Faculty of Science

Syllabus

For

B.Sc. (Hons.)Agriculture Science

(Program Code: SC0141)
(2018-19)

(Approved by the Academic Council vide Resolution No. 34.26 dated 20.06.2019)

INDEX

1. Programme Educational Objectives (PEOs)

PEO 1 Imparting subject-related knowledge along with developing a connection between practical solutions and theory

PEO 2 Exhibit their skill in providing solution in agriculture sectors like Gardening, seed Production , Fruit ,Spices and vegetable Cultivation ,Milk Production , Crop Production and Mushroom Cultivation

PEO 3 To develop scientific, economic and environmental principles underpinning agricultural production and land use among the students.

2. GRADUATE ATTRIBUTES (GAs)

The graduate attributes of B.Sc. Agriculture Science are the summation of the expected course learning outcomes mentioned at the end of each course. Some of them are stated below.

GA1: Discipline-specific Knowledge: Capability of demonstrating comprehensive knowledge of B.Sc. programme and understanding of one or more disciplines which form a part of an undergraduate programme of study.

GA2: Critical Thinking: Ability to employ critical thinking in understanding the concepts in every area of B.Sc. programme.

GA3: Analytical Reasoning: Ability to analyze the results and apply them in various problems appearing in different courses.

GA4: Research-related skills:

Develop a sense of inquiry and capability for asking relevant and intelligent questions, problematizing, synthesizing and articulating; ability to recognize and establish cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.

GA5: Problem Solving:

Capability to solve problems by using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

GA6: Usage of Modern Tools (Information/digital literacy):

Create, select, and apply appropriate techniques, resources, and modern science and IT tools including prediction and modeling to complex science activities with an understanding of the limitations.

GA7: Self-directed learning: Ability to work independently and do in-depth study of various notions of courses of B.Sc. Programme.

GA8: Communication skills:

i. Ability to communicate various concepts of B.Sc. programme effectively using examples and their geometrical visualizations.
ii. Ability to use courses as a precise language of communication in other branches of human knowledge.
iii. Ability to communicate long standing unsolved problems in Agriculture.
iv. Ability to show the importance of their courses of B.Sc. as precursor to various scientific developments since the beginning of the civilization.

GA9. Environment and sustainability:

Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

GA10: Team work and Lifelong learning:

Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.

GA11: Moral and ethical awareness:

Ability to identify unethical behavior such as fabrication, falsification or misrepresentation of data and adopting objective, unbiased and truthful actions in all aspects of the programme.

GA12. Leadership qualities and Entrepreneurship:

Capability for mapping out the tasks in a team or an organization, self-motivating and inspiring team members to engage with the team objectives/vision; and using management skills to follow the mapped path to the destination in a smooth and efficient way.

3. Programme Outcomes (POs):

Students graduating with the B.Sc. Agriculture Science degree should be able to acquire.

PO1: Agricultural knowledge: Discuss and know the natural resource management including soil, water, nutrient scrop production system of field & horticultural crops, plant protection against insect pests, diseases, crop improvement using conventional plant breeding methods and modern biotechnology, agricultural economics, forestry and agricultural extension among farmers and rural sociology for solve the agriculture problems.

PO2: Critical reflection: Demonstrate an ability to engage in critical thinking by analyze situations, survey and selecting viable solutions.

PO3: Analytical reasoning: Calculate, compare and analyze the results and apply them in various problems appearing in different courses in agriculture for solves the agriculture problems.

PO4: Research and project management: Demonstrate knowledge and understand agricultural research and apply these to one's own work, as a member and leader in a team, to manage projects and finance in multidisciplinary environments.

PO5: Problem solving: Identify, formulate, review the problems and solve them and with help of production and protection principles of agricultural sciences.

PO6: Modern tools: Create, select and apply appropriate techniques, resources and modern agricultural engineering and IT tools including prediction and modeling to complex agricultural activities with an understanding of the limitations.

PO7: Self directed learning: Determine the ability to engage in independent and daily experience learning in the broadest context socio-technological changes.

PO8: Communication skill: Generate effectively objectives as a member or leader in diverse teams and in multidisciplinary settings for overall development of group and communicate effectively on complex agricultural activities with the agricultural community and with society for transfer of technology and knowledge for effective report and design documentation, make effective presentations, and give and receive clear instructions.

PO9: Environment and sustainability: Interpret the issues of environment context and sustainable development.

PO10: Team work and Lifelong learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context to technological changes.

PO11: Ethics: Report different value system including your own, interpret the moral view of your decisions, and accept responsibility for them.

PO12: Entrepreneurship: Plans, implements, operates and assumes financial risks in a farming activities, start up and agri- business management or agriculture business.

Mapping of Graduate Attributes (GAs) and Programme Learning Outcomes (POs):

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
PO1	■											
PO2		■										
PO3			■									
PO4				■								
PO5					■							
PO6						■						
PO7							■					
PO8								■				
PO9									■			
PO10										■		
PO11											■	
PO12												■

4. Program Specific Outcomes (PSO)

PSO 1 To Understand the impact of the professional agricultural solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PSO 2 Enable to recognize and examine the relationships between inputs and outputs in their agricultural field to make effective and profitable decisions. To understand mechanics of agripreneurship.

5. Course-Wise Learning Objectives, Structures and Outcomes (CLOSOs)

Course learning outcomes of each course in B.Sc.(Hons) Agriculture as a subject have been enshrined in the end of course contents of each course with their objectives those are in the beginning of the every course

B.Sc. (Ag.) Course Structure (2018-19)

Semester-I

Paper Code	Theory Papers	Internal	External	Practical/ Assignment	Total	Credit
AG 101	Fundamentals of Horticulture	30	50	20	100	2(1+1)
AG 102	Fundamentals of Plant Biochemistry and Biotechnology	30	50	20	100	3(2+1)
AG 103	Fundamentals of Soil Science	30	50	20	100	3(2+1)
AG 104	Introduction to Forestry	30	50	20	100	2(1+1)
AG 105	Comprehension & Communication Skills in English	30	50	20	100	2(1+1)
AG 106	Fundamentals of Agronomy	30	50	20	100	4(3+1)
AG 107A	Introductory Biology	30	50	20	100	2(1+1)
AG 107B	Elementary Mathematics	40	50	10	100	2(2+0)
AG 108	Agricultural Heritage	40	50	10	100	1(1+0)
AG 109	Rural Sociology & Educational Psychology	40	50	10	100	2(2+0)
**AG 110	Human Values and Ethics	-	-	-	-	1(1+0)
**AG 111	NSS/NCC/Physical Education & Yoga Practices	-	-	-	-	2(0+2)
		290/ 300	450	55/60	900	24 (18+3+3

Semester-II

Paper Code	Theory Papers	Internal	External	Practical/ Assignment	Total	Credit
AG 201	Fundamentals of Genetics	30	50	20	100	3(2+1)
AG 202	Agricultural Microbiology	30	50	20	100	2(1+1)
AG 203	Introductory Soil and Water Conservation Engineering	30	50	20	100	2(1+1)
AG 204	Fundamentals of Crop Physiology	30	50	20	100	2(1+1)
AG 205	Fundamentals of Agricultural Economics	40	50	10	100	2(2+0)
AG 206	Fundamentals of Plant Pathology	30	50	20	100	4(3+1)
AG 207	Fundamentals of Entomology	30	50	20	100	4(3+1)
AG 208	Fundamentals of Agricultural Extension Education	30	50	20	100	3(2+1)
AG 209	Communication Skills and Personality Development	30	50	20	100	2(1+1)
		280	450	170 (120+50)	900	24

Semester-III

Paper Code	Theory Papers	Internal	External	Practical/ Assignment	Total	Credit
AG 301	Crop Production Technology-I (Kharif Crops)	30	50	20	100	3(2+1)
AG 302	Fundamentals of Plant Breeding	30	50	20	100	3(2+1)
AG 303	Agricultural Finance and Co-Operation	30	50	20	100	3(2+1)
AG 304	Agriculatural Informatics	30	50	20	100	2(1+1)
AG 305	Farm Machinery and Power	30	50	20	100	2(1+1)
AG 306	Production Technology for Vegetables and Spices	30	50	20	100	2(1+1)
AG 307	Environmental Studies and Disaster Management	30	50	20	100	3(2+1)
AG 308	Statistical Methods	30	50	20	100	2(1+1)
AG 309	Livestock and Poultry Management	30	50	20	100	4(3+1)
		270	450	180 (135+45	900	24

Semester-IV

Paper Code	Theory Papers	Internal	External	Practical/ Assignment	Total	Credit
AG 401	Crop Production Technology – II (Rabi crops)	30	50	20	100	3(2+1)
AG 402	Production Technology for Ornamental Crops, MAP and Landscaping	30	50	20	100	2(1+1)
AG 403	Renewable Energy and Green Technology	30	50	20	100	2(1+1)
AG 404	Problematic Soils and their Management	40	50	10	100	2(2+0)
AG 405	Production Technology for Fruit and Plantation Crops	30	50	20	100	2(1+1)
AG 406	Principles of Seed Technology	30	50	20	100	3(1+2)
AG 407	Farming System & Sustainable Agriculture	40	50	10	100	1(1+0)
AG 408	Agricultural Marketing, Trade & Prices	30	50	20	100	3(2+1)
AG 409	Introductory Agrometeorology & Climate change	30	50	20	100	2(1+1)
AG 410A	Protected Cultivation	30	50	20	100	3(2+1)
AG 410B	Agribusiness Managemnt	30	50	20	100	3(2+1)
AG 410C	Agrochemicals	30	50	20	100	3(2+1)
AG 410D	Commercial Plant Breeding	30	50	20	100	3(2+1)
**AG 411	Educational Tour	-	-	-	-	2(0+2)
		320	500	180 (120+60)	1000	25

Semester-V

Paper Code	Theory Papers	Internal	External	Practical/ Assignment	Total	Credit
AG 501	Principles of Integrated Pest and Disease Management	30	50	20	100	3(2+1)
AG 502	Manures, fertilizers and Soil Fertility Management	30	50	20	100	3(2+1)
AG 503	Pests of Crops and Stored Grains and their Management	30	50	20	100	3(2+1)
AG 504	Diseases of Field and Horticultural Crops and their Management-I	30	50	20	100	3(2+1)
AG 505	Crop Improvement-I (Kharif crops)	30	50	20	100	2(1+1)
AG 506	Entrepreneurship Development and Business Communication	30	50	20	100	2(1+1)
AG 507	Geoinformatics and Nanotechnology and Precision Farming	30	50	20	100	2(1+1)
AG 508	Practical Crop Production- I (Kharif Crops)	0	0	100	100	1(0+1)
AG 509	Intellectual Property Rights	40	50	10	100	1(1+1)
AG 510A	Agricultural Journalism	30	50	20	100	3(2+1)
AG 510B	Landscaping	30	50	20	100	3(2+1)
AG 510C	Food Safety and Standards	30	50	20	100	3(2+1)
AG 510D	Biopesticides & Biofertilizers	30	50	20	100	3(2+1)
		280	450	270 (220+50)	1000	23

Semester-VI

Paper Code	Theory Papers	Internal	External	Practical/ Assignment	Total	Credit
AG 601	Rainfed Agriculture & Watershed Management	30	50	20	100	2(1+1)
AG 602	Protected Cultivation and Secondary Agriculture	30	50	20	100	2(1+1)
AG 603	Diseases of Field and Horticultural Crops and their Management-II	30	50	20	100	3(2+1)
AG 604	Post-harvest Management and Value Addition of Fruits and Vegetables	30	50	20	100	2(1+1)
AG 605	Management of Beneficial Insects	30	50	20	100	2(1+1)
AG 606	Crop Improvement- II (Rabi Crops)	30	50	20	100	2(1+1)
AG 607	Practical Crop Production- II (Rabi Crops)	0	0	100	100	1(0+1)
AG 608	Principles of Organic Farming	30	50	20	100	2(1+1)
AG 609	Farm Management, Production & Resource Economics	30	50	20	100	2(1+1)
AG 610	Principles of Food Science & Nutrition	40	50	10	100	2(2+0)
AG 611 A	Weed Management	30	50	20	100	3(2+1)
AG 611B	Micro Propagation Technologies	30	50	20	100	3(2+1)
AG 611C	Hi-Tech Horticulture	30	50	20	100	3(2+1)
AG 611D	System Simulation and Agro-Advisory	30	50	20	100	3(2+1)
		310	500	290 (235+55)	1100	23

Semester-VII

Paper Code	Theory Papers	Internal	External	Practical/ Assignment	Total	Credit
AG 701	General Orientation & on campus training by different faculties	0	0	50	50	14
AG 702	Village attachment and Swachh Bharat Abhiyan Activities	0	0	400	400	
AG 703	Unit attachment in University/College. KVK/Research Station	0	0	250	250	
AG 704	Plant Clinic	0	0	100	100	2
AG 705	Agro-Industrial Attachment	0	0	150	150	4
AG 706	Project Report Preparation, Presentation and Evaluation	0	0	50	50	-
		0	0	1000	1000	20

Semester-VIII

Paper Code	Theory Papers	Internal	External	Practical/ Assignment	Total	Credit
AG 801	Production Technology for Bioagents and Biofertilizer	0	0	100	100	0+10
AG 802	Seed Production and Technology	0	0	100	100	0+10
AG 803	Mushroom Cultivation Technology	0	0	100	100	0+10
AG 804	Soil, Plant, Water and Seed Testing	0	0	100	100	0+10
AG 805	Commercial Beekeeping	0	0	100	100	0+10
AG 806	Poultry Production Technology	0	0	100	100	0+10
AG 807	Commercial Horticulture	0	0	100	100	0+10
AG 808	Floriculture and Landscaping	0	0	100	100	0+10
AG 809	Food Processing	0	0	100	100	0+10
AG 810	Agriculture Waste Management	0	0	100	100	0+10
AG 811	Organic Production Technology	0	0	100	100	0+10
AG 812	Commercial Sericulture	0	0	100	100	0+10
AG 813	Agri Business Management	0	0	100	100	0+10
AG 814	Agro-Advisory Services	0	0	100	100	0+10
AG 815	Nursery Management	0	0	100	100	0+10
		0	0	200	200	0+20

AG 101	Fundamentals of Horticulture	2(1+1)

Theory

UNIT-A Horticulture- Its definition and branches, importance and scope; horticultural and botanicalclassification; climate and soil for horticultural crops.

UNIT-B Plant propagation-methods and propagating structures; Seed dormancy, Seed germination.

UNIT-C Principles of orchard establishment; Principles and methods of training and pruning, juvenility and flower bud differentiation, unfruitfulness.

UNIT-D Pollination, polliizers and pollinators, fertilization and parthenocarpy, medicinal and aromatic plants.

UNIT-E Importance of plant bio-regulators in horticulture. Irrigation – methods, Fertilizer application in horticultural crops.

Practical

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

Reference:

1. Chada, K.L. (2002) Handbook of Horticulture, ICAR, New Delhi.
2. Neeraj Pratap Singh (2005) Basic concepts of Fruit Science, IBDC Publishers
3. Jitendra Singh (2011) Basic Horticulture, Kalyani Publications, New Delhi

AG 102	Fundamentals of Plant Biochemistry and Biotechnology	3(2+1)

Theory

UNIT-A Importance of Biochemistry. Properties of Water, pH and Buffer. Carbohydrate: Importanceand classification. Structures of Monosaccharides, Reducing and oxidizing properties ofMonosaccharides, Mutarotation; Structure of Disaccharides and Poly saccharides. Lipid: Importance and classification; Structures and properties of fatty acids; storage lipids and membrane lipids. Proteins: Importance of proteins and classification; Structures, titration and zwitterions nature of amino acids; Structural organization of proteins.

UNIT-B Enzymes: General properties; Classification; Mechanism of action; Michaelis & Menten and Line Weaver Burk equation & plots; Introduction to allosteric enzymes.

UNIT-C 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.

UNIT-D Concepts and applications of plant biotechnology: Scope, organ culture, embryo culture,cell suspension culture, callus culture, anther culture, pollen culture and ovule culture andtheir applications; Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization cybrids; Somaclonal variation and its use in crop improvement; cryo-preservation;

UNIT-E 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 aminoacids/lipids, Effect of pH, temperature and substrate concentration on enzyme action, Paperchromatography/ 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.

Reference:

1. NK Gupta and Sunita Gupta, 2017. Fundamentals of plant Biochemistry and biotechnology. Kalyani Publication
2. BD Sing, 2001. Biotechnology Expanding Horizon. Kalyani Publication
3. L. Nelson; Michael M. Cox, Lehninger Principles of Biochemistry. Seventh Edition| ©2017David
4. H.S.Chawla, Introduction to plant biotechnology. 2001. Pinnalani for Oxford & IBH publishing Co. Pvt. Ltd. New Delhi.

AG-103	Fundamental of Soil Science	3(2+1)

Theory

UNIT-A 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;

UNIT-B Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; Soil air, composition, gaseous exchange, problem and plant growth, Soil temperature; source, amount and flow of heat in soil; effect on plant growth,

UNIT-C 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;

UNIT-D 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;

UNIT-E Soil pollution - behaviour of pesticides andinorganic contaminants, prevention and mitigation of soil pollution.

Practical

Study of soil profile in field.Study of soil sampling tools, collection of representative soilsample, 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.

References:-

1. Boul S.W., Hole R.D., McCracken and Southard R.J. (1998).Soil genesis and classification Fourth Ed Panima Publishing corporation, New delhi.
2. Baver, L.D. Gardener, W.H. and gardener W.R.(1976) Soil Physics Wiley Eastern Ltd, New Delhi
3. Biswas, T.D. and Mukherjee, S.K. (2006) Text book of soil science. TataMcGraw Hill publishingCo. Ltd, New Delhi
4. Brady, N.C. and Weil, R.R. (2002) The nature and properties of soils, prentice hall of India Pvt. Ltd, M-97, Connaught Circus, New Delhi
5. Das, D.K. (2002) IntroductorySoilScience,Kalyani publisher, New Delhi
6. Mehra R.K. (2004) Text book of Soil Science, ICAR, New Delhi
7. ISSS (2009) Fundamentals of Soil Science, Div. of Soil Science,IARI, New Delhi

AG-104	Introduction to Forestry	2(1+1)

Theory

UNIT-A Introduction – definitions of basic terms related to forestry, objectives of silviculture, forest classification, salient features of Indian Forest Policies.

UNIT-B 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.

UNIT-C Tending operations – weeding, cleaning, thinning – mechanical, ordinary, crown and advance thinning. Forest menstruation – objectives, diameter measurement, instruments used in diameter measurement; Non instrumental methods of height measurement - shadow and single pole method

UNIT-D 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.

UNIT-E Agroforestry – definitions, importance, criteria of selection of trees in agro forestry, 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.

References-

1. Eyle, Alexandra. 1992. Charles Lathrop Pack: Timberman, Forest Conservationist, and Pioneer in Forest Education. Syracuse, NY: ESF College Foundation and College of Environmental Science and Forestry. Distributed by Syracuse University Press. Available: Internet Archive.
2. Hammond, Herbert. 1991. Seeing the Forest Among the Trees. Winlaw/Vancouver: Polestar Press, 1991.
3. Hart, C. 1994. Practical Forestry for the Agent and Surveyor. Stroud. Sutton Publishing. ISBN 0-86299-962-6
4. Hibberd, B.G. (Ed). 1991. Forestry Practice. Forestry Commission Handbook 6. London. HMSO. ISBN 0-11-710281-4
5. Kimmins, Hammish. 1992. Balancing Act: Environmental Issues in Forestry. Vancouver: University of British Columbia Press.
6. Maser, Chris. 1994. Sustainable Forestry: Philosophy, Science, and Economics. DelRay Beach: St. Lucie Press.

7. Miller, G. Tyler. 1990. Resource Conservation and Management. Belmont: Wadsworth Publishing.
8. Nyland, Ralph D. 2007. Silviculture: Concepts and Applications. 2nd ed. Prospect Heights: Waveland Press.
9. Oosthoek, K. Jan/ Richard Hölzl (eds.) 2019. Managing Northern Europe's Forests. Histories from the Age of Improvement to the Age of Ecology. New York/Oxford: Berghahn Publ.
10. Radkau, Joachim Wood: A History, ISBN 978-0-7456-4688-6, November 2011, Polity
11. Stoddard, Charles H. 1978. Essentials of Forestry. New York: Ronald Press.

AG 105	Comprehension & Communication Skills in English	2(1+1)

Theory

UNIT-A 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.

UNIT-B Reading Comprehension, Vocabulary- Antonym, Synonym, Homophones, Homonyms, often confused words.

UNIT-C 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

UNIT-D Direct and Indirect Narration. Written Skills:Paragraph writing, Precise writing, Report writing and Proposal writing.

UNIT-E 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, commercialand 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.

AG 106	Fundamentals of Agronomy	4(3+1)

Theory

UNIT-A Agronomy and its scope, seeds and sowing, tillage and tilth, crop density and geometry, Crop nutrition, manures and fertilizers, nutrient use efficiency

UNIT-B Water resources, soil-plant-water relationship, crop water requirement, water use efficiency, irrigation- scheduling criteria and methods, quality of irrigation water, logging.

UNIT-C Weeds- importance, classification, crop weed competition, concepts of weed management principles and methods, herbicides- classification, selectivity and resistance, allelopathy.

UNIT-D Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles

UNIT- E Adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.

Practical

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

References:

1. ICAR. 2010. Handbook of Agriculture (6^{th} edition), Indian Council of Agricultural Research, New Delhi.
2. Panda, S.C. 2012. Modern Concepts and Advance Principles in Crop Production. Agrobios (India), Jodhpur
3. Balasubramaniyan, P. and Palaniappan, S.P.2016. Principles and Practices of Agronomy (2^{nd} edition), Agrobios (India), Jodhpur
4. Reddy, T.Yellamanda and Reddy, G.H. Sankara. 2016. Principles of Agronomy (2^{nd} edition) , Kalyani Publishers, Ludhiana
5. Reddy, S.R.2012. Principles of Crop Production (4^{th} edition), Kalyani Publishers, Ludhiana.Gupta, O.P. 2005. Weed Management: Principles and Practices (2^{nd} Ed) Agribios (India) Jodhpur.

AG 107A	Introductory Biology*	2(1+1)

Theory

UNIT-A Introduction to the living world, diversity and characteristics of life, Origin of life, Evolutionand Eugenics

UNIT-B Binomial nomenclature and classification Cell and cell division

UNIT-C Morphology offlowing plants. Seed and seed germination

UNIT-D Plant systematic- viz; Brassicaceae, Fabaceae andPoaceae

UNIT-E Role of animals in agriculture.*e ICAR Fifth Deans' Committee*

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 ofspecimens and slides.Description of plants - Brassicaceae, Fabaceae and Poaceae.

Reference:

1. NK Gupta and Sunita Gupta, 2017.Fundamentals of plant Biochemistry and biotechnology. Kalyani Publication
2. L. Nelson; Michael M. Cox, Lehninger Principles of Biochemistry. Seventh Edition ©2017David

AG 107B	**Elementary Mathematics***	**2(2+0)**

Theory

UNIT-A Straight lines : Distance formula, section formula (internal and external division), Changeof 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 formof equation of line, Intercept form of equation of line, Normal form of equation of line, Generalform of equation of line, Point of intersection of two st. lines,

UNIT-B Angles between two st. lines, Parallellines, 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, Equationof circle passing through three given points, Equation of circle whose diameters is line joining twopoints (x1, y1) & (x2,y2), 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 x2 + y2 = a2.

UNIT-C Differential Calculus: Definition of function, limit and continuity, Simple problems on limit, Simple problemson continuity, Differentiation of xn , ex , sin x & cos x from first principle, Derivatives of sum,difference, product and quotient of two functions, Differentiation of functions of functions (Simpleproblem based on it), Logarithmic differentiation (Simple problem based on it), Differentiation bysubstitution method and simple problems based on it.

UNIT-D Differentiation of Inverse Trigonometricfunctions. Maxima and Minima of the functions of the form y=f (x) (Simple problems based onit).Integral Calculus : Integration of simple functions, Integration of Product of two functions,Integration by substitution method,

UNIT-E Definite Integral (simple problems based on it), Area undersimple well-known curves (simple problems based on it).Matrices and Determinants: Definition of Matrices, Addition, Subtraction, Multiplication,Transpose and Inverse up to 3rd order, Properties of determinants up to 3rd order and theirevaluation**.**

AG 108	**Agricultural Heritage**	**1(1+0)**

Theory

UNIT-A Introduction of Indian agricultural heritage; Ancient agricultural practices, Relevance of heritage to present day agriculture;

UNIT-B Past and present status of agriculture and farmers in society ;Journey of Indian agriculture and its development from past to modern era;

UNIT-C Plant production and protection through indigenous traditional knowledge; Crop voyage in India and world;

UNIT-D Agriculture scope; Importance of agriculture and agricultural resources available in India;

UNIT-E Crop significance and classifications; National agriculture setup in India; Current scenario of Indian agriculture; Indian agricultural concerns and future prospects.

References:

1. ICAR 1989 Handbook of Agriculture, Indian Council of Agricultural Research, New-Delhi
2. Nene, Y.L. 2007. Glimpses of the Agricultural Heritage of India. Asian Agri- Histroy Foundation, Secunderabad, Andhra Pradesh.
3. Nene, Y.L., Saxena, R.C. and Choudhary, S.L.2009. A Textbook on Ancient History of Indian Agriculture, Munshiram Manoharial Publishers Pvt. Ltd,
4. Nene, Y.L., Choudhary, S.L. and Saxena, R.C. 2010. Textbook on Ancient History of Indian Agriculture, Asian Agri-History Foundation.
5. D. Kumari, Manimuthu Veeral. 2014. Text Book on Agricultural Heritage of India. Agrotech Publishing Academy.
6. ICAR. Introductory Agriculture. ICAR e-course. Indian Council of Agricultural Research, New Delhi.

AG 109	**Rural Sociology & Educational Psychology**	**2 (2+0)**

Theory

UNIT-A Sociology and Rural sociology: Definition and scope, its significance in agriculture extension.

UNIT-B Social ecology, Rural society, Social Groups, Social Stratification, Culture concept, Social Institution, Social Change & Development.

UNIT-C Educational psychology: Meaning & its importance in agriculture extension.

UNIT-D Behavior: Cognitive, affective, psychomotor domain, Personality, Learning, Motivation.

UNIT-E Theories of Motivation, Intelligence.

References:

1. Doshi, S.L. 2007. Rural sociology. Rawat Publishers, Delhi.
2. Jayapalan, N. 2002. Rural sociology. Altanic Publishers, New Delhi.
3. Pujari, D. 2002. Educational Psychology in Agriculture, Agrotech Publishing Academy, Udaipur
4. Bhushan, V. and Sachdeva, D.R. 2010. An introduction to Sociology, KitabMahal, New Delhi.
5. Rao, C.N.S. 2015. Sociology, S.Chand& Company, New Delhi.

AG 110	**Human Value and Ethics (Non Gradial)**	**1 (1+0)**

Theory

UNIT-A Values and Ethics-An Introduction.Goal and Mission of Life.Vision of Life.

UNIT-B Principles and Philosophy Self Exploration.Self Awareness.Self Satisfaction.

UNIT-C Decision Making, Motivation, Sensitivity.

UNIT-D Success.Selfless Service.Case Study of Ethical Lives.Positive Spirit.Body, Mind and Soul.

UNIT-E Attachment and Detachment.Spirituality Quotient.Examination.

Reference:

1. Human Values And Professional Ethics by Jayshree Suresh and B. S. Raghavan, S.Chand Publications
2. Human Values & Professional Ethics by S. B. Gogate, Vikas Publishing House Pvt. Ltd., Noida.
3. Professional Ethics and Human Values by Prof. DR.Kiran-Tata McGraw-Hill – 2013.

AG-111A/B/C	NSS/NCC/Physical Education & Yoga Practices	2(0+2)

Theory

UNIT- A 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. all the activities related to the National Service Scheme course is distributed under four different courses viz.

UNIT- B National Service Scheme I, National Service Scheme II, National Service Scheme III and National Service Scheme IV each having one credit load.

UNIT- C Development to be able for self employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society. The entire four courses should be offered continuously for two years.

UNIT- D 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.

References:

1. National Service Scheme: A Report, by Khwaja GhulamSaiyidain. Published by Ministry Of Education, Govt. of India, 1961.
2. Training and consultancy needs in national service scheme, by N. F. Kaikobad, Krishan K. Kapil. Published by Tata Institute of Social Sciences, 1971.
3. National Service Scheme: guide-lines to project-masters, by Andhra University, Dept. of Sociology & Social Work. Published by Dept. of Sociology & Social Work, Andhra University, 1971.
4. National Service Scheme in Gujarat: An Evaluation Report for the Year 1986-87, by Tata Institute of Social Sciences Training Orientation & Research Centre (NSS), India, India. Dept. of Youth Affairs and Sports.Published by The Centre, 1987.
5. National Service Scheme in Maharashtra: An Evaluation Report for the Year 1986-87, by Tata Institute of Social Sciences Training Orientation & Research Centre (NSS), India, India Dept. of Youth Affairs and Sports. Published by The Centre, 1988.
   National Service Scheme in India: A Case Study of Karnataka, by M. B. Dilshad. Published by Trust Publications, 2001.

AG 201	Fundamentals of Genetics	3(2+1)

Theory

UNIT-A Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity.Architecture of chromosome; chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; special types of chromosomes.

UNIT-B Chromosomal theory of inheritance- cell cycle and cell division- mitosis and meiosis.Probability and Chi-square.Dominance relationships, Epistatic interactions with example.Multiple alleles, pleiotropism and pseudoalleles.

UNIT-C Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanisms, chromosome mapping. Structural and numerical variations in chromosome and their implications, Use of haploids, dihaploids and doubled haploids in Genetics.

UNIT-D Mutation, classification, Methods of inducing mutations & CIB technique, mutagenic agents and induction of mutation.Qualitative & Quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance.

UNIT-E Genetic disorders.Nature, structure & replication of genetic material. Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operons.

Practical

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

Reference:

1. Gupta P.K.2004. Cytology, Genetics and evolution. Rastogi Publications, Meerut. (Hindi Edition)
2. Klug, W.W.and Cummings, M.R.2005.Concepts of genetics Pearson Education (Singapore) pvt. Ltd., Indian Branch, PratapGanj, New Delhi.
3. Singh, B.D. 2001.KalyaniPublishing House, New Delhi.
4. Strickberger, M.W.2001.Genetics. Prentice Hall of india. Pvt. Ltd., New Delhi

AG 202	Agricultural Microbiology	2(1+1)

Theory

UNIT-A Introduction Microbial world: Prokaryotic and eukaryotic microbes. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth.

UNIT-B Bacterial genetics: Genetic recombination transformation, conjugation and transduction, plasmids, transposing.

UNIT-C Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and Sulphur cycles.

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

UNIT-E Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste.

Practical

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

References:

1. Biswas, T.D. and Mukherjee, S.K. 1990. Text Book of Soil Sciences, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Mukherjee, N. and Ghosh T. 1998. Agricultural Microbiology, Kalyani Publishers, New Delhi.
3. Pelczar, Jr. Michel J. Chan, E.C.S. and Krieg, Noel R. 1997. Microbiology. Tata McGraw -Hill Edition, 1993. India.
4. Rangaswami, G. and Bagyaraj, D.J. 1993. Agricultural Microbiology. Prentice Hall of India Pvt. Limited, New Delhi.
5. Rao, N.S. 2000. Soil Microbiology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Vishunavat, K. and Kolte, S.J. 2005. Essentials of Phytopathological Techniques. Kalyani Publishers, New Delhi.
7. Sharma, P.D. 2010. Microbiology. 3rd edition Rastogi Publishers, Meerut.
8. Dube H.C. 2007. A Text Book of Fungi, Bacteria & Viruses. 3rd ed. Agrobios India, Jodhpur.
9. Agrios, G.N. 2005. Plant Pathology. 5th ed. Academic Press, New York.

AG 203	**Introductory Soil and Water Conservation Engineering**	**2(1+1)**

Theory

UNIT-A Introduction to Soil and Water Conservation, causes of soil erosion. Definition and agents of soil erosion, water erosion.

UNIT-B Forms of water erosion. Gully classification and control measures.Soil loss estimation by universal Loss Soil Equation. Soil loss measurement techniques.

UNIT-C Principlesof erosion control: Introduction to contouring, strip cropping. Contour bund. Graded bund andbench terracing.

UNIT-D Grassed water ways and their design. Water harvesting and its techniques.

UNIT-E Winderosion: mechanics of wind erosion, types of soil movement. Principles of wind erosion controland 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. Designof contour bunds. Design of graded bunds.Design of bench terracing system.Problem on winderosion.

References:

1. Land and Water Management Engineering. 1982. Murthy V.V.N. Kalyani Pubhliers, New Delhi.
2. Irrigation: Theory and Practices.2012. Michael A.M. Vikas Publishing House Pvt. Ltd., New Delhi.
3. Principles of Agricultural. Engineering. Vol. II. 2012. Michael A.M. and T.P. Ojha. Jain Brothers, New Delhi.
4. Soil and Water Conservation Water Management. 2010. Mahnot, S.C., Singh P.K. and Chaplot, P.C.,. Apex Publication House, Udaipur.

AG 204	Fundamentals of Crop Physiology	2(1+1)

Theory

UNIT-A Introduction to crop physiology and its importance in Agriculture; Plant cell: an Overview; Diffusion and osmosis; Absorption of water, transpiration and Stomatal Physiology;

UNIT-B Mineral nutrition of Plants: Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms;

UNIT-C Photosynthesis: Light and Dark reactions, C3, C4 and CAM plants; Respiration: Glycolysis, TCAcycle and electron transport chain;

UNIT-D Fat Metabolism: Fatty acid synthesis and Breakdown; Plant growth regulators: Physiological roles and agricultural uses.

UNIT-E 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 testfor mineral nutrients, estimation of relative water content, Measurement of photosynthetic CO2assimilation by Infra Red Gas Analyser (IRGA).

Reference:

1. S.N. Pandey and B. K. Sinha.1977.Plant Physiology. Vikas Publishing House Pvt. Ltd, New Delhi.
2. A. Kumar and S.S.Purohit.1998. Plant Physiology Fundamental and Application. Agrobotanica 4E 176 J.N. Vyas Nagar, Bikaner.
3. N.K. Gupta and S. Gupta. 2005. Plant Physiology. Oxford & IBH, New Delhi.
4. M.Bala, S.Gupta and N.K.Gupta.2013.Practicals in Plant Physiology. Scientific publisher, Jodhpur.
5. D.L.Bagdi. 2016.Crop Physiology. New India Publishing Agency, New Delhi.

AG 205	**Fundamentals of Agricultural Economics**	**2(2+0)**

UNIT-A 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.

UNIT-B Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country.Demand: meaning, law of demand, schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity.

UNIT-C Production: process, creation of utility, factors of production, input output relationship. Laws of returns: Law of variable proportions and law of returns to scale. Cost: concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, schedule, supply curve, determinants of supply, elasticity of supply. Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points.

UNIT-D 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 socioeconomic determinants, current policies and programmes on population control. Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, supply, general price index, inflation and deflation.

UNIT-E 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.

Reference:

1. K.K. Dewett and J.D. Verma (1986) Elementary Economic Theory, S. Chand & Company, New Delhi
2. S.K. Mishra and V.K. Puri (1996) Indian Economy, Himalaya Publishing House, New Delhi
3. G.B. Jakhar and S.G. Beri (1996) Elementary Principles of Economics, Oxford University Press (10^{th} Edition), Delhi
4. Berkeley Hill (1980) An Introduction to Economics for students of agriculture, Pergaman Press, Oxford
5. B.L. Gupta (1996) Introduction to Economic Theory, Arya Book Depot, New Delhi

AG 206	Fundamentals of Plant Pathology	4(3+1)

Theory

UNIT-A Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. Historyof Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Pathogenesis. Causes / factors affecting disease development: disease triangle and tetrahedron and classification of plant diseases.

UNIT-B 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. Deans' Committee

UNIT-C 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 andreproduction.

UNIT-D Viruses: nature, structure, replication and transmission. Study of phanerogamic plantparasites.Nematodes: General morphology and reproduction, classification, symptoms and nature ofdamage caused by plant nematodes (Heterodera, Meloidogyne, Anguina, Radopholus etc.)Growth and reproduction of plant pathogens.Liberation / dispersal and survival of plantpathogens.

UNIT-E Types of parasitism and variability in plant pathogens. Pathogenesis. Role of enzymes,toxins and growth regulators in disease development. Defense mechanism in plants**.**Epidemiology:Factors affecting disease development. Principles and methods of plant disease management. Nature,chemical combination, classification, mode of action and formulations of fungicides and antibiotics.

Practical

Acquaintance with various laboratory equipments and microscopy.Collection and preservationof disease specimen.Preparation of media, isolation and Koch's postulates. General study ofdifferent structures of fungi. Study of symptoms of various plant diseases.Study of representativefungal genera.Staining and identification of plant pathogenic bacteria.Transmission of plantviruses.Study of phanerogamic plant parasites.Study of morphological features and identification of plant parasitic nematodes.Samplingand extraction of nematodes from soil and plant material, preparation of nematode mounting. Study of fungicides and their formulations. Methods of pesticide application and their safe use. Calculation of fungicide sprays concentrations**.**

References:

1. Agrios, G.N. 2005. Plant Pathology. 5th ed. Academic Press, New York.
2. Alexopolus, C.J., Mims, C.W. and Blackwell, M. 2013. Introductory Mycology. John Wiley Estern Private Limited, New York.
3. Mehrotra, R.S. and Agrawal, A. 2013. Plant Pathology. 2nd ed. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Singh, R.S. 2011. Introduction to Principles of Plant Pathology. 4th ed. Oxford & IBH Publishing Company. New Delhi.
5. Nene Y.L. and Thapliyal, P.N. 2011. Fungicides in Plant Diseases Control. 3rd Ed. Oxford & IBH published Co. Pvt. Ltd. New Delhi.
6. Dube H.C. 2007. A Text Book of Fungi, Bacteria & Viruses. 3rd ed. Agrobios India, Jodhpur.
7. Dube, H.C. 2012, Modern Plant Pathology, 2nd ed. Agrobios (India), Jodhpur
8. Dube, H.C. 2013, An Introduction to Fungi. 4th ed. , Scientific Publishers India, Jodhpur.

AG-207	Fundamentals of Entomology	4(3+1)

Theory

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

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

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

UNIT-D Systematics: Taxonomy –importance, history and development and binomial nomenclature.Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification ofclass Insecta upto Orders, basic groups of present day insects with special emphasis to ordersand 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.

UNIT-E 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. Insecticides and their formulations. Pesticide appliances and their maintenance.Sampling techniques for estimation ofinsect population and damage.

Reference:

1. Chapman .R.F.1981. Insect Structure and Function, ELBS Publishers New Delhi.
2. David B.V. and Ananthakrishnan .T.N. 2003. General and Applied Entomology, 2nd Ed. Mc graw Hill publishing Co. Ltd. New Delhi.
3. Mathur and Upadhyay, 2005. A Text Book of Entomology, Aman Publishing House, Meerut.
4. Pant. N.C. and Ghai, S. 1981. Insect Physiology and Anatomy, ICAR, New Delhi.
5. Richards O.W. and Davies R.G. 1977. Imm's General Text Book of Entomology, Vol. I & II. Chapman and Hall, London.
6. Snodgrass R.E .2001. Principles of Insect Morphology, CBS Publishers and Distributors, New Delhi.

AG 208	Fundamentals of Agricultural Extension Education	3(2+1)

Theory

UNIT-A 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.);

UNIT-B 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.

UNIT-C Rural Development: concept, meaning, definition; various rural development programmes launched by Govt. of India. Community Dev.-meaning, definition, concept & principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; extension administration: meaning and concept, principles and functions.

UNIT-D Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes; transfer of technology: concept and models, capacity building of extension personnel; extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and Social Media), media mix strategies.

UNIT-E Communication: meaning and definition; Principles and Functions of Communication, models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

Practical

To get acquainted with university extension system. Group discussion- exercise; handlingand use of audio visual equipment's 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.

References-

1. Adivi Reddy, A., 2001, Extension Education, Sree Lakshmi press, Bapatla.
2. Jalihal, K. A. and Veerabhadraiah, V., 2007, Fundamentals of Extension Education and Management in Extension, Concept publishing company, New Delhi.
3. MuthaiahManoraharan, P. and Arunachalam, R., Agricultural Extension, Himalaya Publishing House (Mumbai).
4. Rathore, O. S. et al., 2012, Handbook of Extension Education, Agrotech Publishing Academy, Udaipur.
5. Ray, G. L., 1991 (1st Edition), Extension Communication and Management, Kalyani Publishers, Ludhiana {7th revised edition - 2010}.
6. Supe, S. V., 2013 (2nd Edition), A Text Book of Extension Education, Agrotech Publishing Academy, Udaipur.
7. Van Den Ban, A. W. and Hawkins, H. S., Agricultural Extension, S. K .Jain for CBS Publishers & Distributors, New Delhi.
8. Debabrata Das Gupta. Extension Education. Agrobios (India), Agro house behind Nasrani Cinema, Chaupasani Road, Jodhpur- 342402, Phone -0291-2642319, Fax- 0291-2643993, Email- agrobios@sify.com
10. Sharma, O. P. &Somani, L. L. 2012. Dimension of Agricultural Extension, Agroteh Publishing Academy, Udaipur.

AG 209	Communication Skills and Personality Development	2(1+1)

Theory

UNIT-A Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication;

UNIT-B Listening and note taking, writing skills, oral presentation skills;

UNIT-C Field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles,

UNIT-D Precise writing, summarizing ,abstracting; individual and group presentations, impromptu presentation, public speaking;

UNIT-E Group discussion.Organizing seminars and conferences.

Practical

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

References:

1. Sandhu, A. S. (1999). Textbook on Agricultural Communication; process and methods oxford RIBH Publishing co. Pvt. Ltd. New Delhi.
2. Berlo, David K. (1960). The process of Communication. Nw Yark, Holt, Rinehart and Winston Inc.
3. Dahama, O. P. and Bhatnagar, O.P., 1998, *Education and Communication for Development*, Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.
4. Jalihal, K. A. and Veerabhadraiah, V., 2007, *Fundamentals of Extension Education and Management in Extension*, Concept publishing company, New Delhi.
5. Ray, G. L., 1991 (1st Edition), *Extension Communication and Management*, Kalyani Publishers, Ludhiana {7th revised edition - 2010}.
6. Supe, S. V., 2013 (2nd Edition), *A Text Book of Extension Education*, Agrotech Publishing Academy, Udaipur.

AG-301	**Crop Production Technology – I (*Kharif* crops)**	**3(2+1)**

Theory

UNIT- A Origin, geographical distribution, economic importance of Kharif Crop.

UNIT- B Soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops.

UNIT- C Agronomical practices for Kharif Cereals – rice, maize, sorghum, pearl millet and finger millet.

UNIT- D Agronomical practices for Kharif pulses -pigeon pea, mungbean and urdbean and Oilseeds Crops- Groundnut, and soybean.

UNIT E Cultural Practices for fibre crops- cotton & Jute and 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.

References:

1. Singh, Chhidda, Singh, Prem and Singh, Rajbir. 2003. Modern Techniques of Raising Field Crops, Oxford & IBH Publishing Co., New Delhi.
2. Panda, S.C.2012. Modern Concepts and Advance Principles in Crop Production. Agrobios (India), Jodhpur
3. Singh, S.S.and Singh, Rajesh. 2013. Crop Management Under Irrigated and Rainfed Conditions. Kalyani Publishers, New Delhi.
4. Singh, S.S.and Singh, Rajesh. 2015. Principles and Practices of Agronomy (5^{th} Re-set), Kalyani Publishers, New Delhi, Kalyani Publishers, Ludhiana.
5. Rathore, P.S. 2000. Techniques and Management of Field Crop Production, Agrobios (India), Jodhpur.

AG-302	Fundamentals of Plant Breeding	3(2+1)

Theory

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

UNIT-B Centres of origin/diversity, components of Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self- pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept.

UNIT-C Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross pollinated crops, modes of selection; Population improvement Schemes-Ear to row method, Modified Ear to Row, recurrent selection schemes; Heterosis and inbreedingdepression, development of inbred lines and hybrids, composite and synthetic varieties;

UNIT-D Breeding methods in asexually propagated crops, clonal selection and hybridization; maintenance of breeding records and data collection; Wide hybridization and prebreeding; Polyploidy in relation to plant breeding, mutation breeding-methods anduses;

UNIT-E Breeding for important biotic and abiotic stresses; Biotechnological tools-DNAmarkers and marker assisted selection. Participatory plant breeding; IntellectualProperty Rights, Patenting, Plant Breeders and & Farmer's Rights.

Practical

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

Reference:

1. Alard, R.W. 2000.Principles of Plant Breeding. John Willey & Sons, New York.
2. Chahel, G.S. and S.S. Ghosal.2002.Principles and Procedures of Plant Breeding, Biotechnological and Conventional Approaches. Narosa Publishing House, New Delhi.
3. Singh, B.D. 2005. Plant Breeding. Kalyani Publishing House, New Delhi.
4. Singh, P. 2001.Essentials of Plant Breeding-Principles and Methods. Kalyani Publishing House, New Delhi.

AG -303	Agricultural Finance and Co-Operation	3(2+1)

Theory

UNIT-A 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,

UNIT-B. 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,

UNIT-C. 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.

UNIT-D. Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture.

UNIT-E. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED.

Practicals.

Determination of most profitable level of capital use. Optimum allocation of limited amount of capital among different enterprise. Analysis of progress and performance of cooperatives using published data. Analysis of progress and performance of commercial banks and RRBs using published data. Visit to a commercial bank, cooperative bank and cooperative society to acquire firsthand knowledge of their management, schemes and procedures. Estimation of credit requirement of farm business – A case study.Preparation and analysis of balance sheet – A case study.Preparation and analysis of incom 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 add products. Seminar on selected topics.

References:

1. Reddy, S. and Raghu Ram, P. "Agricultural Finance and Managament" Oxford and IBH, New Delhi
2. Singh, J.P. (1990) "Agricultural Finance- Theory and Practice" Ashish Publishing House, New Delhi
3. Pandey, U.K. "An Introduction to Agricultural Finance" Kalyani Publishes, New Delhi
4. Pandey, Mukesh and Tewari, Deepali "Rural and Agriculture Marketing"
5. Krishnaswami, O.R. "Fundamental of Cooperation"
6. Nelson, A.G. and Murray, W.G. 1988 "Agricultural Finance" IOWA State University Press, Amies, IOWA, USA

AG 304	**Agricultural Informatics**	**2(1+1)**

Theory

UNIT-A Introduction to Computers, Anatomy of computer, Operating Systems, definition and type, Applications of MS Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, uses of DBMS in Agriculture.

UNIT-B World Wide Web (WWW): Concepts and components Introduction to computer programming languages, concepts and standard input/output operations.

UNIT-C e-Agriculture, concepts and applications, Use of ICT in AgricultureComputer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management.

UNIT-D Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc. Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture.

UNIT-E Agriculture Expert System, Soil Information Systems etc. for supporting Farm decisions.Preparation of contingent crop-planning using IT tools.

Reference:

Agro-Informatics Book by G. Vanitha

AG-305	Farm Machinery and Power	2(1+1)

Theory

UNIT- A 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

UNIT- B Study of different components of I.C. engine, I.C. engine terminology and numerical

UNIT-C 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

UNIT- D Estimation of field capacity and power requirements of implements Familiarization with Primary and Secondary Tillage implement, implement for intercultural operations

UNIT- E Familiarization with sowing and planting equipment, Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.

Practicals

Study of different components of I.C. engine. To study air cleaning and cooling system of engine, Familiarization with clutch, transmission, differential and final drive of a tractor, Familiarization with lubrication and fuel supply system of engine, Familiarization with brake, steering, hydraulic control system of engine, Learning of tractor driving, Familiarization with operation of power tiller, Familiarization with different types of primary and secondary tillage implements: mould board plough, disc plough and disc harrow . Familiarization with seed metering mechanism and calibration of seed drill, Familiarization with different types of sprayers and dusters Familiarization with different inter-culture implement, Familiarization with harvesting and threshing equipments and machinery.

References:

1. Jagdeeswar Sahay, Elements of Agricultural Engineering.
2. A.M. Michael and T. P. Ojha Principles of Agricultural Engineering, Vol. 1
3. Kepner, Bainer and Bergar Principles of Farm Machinery
4. Barger, Carleton, Mckilben and Bainer Tractor and their Power Units

AG-306	Production Technology for Vegetables and Spices	2(1+1)

Theory

UNIT-A Importance of vegetables & spices in human nutrition and national economy, kitchen gardening.

UNIT-B Brief about origin, area, climate, soil, improved varieties and Cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield.

UNIT-C Physiological disorders, of important vegetable and spices (Tomato, Brinjal, Chilli, Capsicum, Cucumber, Melons, Gourds, Pumpkin, French bean, Peas

UNIT-D Cole crops such as Cabbage, Cauliflower, Knol-khol; Bulb crops such as Onion, Garlic, Root crops such as Carrot, Radish, and Beetroot

UNIT-E Tuber crops such as Potato; Leafy vegetables such as Amaranth, Palak.Perennial vegetables).

Practical

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

Reference:

1. Choudhary, B.R. (2009). A Text book on production technology of vegetables, Kalyani Publishers.
2. Yawalkar, K. S. (2008) Vegetable crops in India Agri-Horticultural, Pub. House. Nagpur
3. Rana, M.K. (2008) Olericulture in India Kalyani Publishers, New Delhi.
4. Dhaliwal, M.S. (2008). Handbook of Vegetable Crops, Kalyani Publishers, New Delhi.
5. Nath Prem, (1994) Vegetables for the Tropical Regions, ICAR New Delhi
6. Kamath, K.V (2007). Vegetable Crop Production Oxford Book Company

AG-307	Environmental Studies and Disaster Management	3(2+1)

Theory:

UNIT-A 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 andover-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 andusing mineral resources, case studies. d) Food resources: World food problems, changes causedby agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, waterlogging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and nonrenewableenergy sources, use of alternate energy sources. Case studies.

UNIT-B f) Land resources: Landas a resource, land degradation, man induced landslides, soil erosion and desertification. Roleof an individual in conservation of natural resources.Equitable use of resources for sustainablelifestyles.Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers,consumers and decomposers, Energy flow in the ecosystem. Ecological succession, Food chains,food webs and ecological pyramids. Introduction, types, characteristic features, structure andfunction of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desertecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystemdiversity and biogeographical classification of India. Value of biodiversity: consumptive use,productive use, social, ethical, aesthetic and option values.

UNIT-C Biodiversity at global, National andlocal levels, India as a mega-diversity nation.Hot-sports of biodiversity. Threats to biodiversity:habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species ofIndia. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.Environmental Pollution: definition, cause, effects and control measures of: a. Air pollutionb. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollutiong. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban andindustrial wastes. Role of an individual in prevention of pollution.Social Issues and the Environment: From Unsustainable to Sustainable

development, Urbanproblems related to energy, Water conservation, rain water harvesting, watershed management.

UNIT-D Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain,ozone layer depletion, nuclear accidents and holocaust. dies. Wasteland reclamation.Consumerismand waste products.Environment Protection Act.Air (Prevention and Control of Pollution) Act.Water (Prevention and control of Pollution) Act.Wildlife Protection Act.Forest ConservationAct. Issues involved in enforcement of environmental legislation. Public awareness.Human Population and the Environment: population growth, variation among nations,population explosion, Family Welfare Programme. Environment and human health: HumanRights, Value Education, HIV/AIDS. Women and Child Welfare.Role of Information Technologyin Environment and human health.

UNIT-E Disaster Management - Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods,drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves Climatic change: global warming, Sea level rise, ozone depletion.Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire,coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste waterpollution, road accidents, rail accidents, air accidents, sea accidents.Disaster Management- Effect to migrate natural disaster at national and global levels.International strategy for disaster reduction.Concept of disaster management, national disastermanagement framework; financial arrangements; role of NGOs, community –based organizationsand media.Central, state, district and local administration; Armed forces in disaster response;Disaster response; Police and other organizations.

Practical

Pollution case studies. Case Studies- Field work: Visit to a local area to document 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.

References:

1. Bamanayha B.R., Verma, L.N. and Verma A (2005). Fundamentals of Environmental Sciences, Yash Publishing House, Bikaner.
2. Dhaliwal G.S., Sangha G.S. and Ralhan P.K. (2000) Fundamentals of Environmental Sciences,Kalyani Publishers, New Delhi.
3. Odum E.P. and Barrett G.W.(2007) Fundamentals of Ecology, Akash Press, New Delhi.
4. Dhaliwal G.S., and D.S.Kley (2006) Principles of Agricultural Ecology. Himalyan Publishing house, Bombay
5. Brij Gopal, and N.Bhardwaj (2004) Elements of Ecology. Vikash Publishing House, Pvt. Ltd., New Delhi.
6. Mishra, P.C.(2001). Soil pollution and Soil Organism, Ashish Publishing House, 8/81, Punjab Bagh, New Delhi- 110026.
7. Pathak, H.and Kumar, S.(2003). Soil and Green House Effect, CBS Publishers and Distributors, 4596/1-A, 11, Dayaganj, New Delhi – 10002002E

AG 308	Statistical Methods	2(1+1)

Theory

UNIT-A Introduction to Statistics and its Applications in Agriculture, Graphical Representationof Data, Measures of Central Tendency & Dispersion, Definition of Probability, Addition andMultiplication Theorem (without proof).

UNIT-B Simple Problems Based on Probability. Binomial &Poisson Distributions, Definition of Correlation, Scatter Diagram.Karl Pearson's Coefficient ofCorrelation.Linear Regression Equations.

UNIT-C Introduction to Test of Significance, One sample &two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 ×2 ContingencyTable.

UNIT-D Introduction to Analysis of Variance, Analysis of One Way Classification.

UNIT-E Introduction toSampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with andwithout 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 (UngroupedData).Moments, Measures of Skewness & Kurtosis (Grouped Data).Correlation & RegressionAnalysis.Application of One Sample t-test.Application of Two Sample Fisher's t-test.Chi-Squaretest of Goodness of Fit.Chi-Square test of Independence of Attributes for 2 ×2 contingencytable.Analysis of Variance One Way Classification.Analysis of Variance Two Way Classification.Selection of random sample using Simple Random Sampling.

AG 309	Livestock and Poultry Management	4(3+1)

Theory

UNIT-A Role of livestock in the national economy. Reproduction in farm animals and poultry.Housing principles, space requirements for different species of livestock and poultry.

UNIT-B 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.

UNIT-C Improvement of farm animals and poultry.Digestion in livestock and poultry.Classification of feedstuffs. Proximate principles offered.

UNIT-D Nutrients and their functions. Feed ingredients for ration for livestock and poultry. Feed supplements and feed additives. Feeding of livestock and poultry.

UNIT-E 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, 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.

Refrences:

1. Banerjee, G.C. 2013. A Taxe Book of Animal Husbandry. 8th Ed.ICAR.
2. Choudhary J.L. and Gupta Lokesh. 2016. a Text Book of Animal Husbandry. Somani Publication
3. Devendra C and Mecleroy GB 1982. Goat and Sheep Production in Tropics.
4. Dimri,U, Sharma,M C and Tiwari R.2013. Swine Production and Health Management. New India Pub Agency.
5. Sastry N S R and Thomas, Ck 2006. Livestock Production and Management. Kalyani

AG-401	Crop Production Technology – II (*Rabi* crops)	3(2+1)

Theory

UNIT-A Origin, geographical distribution, economic importance, soil and climatic requirements,

UNIT-B varieties, cultural practices and yield of Rabi crops; cereals –wheat and barley,

UNIT-C pulses-chickpea,lentil, peas,

UNIT-D oilseeds-rapeseed, mustard and sunflower; sugar crops-sugarcane;

UNIT-E medicinal and aromatic crops-mentha, lemon grass and citronella, Forage crops-berseem, lucerne and oat.

Practical

Sowing methods of wheat and sugarcane, identification of weeds in rabiseason 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 rabiforage experiments, oil extraction of medicinal crops, visit to research stations of related crops

References:

1. Singh, Chhidda, Singh, Prem and Singh, Rajbir.2003. Modern Techniques of Raising Field Crops, Oxford & IBH Publishing Co., New Delhi.
2. Singh, S.S.1998. Crop Management Under Irrigated and Rainfed Conditions. Kalyani Publishers, New Delhi.
3. Panda, S.C.2012. Modern Concepts and Advance Principles in Crop Production. Agrobios (India), Jodhpur
4. Singh, S.S.and Singh, Rajesh. 2013. Crop Management Under Irrigated and Rainfed Conditions. Kalyani Publishers, New Delhi.
5. Rathore, P.S. 2000. Techniques and Management of Field Crop Production, Agrobios (India), Jodhpur.

AG-402	**Production Technology for Ornamental Crops, MAP and Landscaping**	**2(1+1)**

Theory

UNIT-A Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping.Landscape uses of trees, shrubs and climbers.

UNIT-B Production technology of important cut flowers like rose, gerbera, carnation, lilium and orchids under protected conditionsand gladiolus, tuberose, chrysanthemum under open conditions.

UNIT-C Package of practices for looseflowers like marigold and jasmine under open conditions.Production technology of importantmedicinal plants like ashwagandha, asparagus, aloe, costus, cinnamomum, periwinkle, isabgol.

UNIT-D Aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver.

UNIT-E 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.

Reference

1. Chada, K.L. (2002) Handbook of Horticulture, ICAR, New Delhi.
2. Neeraj Pratap Singh (2005) Basic concepts of Fruit Science, IBDC Publishers.
3. Fullagar, Richard, Judith Field, Tim Denham, and Carol Lentfer (2006) Early and mid Holocene tool-use and processing of taro (Colocasia esculenta), yam (Dioscorea sp.) and other plants at Kuk Swamp in the highlands of Papua New Guinea Journal of Archaeological Science 33: 595–614.
4. Jitendra Singh (2011) Basic Horticulture, Kalyani Publications, New Delhi.
5. Jules Janick. "History of Horticulture". Purdue University. Archived from original on September 10, 2012. Retrieved September 21, 2012.

AG 403	Renewable Energy and Green Technology	2(1+1)

Theory

UNIT-A Classification of energy sources, contribution of these of sources in agricultural sector, Familiarization with biomass utilization for biofuel production and their application.

UNIT-B Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and biooil production and their utilization as bioenergy resource.

UNIT-C introduction of solar energy, collection and their application, Familiarization with solar energy gadgets: solar cooker, solar water heater.

UNIT-D Application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application.

UNIT-E 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.

References-

1. G.D. Rai. Non-Conventional Energy Sources, Kh Publishers, New Delhi.
2. N. S. Rathore. A.K. Kurchania, N.L. Panwar. (2007). Non Conventional Energy Sources, Himanshu Publications.
3. N.S. Rathore. A. K. Kurchania, N.L. Panwar. (2007). Renewable Energy, Theory and Practice, Himanshu Publications.
4. K.C. Khandelwal. & S.S. Mandi. (1990). Biogas Technology.

AG-404	Problematic soils and their management	2(2+0)

Theory

UNIT-A Soil quality and health, Distribution of Waste land and problem soils in India. Theircategorization based on properties. Reclamation and management of Saline and sodic soils, Acidsoils, Acid Sulphate soils, Eroded and Compacted soils, Flooded soils, Polluted soils.Irrigation water – quality and standards, utilization of saline water in agriculture. Remote sensing and GIS in diagnosis and management of problem soils.

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

References:

1. Bear FE. 1964. Chemistry of the Soil. Oxford & IBH.
2. Jurinak JJ. 1978. Salt-affected Soils. Department of Soil Science & Biometeorology. UtahState Univ.
3. USDA Handbook No. 60. 1954. Diagnosis and improvement of Saline and Alkali Soils. Oxford & IBH.
4. Abrol, I.P. and Dhurvanarayana, V.V. (1998) Technologies for wasteland development,ICAR, New Delhi-110012
5. Cirsan Paul, J.(1985) Principles of remote sensing. Longman, New York.
6. Richards, L.A. (1954). Diagnosis and improvement of saline and alkali soils. USDA Hand book No. 60, Washington, DC USA.
7. Somani, L.L. and Totawat, K.L. (1993). Management of salt affected soils and waters. Agrotech publishing Academy, Udaipur.

AG-405	Production Technology for Fruit and Plantation Crops	2(1+1)

Theory

UNIT-A Importance and scope of fruit and plantation crop industry in India.

UNIT-B Importance of rootstocks.

UNIT-C Production technologies for the cultivation of major fruits-mango, banana, citrus, grape, guava, litchi, papaya, sapota, apple, pear, peach, walnut, almond.

UNIT-D Minor fruits- date, ber, pineapple, pomegranate, jackfruit, strawberry.

UNIT-E Plantation crops-coconut, arecanut, cashew, tea, coffee &rubber.

Practical

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

Reference:

1. Bal, J.S., (2010). Fruit Growing Kalyani Publishers, New Delhi.
2. Banday F.A. and Sharma M.K., (2010). Advances in Temperate Fruit Production Kalyani Publishers, New Delhi
3. Bose, T.K., Mitra, S.K. and Sanyal, D., (2002). Tropical and Sub-Tropical-Vol-I, Nayaprakash, Kolkata
4. Chadha, T.R, (2001). Text Book of Temperate Fruits, ICAR Publication.
5. Chattopadhyay T.K., (2009), A text book on Pomology-IV Devoted to Temperate fruits, Kalyani Publishers, New Delhi.
6. K.L.Chadda, (2009), Advanced in Horticulture, Malhotra Publishing House, New Delhi.

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AG-406	Principles of Seed Technology	3(1+2)

Theory

UNIT-A Seed and seed technology: introduction, definition and importance. Deterioration causesof crop varieties and their control; Maintenance of genetic purity during seed production, seedquality; Definition, Characters of good quality seed, different classes of seed.

UNIT-B Foundation andcertified seed production of important cereals, pulses, oilseeds, fodder and vegetables. Seedcertification, phases of certification, procedure for seed certification, field inspection. Seed Act andSeed Act enforcement. Duty and powers of seed inspector, offences and penalties.

UNIT-C Seeds ControlOrder 1983, Varietal Identification through Grow Out Test and Electrophoresis, Molecular andBiochemical test. Detection of genetically modified crops, Transgene contamination in non-GMcrops, GM crops and organic seed production.

UNIT-D 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, stagesand factors affecting seed longevity during storage. Measures for pest and disease control duringstorage.

UNIT-E Seed marketing: structure and organization, sales generation activities, promotionalmedia. Factors affecting seed marketing, Role of WTO and OECD in seed marketing. Private andpublic sectors and their production and marketing strategies.

Practical

Seed production in major cereals: Wheat, Rice, Maize, Sorghum and Bajra. Seed production in major pulses: Urd, Mung, Cowpea, Pigeonpea, Lentil, Gram, Fieldpea. Seed production in major oilseeds: Soybean, Rapeseed and Mustard, Groundnut. Seed production in vegetable crops & Seed spices.

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.

References:

1. Agarwal, R.L.1991.Seed Technology, Oxford & IBH Publishing Co. Delhi
2. Agarwal, P.K. 1999. Seed Technology, ICAR, New Delhi.
3. Subir Sen and Nabinanda Ghosh.1999. Seed Science and Technology, Kalyani Publishers. New Delhi.
4. DhirenraKhare and Mohan S. Bhale.2000. Seed Technology. Scientific Publishers (India), Jodhpur.
5. Maloo,S.R., Intodia, S.K. and Pratap Singh.2008. Beej Pradyogiki.Agrotech Publishing Academy.
6. A.K. Joshi and B.D. Singh.2005.Seed Technology. Kalyani Publishers, New Delhi.
7. Saxena,R.P.1984. BeezSansadhan, GBPA&T, Pantnagar.
8. Singh, B.D. 2005. Plant Breeding. Kalyani Publishing House, New Delhi.

AG 407	Farming System & Sustainable Agriculture	1(1+0)

Theory

UNIT-A Farming System-scope, importance, and concept, Types and systems of farming system and factors affecting types of farming, Farming system components and their maintenance.

UNIT-B 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.

UNIT-C 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.

UNIT-D 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.

UNIT-E 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.

References:

1. Panda, S.C.2004. Cropping Systems and Farming Systems, Agrobios (India), Jodhpur.
2. Panda, S.C.2012. Modern Concepts and Advance Principles in Crop Production. Agrobios (India), Jodhpur
3. Sharma, Arun K. 2002. A Handbook of Organic Farming, Agrobios (India) Ltd., Jodhpur
4. Balasubramaniyan, P. and Palaniappan, S.P.2016. Principles and Practices of Agronomy (2^{nd} edition), Agrobios (India), Jodhpur.
5. Shukla, Rajeev K. 2004. Sustainable Agriculture, Surbhee Publications, Jaipur
6. Palaniappan, S.P.1985. Cropping Systems in the Tropics: Principles and Management, Wiley Easter Ltd. and TNAU, Coimbatore.
7. Reddy S. R. 2016. Principles of Agronomy (5^{th} edition), Kalyani Publishers, Ludhiana.

AG 408	Agricultural Marketing, Trade & Prices	3(2+1)

Theory

UNIT-A 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.

UNIT-B 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:

UNIT-C 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 agriculturalmarketing; meaning and definition of marketing channel;number of channel levels; marketing channels for different farm products;

UNIT-D 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;

UNIT-E 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.

Reference:

1. Acharya SS & Aggarwal NL. (2011) Agricultural Marketing in India, Oxford and IBH
2. J.R. Moore, S.S. Johl and A.M. Khusro (1973) Indian Food Grain Marketing, Printice Hall.
3. A.S. Kahlon & D.S. Tyagi (1983) Agricultural Price Policyin India, Allied Publishers, New Delhi
4. V.K. Bhall and S. Shiva Ramu (1996) International Business-Environment and Management, Anmol Publications (P) Limited, New Delhi
5. Chandra P. (1984) Projects: Preparation, Appraisal & Implementation, McGraw Hill Inc.
6. Sampat Mukherjee (2002) Modern Economic Theory. New Age International
7. Gupta RD & Lekhi RK. (1982) Elementary Economic Theory, Kalyani Publishers
8. S.S.Acharya & N.L.Agarwal,: Agricultural prices-Analysis and Policy, Oxford &IBH Publishing Co. PVT. LTD. New Delhi

AG 409	Introductory Agro meteorology & Climate Change	2(1+1)

Theory

UNIT-A Meaning and scope of agricultural meteorology; Earth atmosphere- its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze;

UNIT-B Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, long wave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature,

UNIT-C 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.

UNIT-D 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.

UNIT-E Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national Agriculture.

Practical

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

References:

1. Sacheti, A.K. 1985.Agricultural Meteorological Instructional Cum Practical Manual (Ed.) NCERT Publication, New Delhi.
2. Lal, D.S. 2005 Climatology, Sharda Pustak Bhawan, Allahabad..
3. Varshneya, M.C. and Balakrishna, Pillai, 2003. Text book of Agricultural Meteorology. ICAR, New-Delhi.
4. Sahu, D.D., 2007. Agrometeorology and Remote sensing: Principles and Practices , Agrobios (India) , Jodhpur.
5. Murithy, K, and Radha, V. 1995. Practical Manual on Agricultural Meteorology , Kalyani Publishers, New-Delhi

AG 410 A	**Protected Cultivation**	**2(1+1)**

Theory

UNIT-A Green house technology: Introduction, Types of Green Houses; Plant response to Green house environment, Planning and design of greenhouses.

UNIT-B Green house equipments, Irrigation systems used in greenhouses, typical applications, passive solar greenhouse, hot air green house heating systems.

UNIT-C Plastic Mulching and soil solarization..

UNIT-D Organic Farming and Vermi Bed Preparation.

UNIT-E Water Resource Management and water ponds.

Practical:

Mulching - Surface covered cultivation – plastics mulching – code of practice.Greenhouse - Plastic film for Greenhouses - Recommendations for Layout, Design and Construction of Greenhouse Structures . Recommendations for Heating, Ventilating and cooling of Greenhouses Steel Tubes for Structural Purpose.Agro Shade nets for Agriculture & Horticulture Purpose

Protection Nets Plant. Vermi-Bed Agro Textiles- High Density Polyethylene (HDPE) Woven Beds For Vermi- culture Specification.

References:

1. Green house: Science and Technology. 2016. Kothari S, S.C.Kaushic and A.N.Mathur. Himanshu Publication, Udaipur.
2. Green House Technology- Application and Practice. Sharma A and V.M.Salokhe. 2006. Agro Tech. publication, Udaipur
3. Principles of Agricultural Engineering, Vol. I. 2012. Michael, A.M. and T. P. Ojha . Jain Brothers, New Delhi.
4. Post Harvest Technology of Cereals, Pulses and Oil Seeds.1999. Chakravarty, A. Oxford and IBH Pub. New Delhi.
5. Agricultural Process Engineering. 1955. Henderson, S.M. and R.L. Perry. John Willy and Sons, New York.
6. Unit operation of Agriculture Processing. 2004. Shay K.M. and Singh, K.K. Vikas Publication House, New Delhi.

AG 410B	AGRIBUSINESS MANAGEMENT	3(2+1)

Theory

UNIT- A 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.

UNIT-B 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.

UNIT-C 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.

UNIT-D Components of a business plan, steps in planning and implementation. 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.

UNIT-E 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 agriculturalcommodities. Net present worthtechnique for selection of viableproject.Internal rate of return.

Reference:

1. Agribusiness Management and Trade. Language: English. Pages: 239. Author: K.B. Vedamurthy.
2. G. L. Meena S. S. Burark D. C. Pant Rajesh Sharma published Fundamentals of *Agribusiness Management*
3. Agribusiness Management (Routledge Textbooks in Environmental and Agricultural Economics) 4th Edition by Freddie L. Barnard (Author), Jay T. Akridge (Author), Frank J. Dooley (Author), John C. Foltz (Author), Elizabeth A. Yeager (Author)
4. Agribusiness and Farm Management at a Glance Vol 1: Objective Fundamentals 2nd ed by L L & G L Meena Somani
5. Fundamentals of Agribusiness Finance by Ralph W. Battles,Robert C. Thompson
6. Farm Business Management: The Fundamentals of Good Practice (Farm Business Management Series) by P.L. Nuthall

AG 410C	Agrochemicals (Elective Course)	3 (2+1)

Theory

UNIT-A An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture. Herbicides-Major classes, properties and important herbicides.Fate of herbicides.

UNIT-B Fungicides - Classification – Inorganic fungicides - characteristics, preparation and use of sulfur and copper, Mode of action-Bordeaux mixture and copper oxychloride.Organic fungicides- Mode of action- Dithiocarbamates-characteristics, preparation and use of Zineb and maneb.Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use.

UNIT-C Introduction and classification of insecticides: inorganic and organic insecticides Organochlorine, Organophosphates, Carbamates, Synthetic pyrethroids Neonicotinoids, Biorationals, Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, Fate of insecticides in soil & plant. IGRs Biopesticides, Reduced risk insecticides, Botanicals, plant and animal systemic insecticides their characteristics and uses.Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea.

UNIT-D Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassiumchloride, potassium sulphate and potassium nitrate. Mixed and complex fertilizers: Sources and compatibility–preparation of major, secondary and micronutrient mixtures.

UNIT-E Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistics and marketing.Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

Practical

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

Urea.Estimation of water soluble P2O5 and citrate soluble P2O5 in single super phosphate.Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer.Determination of copper content in copper oxychloride.Determination of sulphur content in sulphur fungicide.Determination of thiram.Determination of ziram content.

References:

1. Shalini Suri, Biofertilizers and Biopesticides, 2011. APH Publishing Corporation.
2. Arun. K. Sharma. 2011. Handbook of Organic farming. Agrobios (India), Jodhpur.
3. Mathur and Upadhyay, 2005. A Text Book of Entomology, Aman Publishing House, Meerut.
4. David, B.V. and Ramamurthy, V.V. 2016. Elements of Economic Entomology, 8th Ed. Popular Book Depot, Chennai.

AG 410D	Commercial Plant Breeding (Elective Course)	3 (2+1)

Theory

UNIT-A 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.

UNIT-B Genetic purity test of commercial hybrids. Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc.

UNIT-C 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.

UNIT-D IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FR Act.

UNIT-E 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.

Reference:

1. Alard, R.W. 2000.Principles of Plant Breeding. John Willey & Sons, New York.
2. Chahel, G.S. and S.S. Ghosal.2002.Principles and Procedures of Plant Breeding, Biotechnological and Conventional Approaches. Narosa Publishing House, New Delhi.
3. Singh, B.D. 2005. Plant Breeding. Kalyani Publishing House, New Delhi.
4. Singh, P. 2001.Essentials of Plant Breeding-Principles and Methods. Kalyani Publishing House, New Delhi.

AG 411	**Educational Tour (Non Gradial)****	**2 (0+2)****

****Non Gradial Course : Satisfactory / Non Satisfactory**

Course Objective:

To know the education/ types of education in different institutes.
To recognize the location specific new trends in agriculture.

AG 501	Principles of Integrated Pest and Disease Management	2(1+1)

Theory

UNIT-A 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.

UNIT-B 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:

UNIT-C Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment.Introduction to conventional pesticides for the insect pests and disease management. Survey surveillance and forecasting of Insect pest and diseases.

UNIT-D Development and validation of IPM module.Implementation and impact of IPM (IPM module for Insect pest and disease.

UNIT-E Safety issues in pesticide uses. Political, social and legal implication of IPM.Case histories of important IPM programmes.Case histories of important IPM programmes.

Practical

Methods of diagnosis and detection of various insect pests, and plant diseases, Methods of

insect pests and plant disease measurement, Assessment of crop yield losses, calculations based on economics of IPM,Identification of biocontrol agents, different predators and natural enemies. Mass multiplication of Trichoderma, Pseudomonas, Trichogramma, NPV etc.Identification and nature of damage of important insect pests and diseases and their management.Crop (agroecosystem) 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 farmer's fields.

References:

1. Agrios, G.N. 2005. Plant Pathology. 5th ed. Academic Press, New York.
2. Mehrotra, R.S. and Agrawal, A. 2013. Plant Pathology. 2nd ed. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
3. Singh, R.S. 2011. Introduction to Principles of Plant Pathology. 4th ed. Oxford & IBH Publishing Company. New Delhi.
4. Nene Y.L. and Thapliyal, P.N. 2011. Fungicides in Plant Diseases Control. 3rd Ed. Oxford & IBH published Co. Pvt. Ltd. New Delhi.
5. Dube, H.C. 2012, Modern Plant Pathology, 2nd ed. Agrobios (India), Jodhpur

AG-502	Manures Fertilizers and fertility Management	3(2+1)

Theory

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

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

UNIT-C 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.

UNIT-D Chemistry of soil nitrogen, phosphorus, potassium,calcium, magnesium, sulphur and micronutrients. Soil fertility evaluation, Soil testing.

UNIT-E Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants,.Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions.

Practical

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

References:

1. Rai, M.M. (2002) Principal of Soil Science,Mac Millan India Ltd, New Delhi
2. Mehra R.K. (2004) Text book of Soil Science, ICAR New Delhi
3. ISSS (2002) Fundamental of Soil Science Div. of Soil Science,IARI, New Delhi
4. Singh Dhyan, Chhonkar,P.K. and Dwivedi V.S. (2005) Manul on Soil Plant and water analysis. Westville Publishing House,New Delhi
5. Singh Vinay (1996) (Hindi) Soil Science,fertilizer& Manures ,V.K. PrakashanBarotMerrut (U.P)
6. Yawalkar, K.S. and Agarwal. J.P. (1992). Manure and fertilizers. Agriculture-Horticulture Publishing House, Nagpur.
7. Sanchalli, V.K. (1960). Chemistry and Technology of Fertilizers. Reinheblpublishingcorporation, New York,USA.
8. Chopra, S.L. and Kanwar, J.S. (1991). Analytical Agriculture, Chemistry, Kalyani

Publishers, New Delhi.

9. Tandon, H.L.S. (1989). Soil water and fertilizers analysis, Fertilizer Development and Consultant organization, New Delhi

AG-503	Pests of Crops and Stored Grains and Their Management	3(2+1)

Theory

UNIT-A 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

UNIT-B Scientific name, order, family, host range, distribution, nature of damage and control practice other important arthropod pests of various field crop, vegetable crop, fruit crop, plantation crops, ornamental crops, spices and condiments.

UNIT-C Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain.

UNIT-D Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management.

UNIT-E 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 seasonalhistory of various insect pests attacking crops and their produce: (a) Field Crops; (b) VegetableCrops; (c) Fruit Crops; (d) Plantation, gardens, Narcotics, spices & condiments. Identificationof insect pests and Mites associated with stored grain. Determination of insect infestation bydifferent methods.Assessment of losses due to insects.Calculations on the doses of insecticidesapplication technique.Fumigation of grain store / godown.Identification of rodents and rodentcontrol 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.

Reference:

1. Atwal, A.S. and Dhaliwal, G.S. 2002. Agricultural Pests of South Asia and Their Management, Kalyani Publishers, New Delhi.
2. David, B.V. and Ramamurthy, V.V. 2016. Elements of Economic Entomology, 8th Ed. Popular Book Depot, Chennai.
3. Mathur and Upadhyay, 2005. A Text Book of Entomology, Aman Publishing House, Meerut.
4. Nayar, M.R.G.K. 1986. Insects and Mites of Crops in India, ICAR, New Delhi.
5. Srivastava, K.P. 2004. A Text Book of Entomology, Vol.I & II, Kalyani Publishers, New Delhi.
6. Reddy, P. Parvatha 2010. Insect, Mite and Vertebrate Pests and their Management in Horticultural Crops. Scientific Publishers, Jodhpur.

AG 504	Diseases of Field and Horticultural Crops and their Management-I	3(2+1)

Theory

UNIT-A 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.

UNIT-B Bajra :downy mildew and ergot; Groundnut: early and late leaf spots, wilt Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; Pigeonpea:

UNIT-C 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: Phytophthorablight;Tobacco: black shank, black root rot and mosaic.

UNIT-D 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 andblack rot; Brinjal: Phomopsis blight and fruit rot and

UNIT-E 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 wellmounted specimens.

References:

1. Cook, AA. 1981. Diseases of Tropical and Sub-Tropical Field Fiber and Oil Plants. Mac Millan Publishing Co. New York.
2. Gupta V K and Paul Y S. 2002. Diseases of Field Crops. Indus Publishing Co. New Delhi.
3. Mehrotra R S and Agrawal A. 2013. Plant Pathology. 2nd.ed. Tata McGraw-Hill Publishing Co Ltd. New Delhi.
4. Rangaswamy, G and Mahadevan, A. 2001. Diseases of Crop Plants in India. Prentice hall of India Pvt. Ltd. New Delhi.
5. Singh, R.S. 2009. Plant Diseases. 9th ed. Oxford & IBH Publishing Company Pvt. Ltd. New Delhi.
6. Agrios, G.N. 2005. Plant Pathology. 5th ed. Academic Press, New York.
7. Gupta, S.K. and Thind, T.S. 2012. Disease problem in vegetable production. Scientific Publishers, Jodhpur.
8. Singh, R.S. 2012. Diseases of Fruit Crops. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
9. Singh, R.S.1998. Diseases of Vegetable Crops. 3rd ed. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

AG-505	Crop Improvement-I (*Kharif* crops)	2(1+1)

Theory

UNIT-A Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds;fibres; fodders and cash crops; vegetable and horticultural crops;

UNIT-B Plant genetic resources, itsutilization and conservation, study of genetics of qualitative and quantitative characters;

UNIT-C Importantconcepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Majorbreeding objectives and procedures including conventional and modern innovative approachesfor development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stressitolerance and quality (physical, chemical, nutritional);

UNIT-D Hybrid seed production technology inMaize, Rice, Sorghum, Pearl millet and Pigeonpea, etc.

UNIT-E Ideotype concept and climate resilientcrop 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 , Castor, 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.

References:

1. Chopra, V.L. 2000 Breeding of Field Crops (Edt.). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Chaddha.K.L. and Rajendra Gupta. 1995. Advances in Horticulture Vol. II Medicinal and Aromatic Plant. Malhotra Publishing House, New Delhi.
3. Mandal, AK., P.K. Ganguli and S.P. Banerjee. 1991. Advances in Plant Breeding Vol. I and II.CBS Publishers and Distributors, New Delhi.

4. Manjit S. Kang 2004. Crop Improvement: Challenges in the Twenti-First Century (Edt). International Book Distributing Co. Lucknow.
5. Poehlman, J.M. 1987. Breeding of Field Crops. AVI Publishing Co..INC, East Port, Conneacticut, USA.
6. Ram, H.H. and H.G. Singh. 1994. Crop Breeding and Genetics. Kalyani Publishers, New Delhi.
7. Sharma, A.K. 2005.Breeding Technology of Crop Plants (Edt.). Yash Publishing House, Bikaner.
8. Ram.H.H. 2005.Vegetable Breeding — Principles and Practices.Kalyani Publishers, New Delhi.

AG 506	**Entrepreneurship Development and Business Communication**	**2 (1+1)**

Theory

UNIT-A Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs ;SWOT Analysis & achievement motivation,

UNIT-B Government policy and programs and institutions for entrepreneurship development, Impact of economic reforms on Agribusiness/ Agri enterprises,

UNIT-C Entrepreneurial Development Process; Business Leadership Skills; Developing organizational skills (controlling, supervising, problem solving, monitoring & evaluation), Developing Managerial skills, Business Leadership Skills (Communication, direction and motivation Skills),

UNIT-D Problem solving skill, Supply chain management and Total quality management,

UNIT-E Project planning Formulation and report preparation; Financing of enterprise, Opportunities for agri entrepreneurship and rural enterprise.

Practical

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

References:

1. Harold Koontz & Heinz Weihrich. 2004. *Essentials of Management: An International Perspective,* 2nd Ed. Tata Mc-Graw Hill Publishing Pvt Ltd.
2. Chole, R. R. Kapse, P. S. and Deshmukh, P. R.2012. Entrepreneurship Development and Communication Skills scientific Publisher (India), Jodhpur.
3. Bhaskaran, S. 2014. Entrepreneurship Development and Management.Aman Publishing House, Meerut.
4. Mancuso, J. 1974. The Entrepreneurs Handbook (Vol. 192(, Artech House, Inc., USA.
5. Karthikeyan,C. et al. 2008.. A Text Book of Agricultural Extension Management. Atlantic Publishers, New Delhi.
6. Natrajan,K. and Ganeshan, K.P. 2012.Principles of Management. Himalaya Publishing House, New Delhi.
7. Mukesh Pandey & Deepali Tewari. 2010. *The Agribusiness Book.* IBDC Publishers.
8. Nandan H. 2011. *Fundamentals of Entrepreneurship.* PHI Learning Pvt Ltd India.

AG-507	Geoinformatics and Nanotechnology and Precision Farming	2(1+1)

Theory

UNIT-A Precision agriculture: concepts and techniques; their issues and concerns for Indianagriculture; Geo-informatics- definition, concepts, tool and techniques; their use in PrecisionAgriculture.

UNIT-B Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendationusing geospatial technologies;

UNIT-C Spatial data and their management in GIS; Remote sensing conceptsand application in agriculture; Image processing and interpretation;

UNIT-D Global positioning system(GPS), components and its functions; Introduction to crop Simulation Models and their uses foroptimization of Agricultural Inputs; STCR approach for precision agriculture;

UNIT-E Nanotechnology,definition, concepts and techniques, brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors, Use of nanotechnology in seed, water, fertilizer,plant protection for scaling-up farm productivity.

Practical

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

References:

1. Krishna, K.K. 2013. Precision Farming: Soil Fertility and Productivity Aspects. Apple Academic Press
2. Srivastava, G.S. 2014. An Introduction to Geoinformatics. McGrew Hill Education (India) Pvt. Ltd. , New Delhi
3. Gupta, R.K. and Subhash Chander. 2008. Principles of Geoinformatics. Jain Brothers, New Delhi.
4. Choudhary, S. 2011. Applied Nanotechnology in Agriculture. Arise Publishers & Distributors
5. Sekhon, B.S. 2014. Nanotechnology in agri-food production: an overview. *Nanotechnology, Science and Applications***7**:31-532

AG-508	**Practical Crop Production – I (*Kharif* crops)**	**2(0+2)**

Practical

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

References:

1. Yawalkar, K.S., Agarwal, J.P. and Bokde, S. 2008. Manures and Fertilizers (10th edition), Agri-Horticultural Publishing House, Nagpur.
2. Balasubramaniyan, P. and Palaniappan, S.P. 2016. Principles and Practices of AgronomyAgrobios (India), Jodhpur.
3. Reddy, S. R., 2016. Principles of Agronomy (5th edition), Kalyani Publishers, Ludhiana.
4. Singh, S.S. and Singh, Rajesh. 2015. Principles and Practices of Agronomy (5th Re-set), Kalyani Publishers, New Delhi, Kalyani Publishers, Ludhiana.

AG 509	Intellectual Property Rights	1(1+0)

Theory

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

UNIT-B Types of Intellectual Property and legislations covering IPR in India:-Patents, Copyrights, Trademark, Industrial design, Geographical indications, Integrated circuits,

UNIT-C Trade secrets.Patents Act 1970 and Patent system in India, patentability, process and product patent, filingof patent, patent specification, patent claims, Patent opposition and revocation, infringement,Compulsory licensing, Patent Cooperation Treaty, Patent search and patent database.

UNIT-D 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 breeder's rights,

UNIT-E 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 foodand agriculture (ITPGRFA). Indian Biological Diversity Act, 2002 and its salient features, accessand benefit sharing.

Reference books:

1. Erbisch, F.H. and K. Maredia. Intellectual Property Rights in Agricultural Biotechnology. Wallingford: CABI, 1998.
2. Ganguli, Prabudha. Intellectual Property Rights: Unleashing knowledge economy,-New Delhi, McGraw-Hill, 2001
3. India, Ministry of Agriculture. State of Indian farmer. Vol. 5 Technology generation and IPR issues, New Delhi, Academic Foundation, 2004
4. Intellectual Property Rights: Key to new wealth generation,-Delhi NRDC and Aesthetic Technologies, 2001
5. Rothschild, Max and Newman, Scott, Ed. Intellectual Property Rights in Animal Breeding and Genetics. Wallingford: CABI, 2003.
6. Saha, R, ed. Intellectual Property Rights in NAM and other developing countries: A Compendium on law and policies,- Delhi: Daya, 2006.
7. Santaniello, V., R.E. Evension, D. Zeberman, and G.A. Carlson, Eds. Agriculture and Intellectual Property Rights: Economic, institutional and implementation issues in Biotechnology- Hyderabad, University Press, 2003.

AG 510A	Agricultural Journalism (Elective Course)	3 (2+ 1)

Theory

UNIT-A Agricultural Journalism: The nature and scope of agricultural journalism characteristics and training of the agricultural journalist, how agricultural journalism is similar to and different from other types of journalism.

UNIT-B Newspapers and magazines as communication media: Characteristics; kinds and functions of newspapers and magazines, characteristics of newspaper and magazine readers. Form and content of newspapers and magazines: Style and language of newspapers and magazines, parts of newspapers and magazines.

UNIT-C The agricultural story: Types of agricultural stories, subject matter of the agricultural story, structure of the agricultural story. Gathering agricultural information: Sources of agricultural information, interviews, coverage of events, abstracting from research and scientific materials, wire services, other agricultural news sources.

UNIT-D Writing the story: Organizing the material, treatment of the story, writing the news lead and the body, readability measures.

UNIT-E Illustrating agricultural stories: Use of photographs, use of artwork (graphs, charts, maps, etc.), writing the captions. Editorial mechanics: Copy reading, headline and title writing, proofreading, lay outing.

Practical

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

References:

1. Bhaskaran, C, Prakash, R. & Kishore Kumar, N. 2008. Farm Journalism in Media Management. Agro-Tech. Publishing Academy.
2. Chattergee, P.C. 1991. Broadcasting in India. Sage Publication.
3. Chiranjeev, A. 1999. Electronic Media Management. Authors Press.
4. D'Souza, Y.K. 1998. Principles and Ethics of Journalism and Mass Communication. Commonwealth Publication.
5. Defleur, M.L. & Dennis, E.E. 2001. Understanding Mass Communications. Goyalsaab Publication.
6. Jain, S.C. 2006. International Marketing Management. CBS Publication.
7. Keval, J. Kumar. 2004. Mass Communication in India. Jaico Publication.

8. Malhan, P.N. 2004. Communication Media: Yesterday, Today and Tomorrow. Directorate of Publication Division, New delhi

9. Mehta, D.S. 1992. Mass Communication and Journalism in India. Allied Publication.

10. Panigrahy, D. 1993. Media Management in India. P.K. Biswasroy (Ed.). Kanishka Publication.

11. Shrivastava, K.M. 1995. News Writing for Radio and TV. Sterling Publication.

12. Sinha, K.K. 2001. Business Communications. Galgotia Publication.

AG 510B	Landscaping (Elective Course)	3 (2 + 1)

Theory

UNIT-A 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.

UNIT-B 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.

UNIT-C Pot plants: selection, arrangement, management. Bio-aesthetic planning: definition, need, planning; landscaping of urban and rural areas

UNIT-D Peri-urban landscaping, Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions.

UNIT-E Bonsai: principles and management, lawn: establishment and maintenance. CAD application.ort of the ICAR Fifth

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.

References:

1. Randhawa, G. S. 1973. Ornamental Horticulture in India. Today and Tomorrow's Printers and Publishers, New Delhi.
2. Aora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishres, Ludhiana
3. Bose, T. K and Mukherjee, D. 1977. Gardening in India. Oxford & IBH Publishing Co. Pvt. Ltd., Calcutta.

AG 510C	Food Safety and Standards (Elective Course)	3 (2 + 1)

Theory

UNIT-A 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.

UNIT-B 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.

UNIT-C 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.

UNIT-D 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.

UNIT-E Organic foods.Newer approaches to food safety.Recent Outbreaks.Indian and International Standards for food products.

Practical

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

References:

1. Fortin, Neal D. (2017). Food Regulation: Law, Science, Policy, and Practice (2nd ed.). Hoboken, New Jersey: John Wiley Sons , Inc. ISBN 9781118964477. LCCN 2016031565. OCLC 976412308. Retrieved 18 June 2017.
2. Satin, Morton (2008). Food alert!: the ultimate sourcebook for food safety (2nd ed.). New York, NY: Facts On File. ISBN 9780816069682.
3. Clute, Mark (October 2008). Food Industry Quality Control Systems. CRC Press. ISBN 978-0-8493-8028-0.
4. Comprehensive Reviews in Food Science and Food Safety, ISSN 1541-4337 (electronic) ISSN 1541-4337 (paper), Blackwell Publishing.

AG 510D	Bio-pesticides & Bio-fertilizers (Elective Course)	3 (2+ 1)

Theory

UNIT-A History and concept of biopesticides.Importance, scope and potential of biopesticide.Definitions, concepts and classification of biopesticides viz. pathogen, botanical pesticides, and biorationales.Botanicals and their uses. Mass production technology of bio-pesticides.Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes.

UNIT-B Methods of application of biopesticides.Methods of quality control and Techniques of bio-pesticides.Impediments and limitation in production and use of bio-pesticide.Bio-fertilizers - Introduction, status and scope. Structure and characteristic features of bacterial bio-fertilizers- *Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium*and *Frankia*;Cynobacterial.

UNIT-C Bio-fertilizers- Anabaena, Nostoc, Hapalosiphon and fungal bio-fertilizers- AM mycorrhiza and ectomycorhiza. Nitrogen fixation -Free living and symbiotic nitrogen fixation.

UNIT-D Mechanism of phosphate solubilization and phosphate mobilization, K solubilization. Production technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid bio-fertilizers.

UNIT-E FCO specifications and quality control of bio-fertilizers. Application technology for seeds, seedlings, tubers, sets etc. Bio-fertilizers -Storage, shelf life, quality control and marketing. Factors influencing the efficacy of bio-fertilizers.

Practical

Isolation and purification of important biopesticides: *Trichoderma Pseudomonas, Bacillus, Metarhyzium*etc. and its production. Identification of important botanicals. Visit to biopesticide laboratory in nearby area. Field visit to explore naturally infected cadavers. Identification of entomopathogenic entities in field condition. Quality control of biopesticides. Isolation and purification of Azospirillum , Azotobacter, Rhizobium, P-solubilizers and cyanobacteria. Mass multiplication and inoculums production of biofertilizers. Isolation of AM fungi -Wet sieving method and sucrose gradient method. Mass production of AM inoculants.

References:

1. Shalini Suri, Biofertilizers and Biopesticides, 2011. APH Publishing Corporation.
2. Arun. K. Sharma. 2011. Handbook of Organic farming. Agrobios (India), Jodhpur.
3. S.P. Palaniappan and K.Annadurai. 2010. Organic farming – Theory and Practice. Scientific Publishers. Jodhpur

AG-601	Rainfed Agriculture & Watershed Management	2(1+1)

Theory

UNIT- A Rainfed agriculture: Introduction, types, History of rainfed agriculture and watershed in India.

UNIT- B Problems and prospects of rainfed agriculture in India; Soil and climatic conditions prevalent in rainfed areas; Soil and water conservation techniques.

UNIT- C Drought: types, effect of water deficit on physio- morphological characteristics of the plants, Crop adaptation and mitigation to drought.

UNIT- D Concept and importance of Water harvesting and its techniques, efficient utilization of water through soil and crop management practices, Management of crops in rainfed areas.

UNIT- E Contingent crop planning for aberrant weather conditions, Concept, objective, principles and components of watershed management, factors affecting watershed management.

Practical

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

References:

1. Jayanthi, C. and Kalpana, R. 2016. Dryland Agriculture, Kalyani Publishers, Ludhiana.
2. Reddy, S.R. and Reddy, G. Prabhakara. 2015. Dryland Agriculture, Kalyani Publishers, Ludhiana.
3. Murthy, J. V. S. 1994. Watershed Management, Wiley Eastern Limited. New Age International Limited, New Delhi.
4. Dhruva Narayan, V.V. Singh, P.P., Bhardwaj, S.P., U. Sharma, Sikha, A.K., Vital, K.P.R. and Das, S.K. 1987. Watershed Management for Drought Mitigation, ICAR, New Delhi.
5. Singh, R.P., Sharma, S., Padmnabhan, N.V. Das, S.K. and Mishra, P.K. 1990.A Field Manual on Watershed Management, ICAR (CRIDA), Hyderabad.

AG 602	Protected Cultivation and Secondary Agriculture	2(1+1)

Theory

UNIT-A 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.

UNIT-B Green house equipments, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, typical applications, passive solar greenhouse, hot air green house heating systems, green house drying.

UNIT-C 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.

UNIT-D 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).

UNIT-E 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 inan active summer winter cooling system. Determination of drying rate of agricultural productsinside green house. Study of green house equipments. Visit to various Post Harvest Laboratories.Determination of Moisture content of various grains by oven drying & infrared moisturemethods. Determination of engineering properties (shape and size, bulk density and porosity ofbiomaterials).Determination of Moisture content of various grains by moisture meter.Field visitto seed processing plant.

References:

1. Green house: Science and Technology. 2016. Kothari S, S.C.Kaushic and A.N.Mathur. Himanshu Publication, Udaipur.
2. Green House Technology- Application and Practice. Sharma A and V.M.Salokhe. 2006. Agro Tech. publication, Udaipur
3. Principles of Agricultural Engineering, Vol. I. 2012. Michael, A.M. and T. P. Ojha . Jain Brothers, New Delhi.
4. Post Harvest Technology of Cereals, Pulses and Oil Seeds.1999. Chakravarty, A. Oxford and IBH Pub. New Delhi.
5. Unit operation of Agriculture Processing. 2004. Shay K.M. and Singh, K.K. Vikas Publication House, New Delhi.

AG 603	**Diseases of Field and Horticultural Crops and their Management-II**	**3(2+1)**

Theory

UNIT-A 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, ratoo stunting and PokkahBoeng; Sunflower: n

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

UNIT-C 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:

UNIT-D Leaf spot Potato: early and late blight, black scurf, leaf roll, and mosaic; Cucurbits: downy mildew, powdery mildew, wilt;

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

Practical

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

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

References

1. Cook, AA. 1981. Diseases of Tropical and Sub-Tropical Field Fiber and Oil Plants. Mac Millan Publishing Co. New York.
2. Gupta V K and Paul Y S. 2002. Diseases of Field Crops. Indus Publishing Co. New Delhi.
3. Mehrotra R S and Agrawal A. 2013. Plant Pathology. 2nd.ed. Tata McGraw-Hill Publishing Co Ltd. New Delhi.

4. Rangaswamy, G and Mahadevan, A. 2001. Diseases of Crop Plants in India. Prentice hall of India Pvt. Ltd. New Delhi.

5. Singh, R.S. 2009. Plant Diseases. 9th ed. Oxford & IBH Publishing Company Pvt. Ltd. New Delhi.

6. Agrios, G.N. 2005. Plant Pathology. 5th ed. Academic Press, New York.

7. Gupta, S.K. and Thind, T.S. 2012. Disease problem in vegetable production. Scientific Publishers, Jodhpur.

8. Singh, R.S. 2012. Diseases of Fruit Crops. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

9. Singh, R.S.1998. Diseases of Vegetable Crops. 3rd ed. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

AG 604	Post-Harvest Management and Value Addition of Fruits and Vegetables	2(1+1)

Theory

UNIT-A Importance of post-harvest processing of fruits and vegetables, extent and possible causesof post harvest losses;

UNIT-B Pre-harvest factors affecting postharvest quality, maturity, ripening andchanges occurring during ripening;

UNIT-C Respiration and factors affecting respiration rate; Harvestingand field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric); Value addition concept;

UNIT-D Principles and methods of preservation; Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards; Fermented and non-fermented beverages.

UNIT-D Tomatoproducts- Concepts and Standards; Drying/ Dehydration of fruits and vegetables – Concept andmethods, 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.

Reference:

1. Battacharjee, S. K. and De, L. C.,(2005). Post Harvest Technology of Flowers and Ornamentals Plants, Pointer Publisher
2. Jacob John, P., (2008). A Handbook on Post Harvest management of Fruits and vegetables, Daya Publishing House, Delhi
3. Manoranjan, K. and Sangita, S.,(1996) Food Preservation & Processing, Kalyani Publishers
4. Mitra, S. K. (1997) Post Harvest Physiology and Storage of Tropical and Sub-tropical Fruits. CAB International
5. Verma, L. R. and Joshi, V. K. (2000) Post Harvest Technology of Fruits and Vegetables Vol. I & II, Indus Publishing Co., New Delhi
6. Vijay, K.,(2001).Text Book of Food Sciences and Technology, ICAR

AG-605	Management of Beneficial Insects	2(1+1)

Theory

UNIT-A Importance of beneficial Insects, Beekeeping and pollinators, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication.

UNIT-B Insect pests and diseases of honey bee. Role of pollinators in cross pollinated plants. Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves.

UNIT-C Rearing, mounting and harvesting of cocoons. Pest and diseases of silkworm, management, rearing appliances of mulberry silkworm and methods of disinfection.

UNIT-D Species of lac insect, morphology, biology, and host plant, lac production – seed lac, button lac, shellac, lac- products.

UNIT-E 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, voltinismand biology of silkworm.Mulberry cultivation, mulberry varieties and methods of harvestingand preservation of leaves. Species of lac insect, host plant identification. Identification of other important pollinators, weed killers and scavengers. Visit to research and training institutions devoted to beekeeping, sericulture, lac culture and natural enemies. Identification and techniques for mass multiplication of natural enemies.

Reference:

1. DeBach, P. 1974. Biological control by Natural enemies. Cambridge University Press.
2. Dhaliwal GS & Arora R. 2001. *Integrated Pest Management: Concepts and approaches.* Kalyani Publ., New Delhi.
3. Dhaliwal, GS & Koul O. 2007. *Biopesticides and Pest Management*. Kalyani Publ., New Delhi.
4. Gautam, R.D. Biological Pest Suppression, Westvill Publising Co., New Delhi.

5. Manfred Mackaur, Laster E.Ehler and Jens Roland. 1990. Critical Issues in Biological control- Intercept Ltd. Project Directorate of Biological control. 1994. Technology for mass production of Natural enemies. Technical Bulletin -4.
6. Srivastava, K.P. 2004. A Text Book of Entomology, Vol. I, Kalyani Publishers, New Delhi.
7. Abrol, D.P. 2013. Beekeeping: A Comprehensive Guide to Bee and Beekeeping, Scientific Publishers, Jodhpur.

AG 606	Crop Improvement-II *(Rabi crops)*	2 (1+1)

Theory

UNIT-A Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds;fodder crops and cash crops; vegetable and horticultural crops;

UNIT-B Plant genetic resources, itsutilization and conservation;

UNIT-C Study of genetics of qualitative and quantitative characters;

UNIT-D Majorbreeding objectives and procedures including conventional and modern innovative approachesfor development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stresstolerance and quality (physical, chemical, nutritional);

UNIT-E Hybrid seed production technology of rabicrops. 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.

Reference:

1. Chopra, V.L. 2000 Breeding of Field Crops (Edt.). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Chaddha.K.L. and Rajendra Gupta. 1995. Advances in Horticulture Vol. II Medicinal and Aromatic Plant. Malhotra Publishing House, New Delhi.
3. Mandal, AK., P.K. Ganguli and S.P. Banerjee. 1991. Advances in Plant Breeding Vol. I and II.CBS Publishers and Distributors, New Delhi.
4. Manjit S. Kang 2004. Crop Improvement: Challenges in the Twenti-First Century (Edt). International Book Distributing Co. Lucknow.
5. Poehlman, J.M. 1987. Breeding of Field Crops. AVI Publishing Co..INC, East Port, Conneacticut, USA.
6. Ram, H.H. and H.G. Singh. 1994. Crop Breeding and Genetics. Kalyani Publishers, New Delhi.
7. Sharma, A.K. 2005.Breeding Technology of Crop Plants (Edt.). Yash Publishing House, Bikaner.
8. Ram.H.H. 2005.Vegetable Breeding — Principles and Practices.Kalyani Publishers, New Delhi.

AG-607	Practical Crop Production – II (Rabi crops)	1(0+1)

Practical

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

References:

1. Yawalkar, K.S., Agarwal, J.P. and Bokde, S. 2008. Manures and Fertilizers (10th edition), Agri-Horticultural Publishing House, Nagpur.
2. Balasubramaniyan, P. and Palaniappan, S.P.2016. Principles and Practices of Agronomy (2nd edition), Agrobios (India), Jodhpur.
3. Reddy, S. R. 2016. Principles of Agronomy (5th edition), Kalyani Publishers, Ludhiana.
4. Singh, S.S. and Singh, Rajesh. 2015. Principles and Practices of Agronomy (5th Re-set), Kalyani Publishers, New Delhi, Kalyani Publishers, Ludhiana.

AG 608	Principles of Organic Farming	2(1+1)

Theory

UNIT-A Organic farming, principles and its scope in India; Initiatives taken by Government (central/ state), NGOs and other organizations for promotion of organic agriculture;

UNIT-B Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming;

UNIT-C Choice of crops and varieties in organic farming; Fundamentals of insect, pest, disease and weed management under organic mode of production;

UNIT-D Operational structure of NPOP; Certification process and standards of organic farming;

UNIT-E 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.

References:

1. Dhama, A.K. 2014.Organic Farming for Sustainable Agriculture (2nd edition), Agrobios (India), Jodhpur.
2. Sharma, Arun K. 2013. A Handbook of Organic Farming, Agrobios (India), Jodhpur
3. Palaniappan, S.P. and Anandurai, K.1999. Organic Farming – Theory and Practice. Scientific Pub. Jodhpur
4. Thapa, U and Tripathy, P. 2006. Organic Farming in India, Problems and prospects, Agrtech, Publising Academy, Udaipur.

AG 609	Farm Management, Production & Resource Economics	2(1+1)

Theory:

UNIT-A 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 equip-marginal/or principles of opportunity cost and law of comparative advantage.

UNIT-B Meaning and concept of cost, types of costs and their interrelationship, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labour income and farm business income. Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises.

UNIT-C 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.

UNIT-D 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.

UNIT-E 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 equip-marginal returns/opportunity cost principle in allocation of farm resources. Determination of most profitable level of input 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.

References:

1. Mittal, S.K. and Sethi, C.P. "Linear Programming."
2. Tandan, R.K. and Dhondiyal, S.P. "Principles and Methods of Farm Management".
3. Heady, E.O. and Candler, W. "Linear Programming Methods."
4. Johl, S.S. and Kapoor, T.R. "Fundamental of Farm Business Management, Kalyani Publishers, Ludhiana and New Delhi

5. Sankhayan, P.L “Introduction to the Economics of Agricultural Production.”
6. Singh, I.J. “Elements of Farm Management”
7. Dorfman, R. and Samuelson and Solow, R. “Linear Programming and Economic Analysis.”
8. Heady, E.O. and Dillors, J.L.”Agricultural Production Function”.
9. Karam, A.S. and Karan Singh “Economics of Farm Management in India”.
10. M.E. Sharpe and Armonk, N.Y.: Environmental and Natural Resource Economics: Theory, Policy and the Sustainable Society
11. Hartieick, J.M. and Olewiler, N.D.: The Economics of Natural Resource Use.

AG 610	Principles of Food Science & Nutrition	2(2+0)

Theory

UNIT-A Concepts of Food Science (definitions, measurements, density, phase change, pH, osmosis, surface tension, colloidal systems etc.);

UNIT-B Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives, important reactions);

UNIT-C Food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods, Production of fermented foods);

UNIT-D Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying etc.);

UNIT-E 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.

References:-

1. Heldman, Dennis R. "IFT and the Food Science Profession." Food Technology. October 2006. p. 11.
2. Potter, Norman N.; Hotchkiss, Joseph H. (1998). Food Science. Food science texts series (5th ed.). Springer. ISBN 9780834212657.
3. "Food Science Activity Guides". IFT.org. Archived from the original on March 27, 2015. Retrieved February 2, 2015.
4. John M. de Man.1999. Principles of Food Chemistry (Food Science Text Series), Springer Science, Third Edition
5. John M. de Man. 2009. Food process engineering and technology, Academic Press, Elsevier: London and New York, 1st edn.
6. Fratamico PM and Bayles DO (editor). (2005). Foodborne Pathogens: Microbiology and Molecular Biology. Caister Academic Press. ISBN 978-1-904455-00-4.

AG- 611A	Weed Management (Elective Course)	3 (2 + 1)

Theory

UNIT-A Introduction to weeds, characteristics of weeds their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds.

UNIT-B Herbicide classification, concept of adjuvant, surfactant, herbicide formulation and their use.Introduction to mode of action of herbicides and selectivity.

UNIT-C Allelopathy and its application for weed management. Bio-herbicides and their application in agriculture.

UNIT-D Concept of herbicide mixture and utility in agriculture.Herbicide compatibility with agro-chemicals and their application.

UNIT-E 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 agrochemicals study. Shift of weed flora study in long term experiments. Study of methods of herbicide application, spraying equipments. Calculations of herbicide doses and weed control efficiency and weed index.

References:

1. Gupta, O.P. 2015. Weed Management: Principles and Practices (3rd Edition), Agrobios (India), Jodhpur.
2. Gupta, O.P. 2016. Modern Weed Management (3rd edition), Agrobios (India), Jodhpur.
3. Rao, V.S. 2000. Principles of Weed Science (2nd edition), Oxford and IBH Publishing Co., New Delhi.
4. Saraswat, V. N. Bhan, V.M. and Yaduraju, N.T. 2003. Weed Management, ICAR, New Delhi

AG 611B	Micro Propagation Technologies (Elective Course)	3 (2 + 1)

Theory

UNIT-A Introduction, History, Advantages and limitations; Types of cultures (seed, embryo, organ, callus, cell),

UNIT-B Stages of micropropagation, Axillary bud proliferation (Shoot tip and meristem culture, bud culture),

UNIT-C Organogenesis (callus and direct organ formation),

UNIT-D Somatic embryogenesis, cell suspension cultures,

UNIT-E Production of secondary metabolites, Somaclonal variation, Cryopreservation

Practical

Identification and use of equipments in tissue culture Laboratory, Nutrition media composition, sterilization techniques for media, containers and small instruments, sterilization techniques for explants, Preparation of stocks and working solution, Preparation of working medium, Culturing of explants: Seeds, shoot tip and single node, Callus induction, Induction of somatic embryos regeneration of whole plants from different explants, Hardening procedures.

Reference Books

1 BD Sing, 2001. Biotechnology Expanding Horizon. Kalyani Publication

2 H.S.Chawla, Introduction to plant biotechnology. 2001. Pinnalani for Oxford & IBH publishing Co. Pvt. Ltd. New Delhi.

AG 611C	Hi-Tech Horticulture (Elective Course)	3 (2 + 1)

Theory

UNIT-A Introduction & importance; Nursery management and mechanization; micro propagation of horticultural crops, Modern field preparation and planting methods.

UNIT-B Protected cultivation: advantages, controlled conditions, method and techniques,

UNIT-C Micro irrigation systems and its components; EC, pH based fertilizer scheduling, canopy management, high density orcharding.

UNIT-D Components of precision farming: Remote sensing, Geographical Information System (GIS).

UNIT-E Differential Geo-positioning System (DGPS), Variable Rate applicator (VRA), application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

Practical

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

AG 611D	System Simulation and Agro-Advisory (Elective Course)	3 (2 + 1)

Theory

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

UNIT-B Evaluation of crop responses to weather elements; Elementary crop growth models; calibration, validation, verification and sensitivity analysis.

UNIT-C Potential and achievable crop production- concept and modelling techniques for their estimation. Crop production in moisture and nutrients limited conditions; components of soil water and nutrients balance.

UNIT-D Weather forecasting, types, methods, tools & techniques, forecast verification; Value added weather forecast, ITK for weather forecast and its validity;

UNIT-E Crop weather calendars; preparation of agro-advisory bulletin based on weather forecast.Use of crop simulation model for preparation of Agro-advisory and its effective dissemination.

Practical

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

References:

1. Lal, D.S. 2005 Climatology, Sharda Pustak Bhawan, Allahabad..
2. Varshneya, M.C. and Balakrishna, Pillai, 2003. Text book of Agricultural Meteorology. ICAR, New-Delhi.
3. Sahu, D.D., 2007. Agrometeorology and Remote sensing: Principles and Practices , Agrobios (India) , Jodhpur.
4. Murithy, K, and Radha, V. 1995. Practical Manual on Agricultural Meteorology , Kalyani Publishers, New-Delhi

SEMESTER-VII

*Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE &AIA)

Objectives of RAWE Programme:

1. To understand the rural community life and different situations prevailing in villages with special reference to agriculture.
2. To help students to get acquaint with the socio-economic conditions of farmers and their problems with reference to agricultural development.
3. To provide an opportunity to students for practical training in Crop Production, Plant Sciences, Plant Protection, Social Sciences, Animal Production & Dairying, Agrobased Industries and Skill Oriented Training through work experience.
4. To develop communication skill among students in using extension teaching methods in transfer of technology in the villages.
5. To make students to understand the agricultural technologies being followed by farmers and to prepare alternate farm plans to suit to the local situations in consultation with the farmers.
6. To develop confidence and competence in students for solving problems related to agriculture at farmers field.
7. To provide an opportunity to work with KVKs and agro based industries.
8. To help students to acquaint with the on-going thrust agricultural programmes and related transfer of technology (TOT), programmes in agriculture.
9. To impact diagnostic and remedial practical training and skill in crop production, protection through work experience.
10. To develop the communication skills, confidence and competence among the students to interact with the farmers so as to prepare Project Reports on village development plan.

Components of RAWE:

General Orientation & on campus training by different faculties
Village attachment
Unit attachment in University/College. KVK/Research Station
Plant Clinic
Agro-Industrial Attachment
Project Report Preparation, Presentation and Evaluation

SEMESTER- VIII

Modules for Skill Development, entrepreneurship and Agro-industrial Attachment

AG 801	**Production Technology for Bio-agents and Bio-fertilizers**	**10 (0+10)**

Practical:

History and concept of biopesticides.Importance, scope and potential of biopesticide.Definitions, concepts and classification of biopesticides viz. pathogen, botanical pesticides, and biorationales.Botanicals and their uses.Mass production technology of bio-pesticides.Isolation and purification of important biopesticides: *Trichoderma Pseudomonas, Bacillus, Metarhyzium*etc. and its production. Identification of important botanicals. Visit to biopesticide laboratory in nearby area. Field visit to explore naturally infected cadavers. Identification of entomopathogenic entities in field condition.Quality control of biopesticides. Isolation and purification of Azospirillum , Azotobacter, Rhizobium, P-solubilizers and cyanobacteria. Mass multiplication and inoculums production of biofertilizers. Isolation of AM fungi -Wet sieving method and sucrose gradient method. Mass production of AM inoculants.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.

References:

1. Shalini Suri, Biofertilizers and Biopesticides, 2011. APH Publishing Corporation.
2. Arun. K. Sharma. 2011. Handbook of Organic farming. Agrobios (India), Jodhpur.
3. S.P. Palaniappan and K.Annadurai. 2010. Organic farming – Theory and Practice. Scientific Publishers. Jodhpur.

AG-802	Seed Production& Technology	(0+10,)

Practical

Seed production in major cereals: Wheat, Rice, Maize, Sorghum and Bajra. Seed production in major pulses: Urd, Mung, Cowpea, Pigeonpea, Lentil, Gram, Fieldpea. Seed production in major oilseeds: Soybean, Rapeseed and Mustard, Groundnut. Seed production in vegetable crops & Seed spices.

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.

Maintenance of genetic purity during seed production, seedquality; Definition, Characters of good quality seed, different classes of seed.

Reference:

1. Agarwal, R.L.1991.Seed Technology, Oxford & IBH Publishing Co. Delhi
2. Agarwal, P.K. 1999. Seed Technology, ICAR, New Delhi.
3. Subir Sen and Nabinanda Ghosh.1999. Seed Science and Technology, Kalyani Publishers. New Delhi.
4. DhirenraKhare and Mohan S. Bhale.2000. Seed Technology. Scientific Publishers
5. (India), Jodhpur.
6. Maloo,S.R., Intodia, S.K. and Pratap Singh.2008. Beej Pradyogiki.Agrotech Publishing Academy.
7. A.K. Joshi and B.D. Singh.2005.Seed Technology. Kalyani Publishers, New Delhi.
8. Saxena,R.P.1984. BeezSansadhan, GBPA&T, Pantnagar.
9. Singh, B.D. 2005. Plant Breeding. Kalyani Publishing House, New Delhi.

AG 803	Mushroom Cultivation Technology	10 (0+10)

Practical

Role of mushroom in economic growth, nutritional and medicinal values, Taxonomy of mushroom. Pure culture of fungus, preparation of span production Importance of mushroom cultivation, Cultivation procedure of paddystraw mushroom (outdoor/indoor), concepts, types, uses, food values,Acquaintance with edible, non-edible, medicinal and poisonous mushrooms. Reproduction in Fungi,Fungal growth factors,Nutrition of Mushroom.Cultivation procedure of oyster, Mushrooms, Cultivation procedure milk, Mushroom. Organic mushroom production technology. Demonstration on bag preparation of oyster and milk mushrooms. Opportunities and Constraints. Mushroom processing and preservation (drying/ dehydration, pickling and canning) Value addition in mushroom, preparation of value added products, skill development and marketing activities. Mushroom spawn: quality attributes storage and transport, Acquaintance with mushroom contaminants.

References

1. R.D. Rai and T. Arumuganathan (2008). Post Harvest Technology of Mushrooms, Technical Bulletin-2008, NRCM, ICAR, Chambaghat, Solan-1731213, (H.P.).
2. Sharma .B.C&Sharma V. P. Mushroom cultivation in india
3. Tripathi D P, Mushroom Cultivation Export IDH Publishing Company
4. Shubhratar &R. MishraTechnique of Mushroom Cultivation
5. Rajan S. Mushroom Technology .CBS Publisher and Distributer

AG 804	Soil, Plant, Water and Seed Testing	10 (0+10)

Practical

Determination of soil texture by Bouzoukis hydrometer method, capillary rise phenomenon of water in soil column. Laboratory Organization, Laboratory Safety, Quality Control and Standardization Procedures, Data Processing. Concept of seed processing, diversity in seed storage and viability issues, Methods of testing of seed viability. Behavior of seed germination and concept of speed of germination/seed vigor, design of experiments for evaluation of seed related traits. Seed moisture test Germination test – types of germination, Germination test – different methods of germination Seed certification: Procedure.The concentration and composition of dissolved salts in any water determine its quality for irrigation. Mostly the concerns with irrigation water quality relate to possibility of high salt concentration, sodium hazard, carbonate and bicarbonate hazard, or toxic ions (e.g., B or Cl). The analyses required for determining water quality include EC, soluble anions and cations.

References:

1. Maliwal, G. La. and SomaniL.L. 2010. Nature Properties and Management of Sineand Alkali Soils. Agrotech Publishing Academy, Udaipur 313 002. pp. 335.
2. Agrawal, P. K., (2010).Principles of Seed Technology. Indian Council of AgriculturalResearch, New Delhi.
3. Hybrid Seed Production in Field Crops: Principles and Practices by N. C. Singhal, 2003,
    a. Kalyani publication, Delhi

AG 805	Commercial Beekeeping	10 (0+10)

Practical

Importance of beneficial Insects, Honey bee species, castes of bees.Beekeeping and pollinators, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication.Insect pests and diseases of honey bee. Role of pollinators in cross pollinated plants.Seasonal management for beekeeping.Adoption of beekeeping as entrepreneur.Important schemes of government to beekeeping.

Reference:

1. Srivastava, K.P. 2004. A Text Book of Entomology, Vol. I, Kalyani Publishers, New Delhi.
2. Abrol, D.P. 2013. Beekeeping: A Comprehensive Guide to Bee and Beekeeping, Scientific Publishers, Jodhpur.

AG 806	**Poultry Production Technology**	**(0+10)**

Practical

Different types of feather and function and different type of comb and function (Demo). External body poultry. Respiratory, ciculatory diigestive and excretory system. Male and female reproductive system. Egg structure and its function.Nervours and endocrine system (Demo).Immune system.Identification method of poultry.Visit to IDF and IPF to study breeds of poultry and daily routine farm operations and farm records.Culling ofpoultry. Planning and layout of housing forpoultry farm. Hatchery operations, incubation and hatching equipment. Management of chicks, growers and layers. Debeaking, dusting and vaccination

Reference:

1. K.K. Dewett and J.D. Verma (1986) Elementary Economic Theory, S. Chand & Company, New Delhi
2. S.K. Mishra and V.K. Puri (1996) Indian Economy, Himalaya Publishing House, New Delhi
3. G.B. Jakhar and S.G. Beri (1996) Elementary Principles of Economics, Oxford University Press (10^{th} Edition), Delhi

AG 807	Commercial Horticulture	10(0+10)

Practical

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

Reference:

1. Chada, K.L. (2002)Handbook of Horticulture, ICAR, New Delhi.
2. Neeraj Pratap Singh (2005) Basic concepts of Fruit Science, IBDC Publishers
3. Jitendra Singh (2011) Basic Horticulture, Kalyani Publications, New Delhi.

AG 808	Floriculture and landscaping	10(0+10)

Practical

Study of various features of an ornamental garden with suitable plants and identification of plants for each feature, formal gardens (Mughal, Persian, Italian and French gardens) with their different features, special type of gardens (Terrace garden and Rock garden, Commercial Flowers and their packaging, landscaping Highways, Railway stations, Bus terminus and Airports, landscaping factories, places of historic importance, places of worship, landscaping cities, towns, country side, canals and along the bank of rivers, Visit to nearby places of worship, places of historic importance, Airport and highways for study of landscape design

References:

1. Randhawa, G. S. 1973. Ornamental Horticulture in India. Today and Tomorrow's Printers and Publishers, New Delhi.
2. Aora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishres, Ludhiana
3. Bose, T. K and Mukherjee, D. 1977. Gardening in India. Oxford & IBH Publishing Co. Pvt. Ltd., Calcutta.

AG 809	Food Processing	10(0+10)

Practical

Comparison of conventional and microwave processing of food, Preservation of food by the process of freezing, Drying of food using Tray dryer/other dryers, Preservation of food by canning(Fruit/Vegetable/meat), Cut-out analysis of canned food, Osmotic dehydration, Minimal Processing, Testing of Packaging material.

References-

1. Desrosier NW and Desrosier JN, The Technology of Food Preservation, CBS Publication, New Delhi, 1998
2. Paine FA and Paine HY, Handbook of Food Packaging, Thomson Press India Pvt Ltd, NewDelhi- 1992
3. Potter NH, Food Science, CBS Publication, New Delhi, 1998
4. Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press,2006
5. Rao PG, Fundamentals of Food Engineering, PHI Learning Pvt Ltd, New Delhi, 2010
6. Toledo Romeo T, Fundamentals of Food Process Engineering, Aspen Publishers, 1999.

AG 810	Agricultural Waste Management	10 (0+10)

Practical

Composting- Solid waste suitable for composting – Methods of composting – vermicomposting - Mineralization process in composting – Biochemistry of composting – Factors involved - Infrastructure required – maturity parameters – value addition – application methodsBiomass Briquetting– potential agro residues and their characteristics for briquetting – fundamental aspects and technologies involved in briquetting – economic analysis of briquetting – setting up of briquetting plant- appliances for biomass briquettes. Biogas and Bio Ethanol Production ,Screening of suitable lingo cellulosic substrate for biogas production -determination of bio-energy potential of agro-waste by estimating total solids – volatile solids – Calorific value- per cent total carbohydrates, moisture, lignin and cellulosic contents – preparation of feed stocks for anaerobic bio- digestion – types of digesters – factors affecting – nutrient value and utilization of biogas slurry. Ethanol production from lingo cellulosic wastes – Processing of Biomass to Ethanol -pre-treatment-fermentation-distillation.

References:

1. P.D. Grover and S.K. Mishra, Biomass Briquetting: Technology and Practices. Published by FAO Regional Wood Energy Development Programme in Asia, Bangkok, Thailand, 1996.
2. Magdalena Muradin and ZenonFoltynowicz, Potential for Producing Biogas from Agricultural Waste in Rural Plants in Poland. Sustainability, 2014, 6, 5065-5074.
3. Biochar production from agricultural wastes via low-temperature microwave carbonization.
4. Qian Kang, LiseAppels, Tianwei Tan and RafDewil, Bioethanol from Lignocellulosic Biomass: Current Findings Determine Research Priorities The Scientific World Journal, 2014, Article ID 298153, 13 pages.

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AG 811	Organic Production Technology	10(0+10)

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.

References:

1. Dhama, A.K. 2014.Organic Farming for Sustainable Agriculture (2nd edition), Agrobios (India), Jodhpur.
2. Sharma, Arun K. 2013. A Handbook of Organic Farming, Agrobios (India), Jodhpur
3. Palaniappan, S.P. and Anandurai, K.1999. Organic Farming – Theory and Practice. Scientific Pub. Jodhpur
4. Thapa, U and Tripathy, P. 2006. Organic Farming in India, Problems and prospects, Agrtech, Publising Academy, Udaipur.
5. Singh SP. (Ed.). 1994. Technology for Production of Natural Enemies. PDBC, Bangalore.
6. Lampin N. 1990. Orgnaic Farming. Press Books, Ipswitch, UK.

AG 812	Commercial Sericulture	10(0+10)

Practical

1. Sericulture maps:
   a) World maps and Silk Road
   b) Sericulture map of India and West Bengal
2. Preparation of histograms and pie charts on:-
   a) Production of Textile fibres in India
   b) World Silk Production
   c) Pie chart on mulberry and non-mulberry silk production in India
3. Organization set up in India :- (Demonstration & Exercise)
   a) Govt. of India, b) Five traditional states viz., Karnataka, Andhra Pradesh, Tamilnadu, West Bengal and Jammu & Kashmir
4. Identification and study of Sericulture products:Cotton and Silk Yarn different types, Pupae, Silk Yarn, Noil Yarn
5. Laboratory Note Book, Internal Assessment

References:

1. Charsley, s.r. (1982). culture and sericulture. academic press inc., new york, u.s.a
2. Fao manuals- imulberry cultivation. faorome.
3. Foth, h.d. (1984) fundamentals of soil science. 7th edn., john wiley& sons, new york.
4. Ganga, g., and j. sulochanachetty. (1991) an introduction to sericulture.oxford&ibh publishing company.
5. Hasaoaruga (1994). principles of sericulture (translated from japanese) oxford &ibh publishing co., pvt.ltd. new delhi.
6. Kichisaburo m. (1997) moriculture – science of mulberry cultivation. oxford&ibh
7. Krishnaswami, s.; narasimhanna, m.n.; suryanarayan, s.k and kumararaj, s. (1973) sericulture,manual-2 - silkworm rearing. agriculture service bulletin, fao, rome.

AG 813	AGRIBUSINESS MANAGEMENT	10(0 +10)

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 agriculturalcommodities. Net present worthtechnique for selection of viableproject.Internal rate ofreturn.

Reference:

1. *Agribusiness Management* and Trade. Language: English. Pages: 239. Author: K.B. Vedamurthy.
2. G. L. Meena S. S. Burark D. C. Pant Rajesh Sharma published Fundamentals of *Agribusiness Management*
3. Agribusiness Management (Routledge Textbooks in Environmental and Agricultural Economics) 4th Edition by Freddie L. Barnard (Author), Jay T. Akridge (Author), Frank J. Dooley (Author), John C. Foltz (Author), Elizabeth A. Yeager (Author)
4. Agribusiness and Farm Management at a Glance Vol 1: Objective Fundamentals 2nd ed by L L & G L Meena Somani
5. Fundamentals of Agribusiness Finance by Ralph W. Battles,Robert C. Thompson
6. Farm Business Management: The Fundamentals of Good Practice (Farm Business Management Series) by P.L. Nuthall

AG 814	Agro-Advisory Services	10(0+10)

Practical:

Overview of integrated Agro- Advisory services in India, variability in weather/climate impacting agriculture. Precipitation events.Needs of farmers - agro-climate & its variability Weather forecast Short & Medium Range Extended range Seasonal Scale Climate Prediction Pest/disease prognosis & control measures Advice on sowing/harvest, cultivar selection, farm input management & intercultural operations.Strategies to empower farmers- Generate information on Weather & Climate (Observations & Forecast) Impact of likely weather on crop Impact of likely weather on P&D Weather based input management Weather sensitivity of farm operations Develop decision making Tools: Data base Crop/Soil/P&D Modeling Remote Sensing & GIS Crop/Soil Monitoring, Drought Monitoring etc. Disseminate information Outreach, capacity building, Feedback. Operational Agro-Meteorology -TIER 1 Apex Policy Planning Body, Delhi Network of 130 Agromet Field Units TIER 2 National Agromet Service HQ Execution, Pune Network of AAS units in the country TIER 3 State Agromet Centres (28) Coordination/Monitoring TIER 4 Agromet Field Units Agroclimatic Zone Level (130) TIER 5 District Level Extension and Training Input Management as advisory~640 Service Goal: Locale & Crop specific Advisory & Farmer Level Outreach.

Reference

1. Chattopadhyay, N. and Chandras, S., Agrometeorological advisory services for sustainable development in Indian agriculture. Biodiversity International Journal. 2(1): 13-18 (2018).
2. Dhakar, R., Chandran, M.A.S., Nagar, S. and Kumar, S., Significance of Agrometeological advisory services in changing climate scenario. Indian Farming. 66(8): 44-46 (2016).
3. Khobragade, A.M., Ade, A.U. and Vaseem, A.M.G., Usefulness of Agro Advisory Services (AAS) Regarding Climate Change in Selected Villages of AICRPAMNICRA Project for Marathwada Region. Journal of Agroecology and Natural Resource Management. 1(3): 127-129 (2014).
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5. Palkhiwala, K., Agromet Advisory Services - Farmers Empowerment. Press Information Bureau, Government of India. Special Service and Features, May 15, 2012 17: 20 IST (2012).
6. Singh, K.K., Weather forecasting and agromet advisory services in India. India Meteological Department, Ministry of Earth Sciences, Press released, New Delhi. 22: 240-243 (2015).

AG-815	Nursery Management	10(0+10)

Practical

Identification of propagation material and equipment.Layout of nurseries and management of progeny orchard. Use of protrays and root trainers in vegetable nursery.Raising and maintenance of root stock. Multiplication of plants by sexual methods.Raising of seedlings. Propagation by cuttings in Horticultural crops.Propagation by budding in Horticultural crops.Propagation by grafting in Horticultural crops.Use of plant growth regulators in propagation. Potting, repotting or lifting of saplings (packaging) for transportation. Use of propagation media.Tetrazolium salt test for determining germination. Visit of commercial nurseries.

Reference Books

1. Bose, T.K. Mitra, SK and Sandhu MK (1986). Propagation of tropical & sub-tropical horticultural crops, Naya Prakash, Calcutta.
2. Hartman, HT and Kester, DE (1986). Plant propagation principles and practices. Prentice Hall of India Pvt. Ltd., Bombay
3. Gill, SS. Bal, JS and Sadhu, AS (1985). Raising Fruit Nursery, Kalyani Publishers, New Delhi.

6. TEACHING-LEARNING PROCESS/ METHODOLOGY (TLM):

The teaching-learning process should be aimed at systematic exposition of basic concepts so as to acquire knowledge of physical sciences in a canonical manner. In this context, applications of physical science and linkage with the theory constitute a vital aspect of the teaching-learning process. The course offers many modes of learning and assessment methods. Students have great freedom of choice of course which they can study. The various components of teaching learning process are summarized in the following heads.

1. **Class room Lectures:** The most common method of imparting knowledge is through lectures. There are diverse modes of delivering lectures such as through blackboard, power point presentation and other technology aided means. A judicious mix of these means is a key aspect of teaching-learning process.
2. **Tutorials:** To reinforce learning, to monitor progress, and to provide a regular pattern of study, tutorials are essential requirements. During these tutorials, difficulties faced by the students in understanding the lectures, are dealt with. Tutorials are also aimed at solving problems associated with the concepts discussed during the lectures.
3. **Practical:** To provide scientific visualization and obtaining results of Physical sciences in practical sessions. These sessions provide vital insights into scientific concepts and draw learner's attention towards limitations of scientific computations. During practical, scientific models arising in real life problems can also be simulated.
4. **Choice based learning/Open elective:** LOCF in this undergraduate programme provides great flexibility both in terms of variety of courses and range of references in each course.
5. **Field based learning:** Students may enhance their knowledge through field based learning while understanding the practical importance.
6. **Textbooks learning:** A large number of books are included in the list of references of each course for enrichment and enhancement of knowledge.
7. **E-learning:** Learner may also access electronic resources and educational websites for better understanding and updating the concepts.
8. **Self-study materials:** Self-study material provided by the teachers is an integral part of learning. It helps in bridging the gaps in the classroom teaching. It also provides scope for teachers to give additional information beyond classroom learning.
9. **Assignment/Problem solving:** Assignments at regular intervals involving applications of theory are necessary to assimilate basic concepts of courses. Hence, it is incumbent on the part of a learner to complete open-ended projects assigned by the teacher.
10. **Internships:** The teaching-learning process needs to be further supported by other activities devoted to subject-specific and interdisciplinary skills, summer and winter internships. During these internships it is expected that a learner will interact with experts and write a report on a topic provided to the learner.
11. **Institute visits:** Institute visit by a learner is also a part of learning process. During such visits a learner has access to knowledge by attending academic activities such as seminars, colloquia, library consultation and discussion with faculty members. These activities provide guidance and direction for further study.
12. **Industrial visits:** Industrial visits offer an opportunity to observe applications of scientific concepts. These visits also give an opportunity to realize the power of mathematical ideas and their translation in problem solving.

13. **Training programmes:** Training programmes organized by various agencies/institutes provide an opportunity to learn various dimensions of courses.