: anthracnose and fruit rot, wilt and leaf curl;Turmeric: leaf spot Coriander: stem gallMarigold: Botrytis blight; Rose: dieback, powdery mildew and black leaf spot.

Practical

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

Suggested readings:

- Plant Diseases. R.S. Singh
- Plant Pathology. G.N. Agrios

BSAG-314: Post-harvest Management and Value Addition of Fruits and Vegetables (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested reading;

- Post harvest technology of horticultural crops: K.P. Sudheer, V.Indira
- Post harvest technology of horticultural crops: S.K.Sharma , M.C. Nautiyal
- Post harvest technology of fruits and vegetables: L.R.Verma, &V.K. Joshi

BSAG-315: Management of Beneficial Insects (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

Importance of beneficial Insects, Beekeeping, pollinating plant and their cycle, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee.

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

Species of lac insect, morphology, biology, host plant, lac production – seed lac, button lac, shellac, lac-products. Identification of major parasitoids and predators commonly being used in biological control. Insect orders bearing predators and parasitoids used in pest control and their mass multiplication techniques. Important species of pollinator, weed killers and scavengers with their importance.

Practical

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

Suggested reading:

- A text book of Applied Entomology. K.P. Srivastava
- Elements of Economic Entomology. B.V. David and T. Kumarswami
- General and Applied Entomology – B.V. David and T.N. Anantha Krishnan

BSAG-316: Crop Improvement-II (Rabi crops) (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fodder crops and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation; 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); Seed production technology in self pollinated, cross pollinated and vegetatively propagated crops. Hybrid seed production technology of rabi crops.
Ideotype concept and climate resilient crop varieties for future.

Practical

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

Suggested readings:

- Principles of Plant Breeding - R.W. Allard
- Plant Breeding Principles and Methods - B. D. Singh
- Plant Breeding - (Ed.) V. L. Chopra
- Plant Breeding. Analysis and Exploitation of Variation - D. Roy

BSAG-317: Principles of Organic Farming (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested reading:

- The Complete Book on Organic Farming and Production of Organic Compost. By NPCS Board of Consultants & Engineers. Asia Pacific Business Press Inc.
- Organic Farming. By Shalini Suri
- M.K. Gupta, Handbook of Organic Farming and Biofertilizers. ABD Publishers, 2007
- Organic Farming. By A.K. Dahama

BSAG-318: Farm Management, Production & Resource Economics (L-T-P: 1-0-2) Credit: 2(1+1)

Theory

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

Practical

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

Suggested readings:

- Fundamentals of Agriculture. Vol.-1 Arun Katyayan
- Rainfed Agriculture in India: Research and development Scenario. J. Venkataswarelu
- Concise History of Science in India, Agriculture - S.P. Rayachaudhury, D.M. Bose, S.N. Sen and B.V.A. Subbarayappa

BSAG-319: Principles of Food Science and Nutrition (L-T-P: 2-0-0) Credit: 2(2+0)

Theory

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

Suggested readings:

N.L. Kent and A.D. Evers. 1994. Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture, 4th Ed. Elsevier Science Ltd., Oxford, UK.

BSAG-320: Elective Course (L-T-P: 1-0-2) Credit: 3(2+1)- details given separately.

BSAG-321: Practical Crop Production – II (Rabi crops) (L-T-P: 0-0-4) Credit: 2(0+2)

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed treatment, nursery raising, sowing, nutrient management, water management, weed management and management of insect-pests and diseases of crops harvesting, threshing, drying, winnowing, storage and marketing of produce. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of a group of students.

ELECTIVE COURSES

BSAG-218: Agricultural Waste Management Credit: 3(2+1)

Theory

Introduction to agricultural waste management, Nature and characteristics of agricultural waste and their impact on the environment, Kinds of wastes, Classification, role of soil and plants in waste management, sources of waste, impact of waste on soil and plant quality, Biological processes of waste management, Utilization and Recycling of Agricultural waste, Potential of Recyclable Crop Residues and its management, In-situ management of agriculture waste, Composting and Vermicomposting for bio conservation of biodegradable waste, Biogas Technology, Agricultural waste and water, air and animal resources, Impacts of waste on human, animal health and environment. Management of bedding & litter, wasted feed, run-off from feed lots and holding areas and waste water form dairy parlors, agro-waste recycling through farming system, waste management machineries, environmental benefit of waste management.

Practical

Collection and preparation agricultural waste sample. Determination of pH, EC, CECe, heavy metals, BOD, COD, TSS, TDS, NH_4, Total P, and dissolved reactive P. Nutrient status (N, P, K, secondary and micronutrients) analysis of agricultural waste. Waste management equipment operation, Maintenance and safety hazards, computer software and models. Survey of different agri waste from live stock, dairy, poultry, food processing, fruit & vegetable and agri-chemicals, Preparation of compost, Vermicomposting, biogas and analysis of compost.

Suggested readings:

- Environmental science. Anubha Kaushik. New Age Publication . New Delhi
- Environmental Studies. R. Rajgopalan. Oxford Univ. Press, New Delhi.

BSAG-219: Agrochemicals Credit: 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-Majorclasses, properties and important herbicides. Fate of herbicides.

Fungicides - Classification – Inorganic fungicides - characteristics, preparation anduseofsulfurandcopper, Modeofaction-Bordeauxmixtureandcopperoxychloride.

Organicfungicides-Modeofaction-Dithiocarbamates-
characteristics,preparationanduseofZinebandmaneb.

Systemicfungicides-
Benomyl,carboxin,oxycarboxin,Metalaxyl,Carbendazim,characteristicsanduse. 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 Manufacturingofammoniumsulphate,ammonium nitrate,ammoniumchloride, urea. Slow release N-fertilizers. Phosphaticfertilizers:feedstock and manufacturing ofsingle superphosphate. Preparation of bone meal and basic slag. Potassicfertilizers: Naturalsources of potash,manufacturingofpotassiumchloride,potassiumsulphateandpotassiumnitrate.

Mixedandcomplexfertilizers:Sourcesandcompatibility–
preparationofmajor,secondaryandmicronutrientmixtures.Complexfertilizers:Manufacturingofam moniumphosphates,nitrophosphatesandNPKcomplexes. Fertilizercontrolorder. 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 P_2O_5 and citrate soluble P_2O_5 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.

Suggested readings:

- M.K. Gupta, Handbook of Organic Farming and Biofertilizers**.** ABD Publishers, 2007.

BSAG-220: Agri-business Management Credit: 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 behavior analysis, Product Life Cycle (PLC). Sales & Distribution Management. Pricing policy, various pricing methods. Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.

Practical

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

Suggested readings:

- Downey,W.D., Troche, J. K.1981.Agribusiness Management. Mc Graw Hill Inc.,New Delhi
- Gittinger,J.P.1982. Economic Analysis of Agricultural Projects. The Johns Hopkins University Press, Baltimore
- Alagumani ,T., Chinnaiyan, P.,Elangovan, S.1998. Agricultural Management Publishers K9 International, Madurai.
- Philip,K. 2004. Marketing Management. Prentice Hall, New Delhi

BSAG-222: Soil, Plant, Water and Seed Testing Credit: 3(1+2)

Theory

Principle of pH meter, EC meter, spectrophotometer, flame photometer and AAS.
Soil analysis: Objectives, sampling of soil, procedure and precautions. Determination of texture, bulk density. Interpretation of analytical data viz., pH, EC, organic carbon, N, P, K, S and micronutrients (Fe, Mn, Zn, Cu, B) and nutrient index.
Plant analysis: Sampling stages and plant part to be sampled. Analysis of nutrients, Quantitative rating of plant analysis data and interpretation of results, critical nutrient concentration, critical nutrient ranges.
Water analysis: Quality criteria, classification and suitability of irrigation water and water quality index.
Seed: Introduction, definition and importance, seed germination, viability, vigor and storage.
Use of soil testing kit for major and micronutrient analyzer.

Practical

Standardization of solutions and reagents, collection and preparation of soil samples, estimation of pH, EC, organic carbon, NPKS, micronutrients, CEC and exchangeable sodium in soil. Determination of EC and pH of saturation extract/paste. Estimation of cations and anions. Plant sampling and sample preparation for analysis, digestion of plant material and estimation of N, P, K in plant. Rapid plant tissue test for N, P, and K. Determination of EC, pH, cations (Ca^{++}, Mg^{++}, Na^{+}, K^{+}) and anions (B, $CO3^{--}$, $HCO3^{-}$, Cl^{-}) in irrigation water . Computation of SAR and RSC. Seed quality testing: Germination, viability, moisture and vigor.

Suggested readings

- Seed Technology – R.L. Agrawal
- Principles of Seed Technology – G.M. Kulkarni
- Structure Development and Reproduction in Angiosperms – V. Singh, P.C. Pande and D.K.Jain
- Principles of Seed Science & Technology – L.O. Copeland & M.B. KcDonald

BSAG-309: Hi-tech. Horticulture Credit: 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 playhouses and shade net houses, Intercultural operations, tools and equipments identification and application, Micro propagation, Nursery-portrays, micro-irrigation, EC, pH based fertilizer scheduling, canopy management, visit to hi-tech orchard/nursery.

Suggested readings:

- Introductory ornamental horticulture. J. S. Arora. Kalyani Publishers.
- Floriculture in India. G. Randhawa and A. Mukhopadhaya. Allied Pub.
- Floriculture in India - G.S.Randhawa and A. Mukopadhyay
- Complete gardening in India - K.S.G.Gopalswami
- Commercial flowers - T.K.Bose and L.P.Yadav

BSAG-320: Commercial Plant Breeding Credit: 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.

Suggested readings:

- Principles of Plant Breeding - R.W. Allard
- Plant Breeding Principles and Methods - B. D. Singh
- Plant Breeding - (Ed.) V. L. Chopra
- Plant Breeding. Analysis and Exploitation of Variation - D. Roy

BSAG-323: Landscaping Credit: 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.

Suggested readings:

- Introductory ornamental horticulture. J. S. Arora. Kalyani Publishers.
- Floriculture in India. G. Randhawa and A. Mukhopadhaya. Allied Pub.
- Floriculture in India - G.S.Randhawa and A. Mukopadhyay
- Complete gardening in India - K.S.G.Gopalswami
- Commercial flowers - T.K.Bose and L.P.Yadav
- Text Book of Floriculture and Land scaping - N.Roychowdhury and H.P.Mishra

BSAG-324: Weed Management Credit: 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 nutrients and their application. Integration of herbicides with non chemical methods of weed management. Herbicide Resistance and its management.

Practical

Techniques of weed preservation. Weed identification and their losses study. Biology of important weeds. Study of herbicide formulations and mixture of herbicide. Herbicide and nutrient compatibility 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.

Suggested readings:

- Weed management- Principles and Practices. O.P. Singh. Agribios India
- Modern weed management - O.P. Gupta
- Principles of Weed science - V.S. Rao
- Weed management - V.N. Saraswat, V. M. Bhan and N.T. Yaduraju (ICAR)
- All about weed control - S. Subramaniam, A.Mohamed Ali and R. Jaykumar
- Fundamentals of weed Science – Zimdahl

BSAG-325: Food Safety Issues Credit: 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.

Practical

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

Suggested readings:

- Gerard J. Tortora, Berdell R. Funke, Christine L. Case. 2014. Microbiology: An Introduction, 12th Ed. Prentice-Hall, NY, USA.
- Johanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2013. Prescott's Microbiology, 9th Ed. McGraw-Hill Higher Education, NY, USA.
- Michael J. Pelczar Jr., E.C.S. Chan and Noel R. Krieg. 1998. Microbiology, 5th Ed. Tata McGraw-Hill Education, New Delhi.

BSAG-326: Micro propagation Technologies Credit: 3(1+2)

Theory

Meaning and concept of *in vitro* culture and micro-propagation; Historical milestones, advancement and future prospects of micro-propagation; totipotency, dedifferentiation; Tissue culture methodology: Sterile techniques, synthetic and natural media components, growth regulators, environmental requirement, genetic control of regeneration; Plant regeneration pathways - Organogenesis and Somatic embryogenesis;

Micro-propagation- Definition, methods, stages of micro-propagation and its significance; Axillary bud proliferation approach- Shoot tip and meristem culture; Organogenesis- Purpose, methods and requirements for organogenesis, indirect and direct organogenesis; Somatic embryogenesis- Procedures and requirements for organogenesis, indirect and direct embryogenesis; Differences between somatic and gametic embryogenesis, Synthetic seed- Concepts, necessity, procedure and requirements for production of synthetic seeds.

Practical

Laboratory organization, sterilization techniques for explants, glassware, plastic wares, lab wares and working platform. Preparation of stocks and working solution. Preparation and sterilization of growth regulators. Preparation of working medium and experimentation on determining optimum concentration of growth regulators. Callus induction and regeneration of whole plants from different parts of plants. Direct regeneration into whole plants using bud, node and other tissues. Induction of somatic embryos. Experiments of synthetic seeds production and testing storability and germination efficiency.

Suggested readings:

- Genes - B. Lewin
- Fundamentals of Genetics -B. D. Singh
- Genetics - M. W. Strickberger
- Principles of Genetics - E.W.Sinnott, L.C.Dunn, T.Dobzhansky
- Principles of Genetics - E. J.Gardner, M. J.Simmons and D. P. Snustad

BSAG-327: Protected Cultivation Credit: 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.

Suggested readings:

- Dhaliwal GS & Arora R. 2003. Integrated Pest Management – Concepts and Approaches. Kalyani Publ., New Delhi.
- Dhaliwal GS, Singh R & Chhillar BS. 2006. Essentials of Agricultural Entomology. Kalyani Publ., New Delhi.
- Flint MC & Bosch RV. 1981. Introduction to Integrated Pest Management. Springer, Berlin.

BSAG-328: Biopesticides & Biofertilizers Credit: 3(2+1)

cept 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

To study about mass production technology of important biopesticides. Identification of important botanicals. Visit to biopesticide lab. working 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.

Suggested readings:

- Haliwal GS & Arora R. 2001. *Integrated Pest Management: Concepts and Approaches*. Kalyani Publ., New Delhi.