VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

I year

Course code	Fundamentals of Horticulture	L	T	P	C
BAG1022		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Demonstrating fundamental principles of plant growth and development
2. Demonstrating practical applications of horticulture
3. Defining current technologies used in horticultural enterprises

Expected Course Outcome: At the end of the course the student should be able to

1. Comprehend the fundamentals of horticulture in terms of its value
2. Propagate horticultural plants and trees
3. Design orchards and landscapes for architectural firms
4. Decide on the crops, fertilizers and irrigation measures to be followed by farmers
5. Develop career interest in the field of horticulture

Module:1	Horticulture: Scope and Importance	4 hours	CO: 1

Definition, divisions and branches of horticulture. Importance of horticulture in terms of income, employment generation, industry, religious, aesthetic, food, nutritive value and export. Horticultural and botanical classification. Climate and soil for horticultural crops. Influence of environmental factors on horticultural crop production: Temperature, humidity, wind, rainfall and solar radiation. Influence of soil factors: Soil type, pH and EC.

Module:2	Propagating structures and methods	4 hours	CO: 2

Sexual and asexual methods of propagation-seed dormancy and seed germination, stem, leaf and root cuttings, layering, separation, bulbs, corms, division, grafting and budding.

Module:3	Principles of orchard establishment	4 hours	CO: 3

Layout of orchards. Systems of planting. Lawn making, Principles and methods of training and pruning - open center, closed center and modified leader systems. Juvenility and flower bud differentiation: methods for shortening juvenility and bearing habits of fruit trees. Unfruitfulness, pollination, pollinizers and pollinators. Fertilization and parthenocarpy. Medicinal and aromatic plants.

Module:4	Plant bio-regulators and fertilizer application	3 hours	CO: 4

Importance and applications of plant bio-regulators. Irrigation methods - check basin, furrow, ring basin, basin, flood, pitcher, funnel, drip and sprinkler. Fertilizer application methods - broad casting, top dressing, localized placement, contact placement, band placement, row placement, pellet, foliar application, starter solution and fertigation.

Module:5	Contemporary Issues	1 hour	CO: 5

Lecture by Industry Expert

Total Lecture hours:	**16**

List of Experiments		CO: 5
1.	Identification of garden tools.	2.5 hours
2.	Identification of horticultural crops.	5 hours

3.	Preparation of nursery beds- raised and flat beds; sowing of seeds and Seedlings	2.5 hours
4.	Practice of sexual methods of propagation and micropropagation	5 hours
5.	Practice of asexual methods of propagation by divisions, cuttings and Grafting	5 hours
6.	Practice of asexual methods of propagation by budding and layering	5 hours
7.	Training and pruning of fruit trees.	2.5 hours
8.	Layout and planting of orchard (Plan and drawing)	2.5 hours
9.	Preparation of potting mixture, potting and repotting and fertilizer application in different crops	5 hours
10.	Visits to commercial nurseries/orchard	5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Bird. C. 2014. The Fundamentals of Horticulture: Theory and Practice, Royal Horticultural Society, Cambridge University Press, London.
2.	Tiwari, A.K. 2012. Fundamentals of Ornamental Horticulture and Landscape Gardening, New India Pub. Agency, New Delhi, India.
3.	Kumar, N. 2010. Introduction to Horticulture. Oxford &Ibh Publishing Co Pvt Ltd. India.
Reference Books	
1.	Jitendra Singh, 2014. Basic Horticulture. Kalyani Publishers. New Delhi.
2.	Adams, C., Early M., J. Brook And K Bamford. 2014. Principles Of Horticulture: Level 2, 7th Revised Edition., Taylor And Francis, London, UK.
3.	Misra, K.K and R. Kumar. 2014. Fundamentals of Horticulture. Biotech Books, India

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Fundamentals of Plant Biochemistry and Biotechnology	L	T	P	C
BAG1009		2	0	2	3
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on the structure and function of biomolecules
2. Illustrating primary metabolic pathways in plants
3. Describing basic plant biotechnological applications viz., tissue culture, transgenics and marker assisted breeding

Expected Course Outcome: At the end of the course the student should be able to

1. Interpret the importance of biomolecules
2. Describe the role and metabolism of lipids
3. State the structure and functions of nucleic acids
4. Develop interest in micro propagating plants
5. Define biotechnological techniques involved in breeding plants
6. Analyze and interpret biochemical data

Module:1	Biochemical Foundations and Carbohydrates	6 hours	CO: 1

Importance of biochemistry, properties of water, pH and buffer. Carbohydrate: Importance and classification. Structures of monosaccharides, reducing and oxidizing properties of monosaccharides, mutarotation; structure of disaccharides and poly saccharides. Glycolysis, TCA cycle, glyoxylate cycle and electron transport chain.

Module:2	Lipids	4 hours	CO: 2

Importance and classification of lipids; structures and properties of fatty acids. Storage lipids and membrane lipids. Beta oxidation and biosynthesis of fatty acids.

Module:3	Proteins and Nucleic acids	8 hours	CO: 3

Importance of proteins and classification. Structures, titration and zwitterions nature of amino acids. Structural organization of proteins. General properties, classification and mechanism of action of enzymes. Michaelis & Menten and Line Weaver Burk equation & plots. Introduction to allosteric enzymes. Importance and classification of nucleic acid. Structure of nucleotides, A, B & Z DNA; RNA: Types, secondary and tertiary structure.

Module:4	Plant tissue culture and its applications	6 hours	CO: 4

Scope, concepts and applications of plant biotechnology. Totipotency, plasticity and culture types and their applications: organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture. Micro-propagation methods, organogenesis and embryogenesis. Synthetic seeds and their significance; Embryo rescue and its significance; Somatic hybridization and cybrids; Somaclonal variation and its use in crop improvement; Cryo-preservation.

Module:5	Transgenics and marker assisted breeding	6 hours	CO: 5

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.

Module:6	**Contemporary Issues**	**2 hours**	**CO: 1**
Lecture by Industrial Expert			
		Total Lecture hours:	**32**
List of Experiments			**CO: 6**
1.	Preparation of solution, pH & buffers		2.5 hours
2.	Qualitative tests of carbohydrates and amino acids		2.5 hours
3.	Quantitative estimation of glucose/proteins		2.5 hours
4.	Titration methods for estimation of amino acids/lipids		5 hours
5.	Effect of pH, temperature and substrate concentration on enzyme action		5 hours
6.	Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides		5 hours
7.	Sterilization techniques, composition of various tissue culture media and preparation of stock solutions for MS nutrient medium		5 hours
8.	Callus induction from various explants, micro-propagation, hardening and acclimatization		5 hours
9.	Demonstration on isolation of DNA		5 hours
10.	Demonstration of gel electrophoresis techniques and DNA finger printing		5 hours
		Total Laboratory Hours	**40**

Text Books

1.	David L. Nelson and Michael M. Cox. 2017. Lehninger Principles of Biochemistry: International Edition. 7th edition, W.H. Freeman. USA.
2.	Adrian Slater, N W Scott, M Fowler. 2014. Plant Biotechnology: The Genetic Manipulation of Plants, second Edition, Oxford University Press. UK.

Reference Books

1.	Lincoln Taiz, Eduardo Zeiger, Ian M. Moller, and Angus Murphy. 2018. Plant Physiology and Development, International Sixth Edition. Sinauer; Oxford University Press; USA.
2.	Sawhney, S.K. and R. Singh. Introductory Practical Biochemistry. 2014 Reprint. Narosa Publishing House, India.
3.	Michael R. Green and Joseph Sambrook. 2012. Molecular Cloning A Laboratory Manual. 4th edition. Cold Spring Harbor Laboratory Press. USA.
4.	M.K. Razdan. 2014. Introduction to Plant Tissue Culture. 2nd Edition, Oxford and IBH Publishing Company, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test

Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Fundamentals of Soil Science	L	T	P	C
BAG1020		2	0	2	3
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Describing the fundamental concepts of soil science
2. Imparting the knowledge on soil properties, soil water plant relationship and its importance
3. Stating the various aspects of soil science and substantiating through laboratory experiments

Expected Course Outcome: At the end of the course the student should be able to

1. Acquire knowledge on the importance of soil to agriculture
2. Value the physical properties of soil
3. Classify soil type, soil texture and soil structure required for an agricultural field
4. Analyze soil, water and nutrients related to crop growth
5. State techniques to mitigate soil pollution
6. Identify soil related problems in agricultural fields and provide suitable solutions

Module:1	Soil in perspective	6 hours	CO: 1

Soil as a natural body. Pedological and edaphological concepts of soil. Genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation. Soil profile and components of soil.

Module:2	Physical Properties	4 hours	CO: 2

Soil texture, structure, density, porosity, colour, consistency and plasticity.

Module:3	Taxonomy	8 hours	CO: 3

Soil taxonomy classification and soils of India. Soil water retention, movement and availability. Soil air, composition, gaseous exchange, problems and plant growth. Soil temperature: source, amount and flow of heat in soil and its effect on plant growth.

Module:4	Reaction and Colloids	8 hours	CO: 4

Soil pH, acidity, alkalinity, buffering and effect of pH on nutrient availability. Soil colloids: inorganic and organic. Silicate clays: constitution and properties. Sources of charge: ion exchange, cation exchange capacity and base saturation. Soil organic matter: composition, properties and its influence on soil properties. Humic substances - nature and properties.

Module:5	Organisms	4 hours	CO: 5

Macro and micro soil organisms, their beneficial and harmful effects. Soil pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

Module:6	Contemporary Issues	2 hours	CO: 1

Lecture by Industrial Expert

	Total Lecture hours:	**32**
List of Experiments		**CO: 6**
1.	Study of soil profile under field conditions.	2.5 hours
2.	Study of soil sampling tools, collection of representative soil sample, its processing and storage.	5 hours

3.	Study of soil forming rocks and minerals.	2.5 hours
4.	Determination of soil density, moisture content and porosity.	5 hours
5.	Determination of soil texture by feel and Bouyoucos Methods	5 hours
6.	Studies of capillary rise phenomenon of water in soil column and water movement in soil	5 hours
7.	Determination of soil pH, electrical conductivity and cation exchange capacity of soil.	5 hours
8.	Determination of soil colour and estimation of organic matter content of soil.	5 hours
9.	Study of soil map	2.5 hours
10.	Demonstration of heat transfer in soil	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Raymond R. Weil and Nyle C. Brady. 2016. The Nature and Properties of Soils. Pearson, UK.
2.	Biswas. T.D and S.K. Mukherjee. 2017. Text book of Soil Science. 2nd Edition, McGraw-Hill Education. USA.
Reference Books	
1.	HenryD. Foth. 1990. Fundamentalsof Soil Science. 8th Edition. John Wiley& Sons. USA.
2.	Soil Science-An Introduction. 2015. Indian Society of Soil Science. India.
3.	Martin Alexander. 1991. Introduction to Soil Microbiology. 2nd Edition, Krieger pub.Co. USA.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Introduction To Forestry	L	T	P	C
BAG1010		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on the concepts of forestry
2. Describing the techniques of natural and artificial regeneration of forests
3. Discussing the methods of forest mensuration and agroforestry

Expected Course Outcome: At the end of the course the student should be able to

1. Recognize the importance of forestry
2. Explain and appreciate the techniques involved in forest regeneration
3. Describe mensuration techniques to quantify forests data
4. Plan to regenerate a forest
5. Prepare an agroforestry system to support human sustenance

Module:1	Introduction to Forestry	2 hours	CO: 1

Definitions of basic terms related to forestry, objectives of silviculture, forest classification, and salient features of Indian Forest Policies.

Module:2	Regeneration	5 hours	CO: 2

Forest regeneration, Natural regeneration - natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers; Artificial regeneration – objectives, choice between natural and artificial regeneration, essential preliminary considerations. Crown classification. Tending operations – weeding, cleaning, thinning – mechanical, ordinary, crown and advance thinning

Module:3	Mensuration	5 hours	CO: 3

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

Module:4	Agroforestry	3 hours	CO: 4

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

Module:5	Contemporary Issues	1 hour	CO: 1

Lecture by Industrial Expert

Total Lecture hours:	16
List of Experiments	**CO: 5**

1.	Identification of tree-species	5 hours
2.	Diameter measurements using calipers and tape	2.5 hours
3.	Diameter measurements of forked, buttressed, fluted and leaning trees	2.5 hours
4.	Height measurement of standing trees by shadow method and single pole method	5 hours
5.	Height measurement of standing trees by hypsometer	2.5 hours
6.	Volume measurement of logs using various formulae	5 hours
7.	Nursery lay out and seed sowing techniques	5 hours
8.	Vegetative propagation techniques	5 hours
9.	Forest plantations and their management	2.5 hours
10.	Visits of nearby forest based industries	5 hours
	Total Laboratory Hours	**40**

Text Book

1.	Grebner, D.L. and Bettinger, P. and Siry, J.P. 2013. Introduction to Forestry and Natural Resources. Academic Press. USA.
2.	Kershaw, J.A. and Ducey, M.J. and Beers, T.W. and Husch, B. 2016. Forest Mensuration. Wiley. USA.

Reference Books

1.	Nair, P.K.R. and Garrity, D. 2012. Agroforestry - The Future of Global Land Use. Springer Netherlands.
2.	Montagnini, F. and Ashton, M.S. 1999. The Silvicultural Basis For Agroforestry Systems. CRC Press. USA.
3.	Fournier, M.V. 2009. Forest Regeneration: Ecology, Management and Economics. Nova Science. USA.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test

Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Comprehension and Communication Skills in English	L	T	P	C
ENG1010		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Enhancing communication skills in English
2. Developing writing skills and improving vocabulary
3. Imparting knowledge on developing presentation skills

Expected Course Outcome: At the end of the course the student should be able to

1. Analyze grammatical errors
2. Identify correct pronunciation
3. Express writing skills
4. Comprehend the course materials of all courses and improve oral communication skills
5. Demonstrate presentation skills
6. Illustrate communication skills

Module:1	Functional grammar	3 hours	CO: 1

Articles, Prepositions, Verbs, Subject verb Agreement; Transformation and Synthesis.

Module:2	Vocabulary	4 hours	CO: 2

Antonym, Synonym, Homophones, Homonyms, Words often confused; Case Studies – TOEFL and Competitive Exam Papers.

Module:3	Facets of technical written communication	5 hours	CO: 3

The Style: Importance of professional writing; Written Skills - Paragraph writing, Synopsis writing, Precise writing, Report writing and Proposal writing; A Dilemma - A layman looks at science, Raymond B. Fosdick; Preparation of Curriculum Vitae and Job applications.

Module:4	Principles of oral communication	3 hours	CO: 4

Reading Comprehension; Direct and Indirect Narration; You and Your English - Spoken English and broken English, G.B. Shaw; War minus Shooting - The Sporting Spirit; Interviews: kinds, importance and process.

Module:5	Contemporary Issues	1 hour	CO: 5

Lecture by an Expert

	Total Lecture hours:	16
List of Experiments		CO: 6
1.	Listening Comprehension: Listening to short talks, lectures & speeches (scientific, commercial and general in nature).	2.5 hours
2.	Oral Communication: Phonetics, stress and intonation.	2.5 hours
3.	Conversation practice, conversation: rate of speech, clarity of voice	2.5 hours
4.	Conversation practice: Speaking and listening with politeness.	5 hours
5.	Reading skills: Reading dialogues and Rapid reading.	5 hours
6.	Reading skills: Intensive Reading (Skimming & Scanning); Improving reading skill.	5 hours
7.	Mock Interviews: Introduction, practice and testing.	5 hours

8.	Introduction to leadership; Leadership Skills: Testing initiative, intellectual ability and team spirit	5 hours
9.	Introduction to group discussions	2.5 hours
10.	Enrichment of vocabulary based on TOEFL, IELTS, BEC and other	5 hours
	competitive examinations – an introduction and practice.	
	Total Laboratory Hours	**40**

Text Books	
1.	Raymond Murphy. 2015.Essential grammar in use. 3rd edition. Cambridge University Press. UK.
2.	Kenneth Anderson, Joan Maclean, Tony Lynch. 2013. Study Speaking. 2nd Edition. Cambridge University Press, UK.
Reference Books	
1.	Karin Knisely. 2017. A Student Handbook for Writing in Biology. 5th Edition. W. H. Freeman, UK.
2.	Darla-Jean Weatherford. 2016. Technical Writing in Engineering Professions. Tulsa, Oklahoma :PennWell Corp., USA.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

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Course code	Human Values and Ethics	L	T	P	C
BAG1028		1	0	0	1
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

4. Inculcate moral values and ethical standards in students
5. Diffuse knowledge on social and emotional intelligence
6. Appreciate the need and importance of physical, emotional and social heal

Expected Course Outcome: At the end of the course the student should be able to

6. Ability to follow sound morals and ethical values
7. Exhibit mental strength
8. Develop social intelligence
9. Become morally sound and ethically scrupulous
10. Live as good citizens

Module:1	Introduction	4 hours	

Values and ethics: Intrinsic and extrinsic values, norms, morals, goals and missions. Vision of life: principles and philosophies.

Module:2	Self	3 hours	

Self-exploration, self-awareness, self-reflection, process of self-discovery, self-actualization, self-development, self-mastery and self-satisfaction.

Module:3	Process	4 hours	

Decision making. Motivation. Sensitivity. Success. Selfless Service.

Module:4	Case studies	4 hours	

Ethical lives, positive spirit, body, mind and soul. Attachment and detachment. Spirituality Quotient. Examination.

Module:5	Contemporary Issues	1 hour	

Lecture by Industry Expert

Total Lecture hours: 16

Text Books

1. Som Kolekar. 2021. A Compass and Atlas for Life: Self-Exploration, Self-Discovery and Self-Awareness. Notion Press, Chennai, India.
   .
2. Naagarazan, R. S. 2020. A Textbook on Professional Ethics and Human Values. 2020. New Age International Private Limited. Delhi, India.

Reference Books

1. Sarah Banks. 2020. Ethics and Values in Social Work. Practical social work series. Sth Edition. Red Globe Press, UK.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test

Recommended by Board of Studies	29-10-2021		
Approved by Academic Council	No.64	Date	16-12-2021

Course code	Introduction to Aptitude and General Awareness	L	T	P	C
LFS1101		3	0	0	1
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. To enhance the logical reasoning skills of the students and improve the problem- solving abilities
2. To strengthen the ability to solve quantitative aptitude problems
3. To enrich the roots of communication and the basics of grammar
4. To create awareness on the social details of the world

Expected Course Outcome: At the end of the course the student should be able to

1. Learn to solve problems of Quantitative Aptitude confidently
2. Understand all corners of vocabulary and grammar
3. Solve numerical exercises and general reasoning
4. Exhibit competency in general awareness

Module:1	Quantitative ability	13 hours

Percentage: Percentages as Fractions and Decimals Percentage Increase / Decrease, Profit Loss and Discount: Basic terminologies in profit and loss, Problems Based on Ages, .Ratio and Proportion, Mixtures and Solutions Interest Calculation Geometry and Mensuration Word Problems, Speed Maths: Addition and subtraction of bigger numbers Square and square Roots, Cubes and Cube Roots Vedic Maths techniques Multiplication Shortcuts, Multiplication of 3 and higher digit numbers Simplifications, Comparing fractions, Shortcuts to find HCF and LCM Divisibility tests shortcuts.

Module:2	Reasoning ability	7 hours

Series (Number Series and Alpha Series),Coding and Decoding Ordering, Ranking and Grading Puzzles:Sudoku, Mind-bender style word statement puzzles Anagrams, Rebus puzzles Non-Verbal Reasoning Blood Relation, Directions.

Module:3	Verbal ability	8 hours

Parts of speech, Articles: Definite and Indefinite ArticlesOmission of Articles, Subject Verb agreementVocabulary Building, SynonymsAntonymsAnalogy, Degree of Comparison, Miscellaneous, Grammar, (Idioms, Phrasal, Verbs, Collocations, Gerunds, and Infinitives).

Module:4	Current affairs and general knowledge	6 hours

Country Capitals, Currencies - Fields and Awards - General News.

Module:5	Computer awareness	3 hours

Computer-Introduction, Types, Generation, Hardware and Software related Concepts

Module:6	Banking awareness	3 hours

Bank Ancillary Services, Banker and Customer - Negotiable Instrument Act, Principles of Lending - Internet Banking and Mobile Banking.

Module:7	Glossary	3 hours

Banking Terms Glossary

Module:8	**Lessons on excellence**	**2 hours**
Skill Introspection - Skill Acquisition - Consistent Practice		
	Total Lecture hours:	**45**

Text Books	
1.	SMART. (2018). Place Mentor, 1st (Ed.). Chennai: Oxford University Press.
2.	Aggarwal, R.S. (2017). Quantitative Aptitude for Competitive Examinations, 3rd (Ed.). New Delhi: S. Chand Publishing.
3.	FACE. (2016). Aptipedia Aptitude Encyclopedia, 1st (Ed.). New Delhi: Wiley Publications.
Reference Books	
1.	Sharma Arun. (2016). Quantitative Aptitude, 7th (Ed.) Noida: McGraw Hill Education Pvt. Ltd.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and FAT (Computer based)			
Recommended by Board of Studies	29-10-2021		
Approved by Academic Council	No.64	**Date**	16-12-2021

Course code	Fundamentals of Agronomy	L	T	P	C
BAG1013		3	0	2	4
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on different crops, crop nutrition and growth
2. Describing crop-water relations in association to crop growth and development
3. Illustrating crop management, cropping pattern and weed management

Expected Course Outcome: At the end of the course the student should be able to

1. Express knowledge gained on the principles of agronomy
2. Recognize the various nutrients and their effects on plant health
3. Plan irrigation measures for plant growth and development
4. Manage weeds in a field
5. Plan for sustainable agricultural production
6. Apply scientific methods and tools in field preparation and for designing cropping

Module:1	**Agronomy of field preparation**	**6 hours**	**CO: 1**
Agronomy and its scope, seeds and sowing, tillage and tilth, crop density and geometry.			
Module:2	**Crop nutrition**	**6 hours**	**CO: 2**
Crop nutrition, manures and fertilizers and nutrient use efficiency.			
Module:3	**Soil-plant-water-relations**	**9 hours**	**CO: 3**
Water resources, soil-plant-water relationship, crop water requirement, water use efficiency, irrigation-scheduling criteria and methods, quality of irrigation water and logging.			
Module:4	**Weed science**	**8 hours**	**CO: 4**
Weeds-importance, classification, crop weed competition, concepts of weed management principles and methods, herbicides-classification, selectivity, resistance and allelopathy.			
Module:5	**Growth and development of crops**	**7 hours**	**CO: 5**
Growth and development of crops. Factors affecting growth and development; plant ideotypes.			
Module:6	**Cropping pattern**	**6 hours**	**CO: 5**
Crop rotation and its principles; adaptation and distribution of crops.			
Module:7	**Crop management**	**4 hours**	**CO: 5**
Crop management technologies in problematic areas, harvesting and threshing of crops.			
Module:8	**Contemporary issues**	**2 hours**	**CO: 5**
Lecture by Industrial Expert			
		Total Lecture hours:	**48**

List of Experiments		**CO: 6**
1.	Identification of crops and seeds	2.5 hours
2.	Identification of fertilizers, manures and pesticides and methods of application	5 hours
3.	Identification of tillage implements and methods of using – one way plough, reversible plough, harrow, leveler and seed drill	5 hours

4.	Agroclimatic zones in India	2.5 hours
5.	Identification of weeds, herbicides and methods of application	5 hours
6.	Seed germination and viability test	2.5 hours
7.	Yield contributing characters and yield estimation	2.5 hours
8.	Numerical exercises on fertilizer requirement, plant population, herbicide and water requirement	5 hours
9.	Soil moisture measuring devices and measurements of irrigation water	5 hours
10.	Measurement of field capacity, bulk density and infiltration rate	5 hours
	Total Laboratory Hours	**40**

Text Books

1.	Yellamanda Reddy, T. and Sankara Reddy, G.H. 2015. Principles of Agronomy. 1st Edition Kalyani Publishers, Bengaluru.
2.	Reddy, S.R. 2014. Introduction to Agronomy and Principles of Crop Production. 1st Edition, Kalyani Publishers, New Delhi.

Reference Books

1.	Craig C. Sheaffer and Kristine M. Moncada. 2011. Introduction to Agronomy. 2nd Edition, Delmar Cengage Learning, Australia.
2.	ArunKatyayan. 2017. Fundamentals of Agriculture. Volume 1 and 2. Kushal Publications and Distributors, India.
3.	Franeisco J. Villalobos and Elias Fereres. 2016. Principles of Agronomy for Sustainable Agriculture, Springer, Mexico.
4.	Chandrasekaran, B., Annadurai, K. and Somasundaram, E. 2018. A Textbook of Agronomy. New Age International Publishers, New Delhi.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test

Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Introductory Biology	L	T	P	C
BAG1000		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on the mechanisms of natural selection and their impact on evolution
2. Discussing the fundamentals of plant biology and taxonomy
3. Differentiating prokaryotes from eukaryotes

Expected Course Outcome: At the end of the course the student should be able to

1. Compare living organisms
2. Classify and name living beings
3. Describe cell and its division
4. Interpret flowering plants and state the role of animals in agriculture
5. Illustrate theory of life
6. Describe plant organs and gain interest in learning biological sciences

Module:1	Introduction to the living world	4 hours	CO: 1

Characteristics of living things: Growth, development, reproduction, regulation and homoeostasis. Diversity of Life: Major domains/kingdoms- Bacteria (Eubacteria), Archaea (Archebacteria) and Eukarya. Salient features, classification and alternation of generations in Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

Module:2	Origin of Life and nomenclature	4 hours	CO: 2

Theories: Special creation, extra-terrestrial and spontaneous, Miller-Urey's experiment and path of evolution of chemical molecules of living beings. Origin of cells – Endosymbiotic theory and Bubble theory. Theories of evolution. Nomenclature of living beings: Importance of classification and nomenclature, polynomial, binomial and trinomial systems.

Module:3	Cell and Cell Division	3 hours	CO: 3

Cell structure and organization of plants and animals - Cell theory and cell as the basic unit of life. Prokaryotic, plant and animal cell. Mitosis and meiosis.

Module:4	Flowering plants and role of animals in agriculture	4 hours	CO: 4

Roots, Stems, Leaves and their modifications. Types of inflorescences and flowers. Monocots and dicots seeds and their germination. Plant systematics: Brassicaceae, Fabaceae and Poaceae. Animals of draught, milch, meat, fur, wool and manure.

Module:5	Contemporary Issues	1 hour	CO: 5

Visit to a biological museum

	Total Lecture hours:	16
List of Experiments		CO: 6
1.	External morphology and internal anatomy of monocot and dicot roots – Rice, Maize, Brassica and any legume.	5 hours
2.	External morphology and internal anatomy of monocot and dicot stem – Rice, Maize, Brassica and any legume.	5 hours

3.	External morphology and internal anatomy of monocot and dicot leaf – Rice, Maize, Brassica and any legume.	5 hours
4.	Modifications of roots, stems and leaves and fruits	5 hours
5.	Analyzing permanent slides - Parenchyma, collenchyma and sclerenchyma.	2.5 hours
6.	Study of mitosis in onion root tip cells	2.5 hours
7.	Internal anatomy of ovary of monocots and dicots - Any millet and legume.	5 hours
8.	Study on floral biology of an example specimen belonging to Fabaceae family.	5 hours
9.	Study on floral biology of an example specimen belonging to Brassicaceae family.	2.5 hours
10.	Study on floral biology of an example specimen belonging to Poaceae family.	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Raven P, Mason Johnson G.B, Losos, J. B and S.S. Singer. 2013. Biology, 10th edition, McGraw Hill Publications. U.K.
2.	Neil A. Campbell, Urry, L.A., Cain, M.l., Wasserman, S.A., P. V. Minorsky and J.B. Reece. 2018. Biology: A Global Approach, Pearson Education Ltd, Essex, England. UK.
Reference Books	
1.	James D. Mauseth Botany: 2016. An Introduction to Plant Biology. 6th Edition. Jones and Bartlett Learning Inc. Burlington, Wall street, MA, USA.
2.	Bidlack, J., S. Jansky and K. Stern. 2017. Stern's Introductory Plant Biology. 14th edition. McGraw-Hill Publishing Company. UK.
3.	Bidlack, J., S.Jansky and K. Stern. 2017. Laboratory Manual for Stern's Introductory Plant Biology 14th edition. McGraw-Hill Publishing Company, UK.
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test	

Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Elementary Mathematics	L	T	P	C
MAT1000		2	0	0	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Improving the mathematical knowledge of students who have come from a science background
2. Imparting higher secondary level mathematics so that they can understand mathematical formulas applicable for other courses
3. Interlinking mathematics with science

Expected Course Outcome: At the end of the course the student should be able to

1. Device formulas for straight lines
2. Comprehend the use of Slope-Intercept
3. Apply the knowledge gained in designing fields
4. Acquire interest to utilize calculus in agriculture
5. Integrate product of functions and define matrices and determinants
6. Link mathematics with agricultural engineering

Module:1	Straight Lines	4 hours	CO: 1

Distance formula, section formula (internal and external division), change of axes (only origin changed), equation of co-ordinate axes and equation of lines parallel to axes.

Module:2	Slope-Intercept	6 hours	CO: 2

Slope-intercept form of equation of line, slope-point form of equation of line, two point form of equation of line, intercept form of equation of line, normal form of equation of line, general form of equation of line, point of intersection of two straight lines, angles between two straight lines, parallel lines, perpendicular lines, angle of bisectors between two lines, area of triangle and quadrilateral.

Module:3	Circle	6 hours	CO: 3

Equation of circle whose centre and radius is known, general equation of a circle, equation of circle passing through three given points, simple problems on equation of circle whose diameter is the line joining two points (x_1, y_1) & (x_2,y_2), tangent and normal to the given circle at the given point, condition of tangency of a line $y = mx + c$ to the given circle $x^2 + y^2 = a^2$.

Module:4	Differential Calculus	6 hours	CO: 4

Definition of function, limit and continuity. Simple problems on limit and continuity. Differentiation of x^n , e^x , sinx & cos x from first principle, derivatives of sum, difference, product and quotient of two functions, differentiation of functions of functions, logarithmic differentiation, differentiation by substitution method and simple problems based on it. Differentiation of inverse trigonometric functions. Simple problems on Maxima and Minima of the functions of the form y=f (x).

Module:5	Integral Calculus and Matrices and Determinants	8 hours	CO: 5

Integration of simple functions, integration of product of two functions and integration by substitution method. Simple problems on definite Integral and area under simple well-known curves. Definition of matrices, addition, subtraction, multiplication, transpose and inverse up to 3^{rd} order, properties of determinants up to 3^{rd} order and their evaluation.

Module:6	**Contemporary Issues**	**2 hour**	**CO: 6**
Lecture by an expert			
		Total Lecture hours:	**30**

Text Book	
1.	Stroud, K.A.and Dexter J. Booth. 2013. Engineering Mathematics. 7th edition. Industrial Press. USA.
2.	Lewingdon Parsons, G. 2016. Elementary Differential and Integral Calculus. Cambridge University Press Publishing Company, UK
Reference Book	
1.	Grewal, B.S. 2015. Higher engineering mathematics.43rd edition. Khanna Publishers. India.
2.	Aitken, A. C. 2012. Determinants and Matrices. Brousson Press, USA.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Agricultural Heritage	L	T	P	C
BAG1001		1	0	0	1
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Discussing the importance and relevance of agriculture across civilizations
2. Illustrating a lucid picture on Indian agriculture
3. Imparting knowledge on historical best agricultural practices relevant to today's agriculture

Expected Course Outcome: At the end of the course the student should be able to

1. Appreciate agriculture practiced throughout the world
2. Understand the rich agricultural heritage of India
3. Integrate judicious traditional agricultural practices with modern methods
4. Plan on using agricultural resources
5. Comprehend agricultural issues

Module:1	World Agriculture	4 hours	CO: 1

Scope of agriculture; Crop voyage in India and the world; Crop significance and classifications; Past and present status of agriculture and farmers in society.

Module:2	History of Indian Agriculture	4 hours	CO: 2

Introduction of Indian agricultural heritage; Relevance of heritage to present day agriculture; Ancient agricultural practices; Plant production and protection through indigenous traditional knowledge.

Module:3	Trends in Indian Agriculture	4 hours	CO: 3

Journey of Indian agriculture and its development from past to modern era;Current scenario of Indian agriculture; Indian agricultural concerns and future prospects.

Module:4	Indian Agricultural Resources	3 hours	CO: 4

Importance of agriculture and agricultural resources available in India; National agriculture setup in India.

Module:5	Contemporary Issues	1 hour	CO: 5

Lecture by Industrial Expert

Total Lecture hours:	16

Text Books

1. Parviz Koohaf kan and Miguel A. Altieri. 2016. Forgotten Agricultural Heritage: Reconnecting food systems and sustainable development. Taylor & Francis Group. UK.
2. Kumari, D. and M. Veeral. 2012. A Text Book on Agricultural Heritage of India. Agrotech Publishing Academy, Udaipur, India.

Reference Books

1. Jana, B.L.2015. Introductory Agriculture: Ancient Heritage, Agricultural Scenario & Gender Equity in Agriculture. Pointer Publishers, Jaipur, India.
2. Introductory Agriculture 2016. http://www.agrimoon.com/introductory-agriculture-icar-ecourse-pdf-books/

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Rural Sociology and Educational Psychology	L	T	P	C
BAG1026		2	0	0	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Explaining the structure and functioning of rural societies in India
2. Discussing the role of human behavior in effecting constructive changes for rural development
3. Imparting knowledge on education psychology

Expected Course Outcome: At the end of the course the student should be able to

1. Classify rural social groups of India
2. Describe social values
3. Plan social change using agricultural based development programs
4. Assess farmers based on personality determinants
5. Plan to bring in a behavioural change
6. Bring in new extension activities suitable for the society

Module:1	Introduction to sociology	4 hours	CO: 1

Definition and scope of sociology and rural sociology and its significance in agricultural extension. Social groups: classification, factors considered in formation of group.

Module:2	Indian rural society	6 hours	CO: 2

Basis and forms of rural social stratifications. Characteristics and differences between class and caste systems. Culture concept: customs, folkways, mores, taboos and rituals. Social values in rural societies.

Module:3	Social Change & Development	8 hours	CO: 3

Social Institution: family, village panchayat, co-operatives, their functions and significance in agricultural extension. Social organization: types, characteristics and relevance to social institutions. Rural social changes: processes and factors of transformation. Concepts of social ecology and its comparison to traditional rural values. Planned social change: approaches to rural planning and Indian rural development programs (IRDPs). Status and role of women in agriculture and rural development.

Module:4	Educational psychology	6 hours	CO: 4

Meaning, scope and its importance in agricultural extension. Cognitive, affective, psychomotor domains of learning. Intelligence: meaning, factors affecting intelligence.

Module:5	Personality and Behavior	6 hours	CO: 5

Motivation: definition, theories, modes of motivation, relationship of motivation with behavioral trait and humanistic personality patterns. Persistence and changes in personality determinants: physical, intellectual, emotional, social, educational and family.

Module:6	Contemporary Issues	2 hours	CO: 6

Lecture by Industrial Expert

Total Lecture hours:	32

Text Books

1. Chitambar, J.B. 2018. Introductory rural sociology. 3rd edition. New Age International Private Limited, India.

2.	Anita. Woolfolk and VijShivani. 2017. Educational Psychology. 13th edition. Pearson Education, India.
Reference Books	
1.	Bettina B. Bock and Sally Shortall. 2016. Gender and Rural Globalization: International Perspectives on Gender and Rural Development. CABI Publishing, UK.
2.	Ashok K. Singh. 2014**.** Extension Strategies for Agriculture and Rural Development. Daya Publishing House, India.
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test	

Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Fundamentals of Genetics	L	T	P	C
BAG1014		2	0	2	3
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on the fundamental aspects of genetics and its applications
2. Describing cell division and the functions of the genetic material
3. Illustrating the molecular mechanisms of inheritance and gene regulation

Expected Course Outcome: At the end of the course the student should be able to

1. Apply the knowledge gained on inheritance and variation
2. Develop problem-solving skills pertaining to inheritance
3. Relate mutation to evolution and heredity
4. Interpret the functions of genetic material.
5. Solve and analyze problems in basic genetics

Module:1	Principles of inheritance	8 hours	CO: 1

Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity for qualitative traits. Chromosomal theory of inheritance. Dominance relationships and epistatic interactions with examples. Multiple alleles, blood group genetics, pleiotropism and pseudoalleles. Probability and Chi-square.

Module:2	Linkage, quantitative and maternal inheritance	6 hours	CO: 2

Recombination and its estimation, crossing over mechanisms and chromosome mapping. Sex determination, sex linkage, sex limited and sex influenced traits. Quantitative traits, polygenes and continuous variations, multiple factor hypothesis, cytoplasmic inheritance.

Module:3	Chromosome architecture and mutation	8 hours	CO: 3

Chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere. Classification of chromosomes. Special types of chromosomes. Mutation: classification, methods of inducing mutations and CIB technique, mutagenic agents and induction of mutation. Structural and numerical variations in chromosome and their implications. Genetic disorders. Use of haploids, dihaploids and doubled haploids in genetics.

Module:4	Cell cycle	2 hours	CO: 4

Cell division- mitosis and meiosis.

Module:5	Structure and functions of genetic material	6 hours	CO: 4

Nature, structure and replication of genetic material. Protein synthesis, transcription and translational mechanism of genetic material. Gene concept: Gene structure, function and regulation. Lac and Trp operons.

Module:6	Contemporary Issues	2 hours	CO: 1

Lecture by Industrial Expert

	Total Lecture hours:	32

List of Experiments		CO: 5
1.	Principles and handling of microscopes	2.5 hours
2.	Studying the diversity of cells using permanent slides	2.5 hours

3.	Growing root tips of onion and analyzing the mitotic stages.	5 hours
4.	Comparison of various stages of Meiosis I and Meiosis II during microsporogenesis of *Rhoeo discolor*.	5 hours
5.	Analyzing experimental data of monohybrid, dihybrid, trihybrid, test and back cross populations.	5 hours
6.	Identification of inheritance pattern based on offspring data, epistatic interactions and testing discrete ratios by chi-square test	5 hours
7.	Calculating recombination frequencies between traits and construction of chromosomal maps based on two point and three point test cross data	5 hours
8.	Analyzing genetics based experimental data on probability	2.5 hours
9.	Sex linked inheritance in Drosophila	2.5 hours
10.	Study of models on DNA and RNA structures	5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Singh, B.D. 2013. Genetics. 2nd edition. Kalyani Publishers, India.
2.	Arnold Berk , Chris A. Kaiser , Harvey Lodish , Angelika Amon, HiddePloegh, Anthony Bretscher, Monty Krieger, Kelsey C. Martin. 2016. Molecular Cell Biology, 8th edition, W.H. Freeman. USA.
Reference Books	
1.	Gardner, E.J., Simmons, M.J., and Snustad. D.P. 2006. Principles of genetics. 8th edition. Wiley India, India.
2.	Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick. 2017. Lewin's GENES XII. 12th revised edition. Jones and Bartlett Publishers Inc., USA.
3.	David L. Nelson and Michael M. Cox. 2017. Lehninger Principles of Biochemistry: International Edition. 7th edition, W.H. Freeman. USA.
4.	Anthony J.F. Griffiths, Susan R. Wessler, Sean B. Carroll and John Doebley. 2015.Introduction to Genetic Analysis. 11th edition. W.H. Freeman. USA.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Agricultural Microbiology	L	T	P	C
BAG1011		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on the fundamental aspects of agricultural microbiology and introduce them to its applications
2. Describing the relationship between microbes and plants
3. Defining the role of microbes in enhancing the productivity of crops by enriching soil fertility

Expected Course Outcome: At the end of the course the student should be able to

1. Discriminate prokaryotic and eukaryotic microbes
2. Delineate the structure and growth of bacteria
3. Utilize microbes as models to study genetics
4. Use microbes in enriching specific plant nutrients
5. Analyze the ubiquitous nature of microbes inhabiting a wide range of ecological habitats
6. Practice bacterial isolation

Module:1	Microbial World	3 hours	CO: 1

Prokaryotic and eukaryotic microbes.

Module:2	Bacteria	3 hours	CO: 2

Bacterial cell structure, chemoautotrophy, photo autotrophy and growth.

Module:3	Microbial Genetics and Biogeochemical Cycle	4 hours	CO: 3

Genetic recombination – transformation, conjugation and transduction. Plasmids and transposons. Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and Sulphur cycles.

Module:4	Biological Nitrogen Fixation	4 hours	CO: 4

Symbiotic, associative and asymbiotic microbes involved in nitrogen fixation. Azolla, blue green algae and mycorrhiza.Rhizosphere and phyllosphere. Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste.

Module:5	Contemporary Issues	1 hours	CO: 5

Lecture by Industrial Expert

	Total Lecture hours:	16

List of Experiments		CO: 6
1.	Introduction to microbiology laboratory and its equipment's.	2.5 hours
2.	Microscopy: various types, functional parts, principle, resolving power and numerical aperture. Staining and microscopic examination of microbes.	5 hours
3.	Methods of sterilization.	5 hours
4.	Nutritional media and their preparations.	5 hours
5.	Enumeration of microbial population in soil-bacteria, fungi and actinomycetes.	5 hours
6.	Methods of isolation and purification of microbial cultures.	2.5 hours
7.	Isolation of *Rhizobium* from legume root nodule	5 hours
8.	Isolation of *Azotobacter* from soil.	2.5 hours
9.	Isolation of *Azospirillum* from roots	5 hours

10.	Isolation of BGA.	2.5 hours
	Total Laboratory Hours	**40**
Text Books		
1.	Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley and David A. Stahl. 2017. Brock Biology of Microorganisms.15th Edition. Pearson. UK.	
2.	Roger Y. Stanier, John L. Ingraham, Mark L Wheelis and Rage R Painter. 1992. General Microbiology. 5th Edition. Macmillan, Hampshire &London. UK.	
Reference Books		
1.	Bagyaraj D. J. and G.Rangaswami. 2007.Agricultural Microbiology 2nd Edition. PHI Learning Private Limited. India.	
2.	Aneja K.R. 2017.Fundamental Agricultural Microbiology. New Age International Publishers, India.	
3.	Subba Rao, N.S. 2017. Soil Microbiology. 5th Edition(PB),Published by Medtec. University Book Store. New Delhi, India.	
4.	Martin Alexander. 1991. Introduction to Soil Microbiology. 2nd Edition, Krieger pub.Co. USA.	

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Soil and Water Conservation Engineering	L	T	P	C
BAG2009		1	0	2	2
Pre-requisite	None	1.0			

Course Objectives: The course is aimed at

1. Providing knowledge on different surveying methods used in agricultural field
2. Imparting knowledge on the loss of soil and techniques to conserve soil
3. Describing techniques of water harvesting and watershed concepts

Expected Course Outcome: At the end of the course the student should be able to

1. Apply different surveying methods to measure area in agricultural field
2. Determine soil loss for a specific area based on erosivity and erodibility factor
3. Relate different techniques to control wind erosion
4. Apply rain water harvesting methods to conserve water
5. Interpret case studies related to soil and water conservation
6. Design irrigation systems and plan erosion control measures

Module:1	Surveying, soil and water erosion	5 hours	CO: 1

Surveying and leveling: chain, compass, plane table survey, land measurement and computation of area. Simpson's rule and Trapezoidal rule. Soil erosion: causes, effects of soil erosion, geologic and accelerated erosion. Universal soil loss equation. Soil loss measurement techniques. Water erosion: causes, forms, erosivity and erodibility. Mechanics of water erosion: splash, sheet, rill and gully erosion.

Module:2	Erosion control and conservation techniques	5 hours	CO: 2

Biological measures: contour cultivation, strip cropping and cropping systems. Vegetative measures:*23etiver* and other natural grass barriers. Mechanical measures: contour bund, graded bund, broad beds and furrows, basin listing, random tie ridging. Mechanical measures for hill slopes: contour trench, bench terrace, contour stone wall and gully control structures.

Module:3	Wind erosion	3 hours	CO: 3

Factors influencing wind erosion. Mechanics of wind erosion: suspension, saltation and surface creep. Control measures: windbreaks and shelterbelts. Sand dunes and their stabilization.

Module:4	Rain water harvesting	2 hours	CO: 4

In-situ soil moisture conservation: micro catchments and eroded catchments. Roof water harvesting: storage and its use for domestic and groundwater recharge. Farm ponds and percolation ponds. Watershed concept and watershed management.

Module:5	Contemporary Issues	1 hours	CO: 5

Lecture by expert

	Total Lecture hours:	16
List of Experiments		CO: 6
1.	Study of survey instruments-chains, compass, plane table, dumpy level; chains &cross staff survey-linear measurement, plotting & finding areas.	5 hours
2.	Compass survey: observation of bearings, computation angles, radiation and intersection method	5 hours
3.	Leveling: fly levels, determination of difference in elevation	2.5 hours

4.	Calculation of erosion index, estimation and measurement of soil loss	5 hours
5.	Contour maps: Area and volume computations	2.5 hours
6.	Design of grassed water ways and bench terracing system	5 hours
7.	Design of a contour bund and graded bund	2.5 hours
8.	Water flow measurement, water duty and irrigation efficiency	5 hours
9.	Water requirement, agricultural drainage, sprinkler and drip system lay out	5 hours
10.	Problems on wind erosion	2.5 hours
	Total Laboratory Hours	**40**

Text Book

1.	Huffman, Rodney L., Delmar D. Fangmeier, William J. Elliot, and Stephen R. Workman. 2013. Soil and Water Conservation Engineering, 7th edition. American Society of Agricultural Engineers. Michigan, USA.
2.	Khan Towhid Osman. 2013. Soil Degradation, Conservation and Remediation. Springer, Germany.

Reference Books

1.	Ghanashyam Das. 2009. Hydrology and Soil Conservation engineering: Including Watershed Management. Prentice Hall India Learning Private Limited, India.
2.	Gurmail Singh et al., 1990. Manual ofsoil and water Conservation practices in India.Oxford & IBH Publishing Co., New Delhi, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test

Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Fundamentals of Crop Physiology	L	T	P	C
BAG1012		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Instilling information on basic plant physiological functions, processes and its importance in crop production.
2. Infusing knowledge on growth and development, and to make the students understand how knowledge about these concepts has led to improved productivity in modern agriculture.
3. Imparting knowledge on remedy measures involved in solving plant physiological problems.

Expected Course Outcome: At the end of the course the student should be able to

1. Define different physiological process at plant and cellular level
2. Summarize mechanisms of uptake, transport and translocation of water and nutrients
3. Distinguish carbon cycles in plants and define lipid metabolism
4. Relate the importance of growth regulators in plant growth
5. Explain nutrient deficiencies and physiological requirements of plants
6. Interpret and measure plant physiological data

Module:1	Physiology and cell biology of plants	3 hours	CO: 1

Crop physiology and its importance in agriculture. Overview of plant cell: biomembrane, organelles and the cytoskeleton.

Module:2	Absorption of Water, Mineral Nutrition and BNF	4 hours	CO: 2

Active and passive absorption of water. Diffusion and osmosis.Water potential and its importance. Stomatal Physiology, transpiration and water use efficiency. Mengel`s classification of mineral nutrients in plants. Nutrient uptake mechanisms. Functional roles and deficiency symptoms of macro and micro nutrients.

Module:3	Photosynthesis and Lipid Metabolism	4 hours	CO: 3

Photosynthesis: Light and dark reactions - C3, C4 and CAM; Respiration: Glycolysis, TCA cycle and electron transport chain; Fat Metabolism. Fatty acid synthesis and breakdown

Module:4	Plant Growth Regulators and Growth Analysis	4 hours	CO: 4

Auxins, cytokinins, gibberellins, Abscisic acid and ethylene- physiological roles and agricultural uses. Physiological aspects of growth and development of major crops - growth analysis androle of physiological growth parameters in crop productivity.

Module:5	Contemporary Issues	1 hours	CO: 5

Lecture by Industrial Expert

	Total Lecture hours:	**16**
List of Experiments		**CO: 6**
1.	Study of Plant cells; Permanent slide studies on anatomy of C3 and C4 leaves	2.5 hours
2.	Stomatal frequency and index studies.	2.5 hours
3.	Imbibition and Seed germination studies; Demonstration of Osmosis and Plasmolysis.	5 hours
4.	Separation of photosynthetic pigments through paper chromatography.	5 hours

5.	Measurement of root pressure.	2.5 hours
6.	Measurement of absorption spectrum of chloroplastic pigments and fluorescence	5 hours
7.	Measurement of Photosynthesis and respiratory quotient (RQ).	5 hours
8.	Measurement of transpiration and estimation of relative water content	5 hours
9.	Tissue test for mineral nutrients.	5 hours
10.	Measurement of photosynthetic CO_2 assimilation by Infra-Red Gas Analyzer (IRGA).	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Lincoln Taiz, Eduardo Zeiger, Ian M. Moller, and Angus Murphy. 2018. Plant Physiology and Development, International Sixth Edition. Sinauer; Oxford University Press; USA.
2.	Frank B. Salisbury. 2006. Plant physiology. 4th edition. Sinauer Associates, Inc., USA.
Reference Books	
1.	Mohr, H and P. Schopfer. 1995. Plant physiology, Springer-Verlag, Germany.
2.	Buchanan. B. B. 2015. Biochemistry and Molecular Biology of Plants. 2nd Edition. Wiley-Blackwell, USA.
3.	Willey, N. 2016. Environmental Plant Physiology, 1st Edition, Garland Science, Taylor and Francis Group, LLC, UK.
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test	

Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Fundamentals of Agricultural Economics	L	T	P	C
BAG1017		2	0	0	2
Pre-requisite	None	Syllabus version			

Course Objectives: The course is aimed at

1. Imparting knowledge on the basics of economics.
2. Explaining on the factors of production and economy.
3. Enhancing the ability of analyzing economic models to facilitate creation of innovative ideas.

Expected Course Outcome: At the end of the course the student should be able to

1. Apply the knowledge gained on the fundamentals of economics
2. Employ agricultural economic applications
3. Practice applying mathematical models to agro-economics
4. Interpret market structures responsible for creating national income
5. Analyze agro economic growth and develop policies
6. Integrate agro-economic knowledge with real time application

Module:1	Economics	6 hours	CO: 1

Meaning, scope and subject matter. Definitions, activities and approaches to economic analysis. Micro and macroeconomics, positive and normative analysis. Nature of economic theory. Rationality assumption and 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.

Module:2	Agricultural Economics	2 hours	CO: 2

Meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country.

Module:3	Demand, production, returns, cost and supply	8 hours	CO: 3

Demand: meaning, law of demand, schedule and demand curve, determinants, utility theory, law of diminishing marginal utility and equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve and concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Production: process, creation of utility, factors of production, input output relationship. *Laws of returns*: Law of variable proportions and law of returns to scale. *Cost:* concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, schedule, supply curve, determinants of supply and elasticity of supply.

Module:4	Market structure and National Income	6 hours	CO: 4

Meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points. Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit. Meaning and importance of national income, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement.

Module:5	Population, money, banking, finance, tax and economic systems	8 hours	CO: 5

Importance of population. 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. Banking: Role in modern economy, types of banks, functions of commercial and central bank and 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 and VAT. *Economic systems:* Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies and elements of economic planning.			
Module:6	**Contemporary Issues**	**2 hours**	**CO: 6**
Lecture by Industrial Expert			
		Total Lecture hours:	**32**
Text Book			
1	Andrew Barkley and Paul W. Barkley. 2013. Principles of Agricultural Economics. Routledge, Taylor and Francis Group, New York, USA.		
2.	Amarjit Singh, A.N. Sadhu and Jasbir Singh. 2016. Fundamentals of Agricultural Economics. Himalaya Publishing House, India.		
Reference Books			
1.	Edwin Griswold Nourse. 2017.Agricultural Economics: A Selection of Materials in Which Economic Principles Are Applied to the Practice of Agriculture. CHIZINE PUBN. Canada.		
2.	Thomas Sowell. 2010. Basic Economics 4th Edition: A Common Sense Guide to the Economy. Blackstone Audio, Inc., Unabridged edition. USA.		
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Fundamentals of Plant Pathology	L	T	P	C
BAG1019		3	0	2	4
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on importance of plant diseases, pathogens and development of plant diseases, disease cycle, physiology of pathogens and plant defense
2. Describing epidemiology of plant diseases and strategies for management
3. Explaining morphology, vegetative, reproductive structures and resting structures of fungi, bacteria, nematodes and other plant pathogens.

Expected Course Outcome: At the end of the course the student should be able to

1. Recognize the importance and scope of plant pathology and analyze the causes and factors leading to pathogenesis
2. Classify pathogens taxonomically for designing effective disease management strategies
3. Differentiate plant pathogens based on morphology, vegetative, reproductive and resting structures.
4. Relate disease cycles, physiology of pathogens and plant defense
5. Describe epidemiology of plant diseases and strategies for disease management
6. Practice identifying and controlling pathogens

Module:1	Importance of plant diseases	4 hours	CO: 1

Importance,scope and objectives of plant pathology. History of plant pathology with special reference to Indian work. Terms and concepts in Plant Pathology.

Module:2	Plant pathogenesis	6 hours	CO: 1

Causes and factors affecting disease development: disease triangle and tetrahedron and classification of plant diseases.

Module:3	Plant pathogenic organisms	6 hours	CO: 2

Important groups**:** fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them.

Module:4	Fungal pathogens, diseases and symptoms	6 hours	CO: 3

General characters and 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.

Module:5	Bacteria, viruses and nematodes	6 hours	CO: 3

General morphological characters, basic methods of methods of classification and reproduction. Nature, structure, replication and transmission of viruses. Study of phanerogamic plant parasites. General morphology, reproduction, classification, symptoms and nature of damage caused by plant nematodes (*Heterodera, Meloidogyne*, *Anguinaand Radopholus*).

Module:6	Disease cycle, physiology and plant defense	8 hours	CO: 4

Growth and reproduction of plant pathogens. Liberation or dispersal and survival of plant pathogens. Types of parasitism and variability in plant pathogens. Pathogenesis. Role of enzymes, toxins and growth regulators in disease development. Defense mechanism in plants.			
Module:7	**Epidemiology and principles of disease management**	**6 hours**	**CO: 5**
Factors affecting disease development. Principles and methods of plant disease management. Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.			
Module:8	**Contemporary issues**	**2 hours**	**CO: 1**
Lecture by Industrial Expert			
Total Lecture hours:			**48**
List of Experiments			**CO: 6**
1.	Acquaintance with various laboratory equipments and microscopy.		2.5 hours
2.	Collection and preservation of disease specimen.		2.5 hours
3.	Preparation of media, isolation and Koch's postulates.		5 hours
4.	Identification of different fungi and bacteria – staining methods.		5 hours
5.	Identification of symptoms of various plant diseases.		5 hours
6.	Transmission of plant viruses and study of phanerogamic plant parasites.		5 hours
7.	Morphological features and identification of plant parasitic nematodes.		2.5 hours
8.	Sampling, extraction and nematode mounting from soil and plants.		5 hours
9.	Study of fungicides, formulations and biological control agents.		2.5 hours
10.	Methods of fungicide and biocontrol applications, safety and calculation of spray concentrations.		5 hours
Total Laboratory Hours			**40**
Text Books			
1.	Singh, R.S. 2017. Introduction to Principles of Plant Pathology. 5th Edition, MedTech Publishers, India.		
2.	Mehrotra, R.S. and A. Aggarwal. 2017. Plant Pathology. 3rd Edition, Tata McGraw Hill Publishing Co Ltd., India.		
Reference Books			
1.	Bhattacharya, U.K. 2017. Plant Pathology at a Glance. 1st Edition, Kalyani Publishers, India.		
2.	Aneja, K.R. 2015. An Introduction to Mycology. 2nd Edition, New Age International Pvt. Ltd., Chennai, India.		
3.	Narayanasamy, P. 2017. Microbial Plant Pathogens: Detection and Management in Seeds and Propagules. Wiley-Blackwell. New Jersey, USA.		
4.	Lacomme, C. 2015. Plant Pathology Techniques and Protocols. Humana Press, New York, USA.		
5.	Singh, R.S. 2017. Plant Diseases. 10th Edition, MedTech Publishers, India.		
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Fundamentals of Entomology	L	T	P	C
BAG1021		3	0	2	4
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Providing deeper understanding on the biology of insects
2. Imparting knowledge on historical evolutionary relationships of insect orders and families
3. Describing insect life cycle, morphology and adaptation to a wide variety of natural environments by taking students on field trips and collecting insects

Expected Course Outcome: At the end of the course the student should be able to

1. Express knowledge gained on the historic contributions of eminent scientists in the field of entomology and fascinating facts about insects
2. Describe insect's anatomy and morphology
3. Infer biochemical and physiological processes governing insect metabolism, growth, and form
4. Relate ecological relationships of insects with other life forms
5. Devise pest control measures
6. Identify insects based on their key taxonomic characters

Module:1	History and Importance of Insecta	4 hours	CO: 1

History of Entomology in India: Contributions of eminent entomologists, locations and year of establishment of entomological institutions. Major points related to dominance of Insecta in animal kingdom. Contributory factors for abundance of insects-structural, developmental and protective characters and construction of protected niches of Insecta.

Module:2	Phylum Arthropoda: Classification and Morphology	6 hours	CO: 2

Classification of phylum Arthropoda up to classes. Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, wing venation, modifications and wing coupling apparatus.

Module:3	Metamorphosis and Organ Systems	8 hours	CO: 3

Metamorphosis and diapause in insects. Types of larvae and pupae. Structure of male and female genital organ. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs like simple and compound eyes, chemoreceptor.

Module:4	Insect Ecology	4 hours	CO: 4

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

Module:5	IPM and classification of Insecticides	8 hours	CO: 5

Categories of pests. Concept of IPM. Practices, scope and limitations of IPM. Classification, formulations and toxicity of insecticides. Chemical control, importance, hazards and limitations. Recent methods of pest control, repellents, anti-feedants, hormones, attractants, gamma radiation. Insecticides Act 1968- Important provisions. Application techniques of spray fluids. Symptoms of poisoning, first aid and antidotes.			
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Module:6	**Insect Systematics I**	**8 hours**	**CO: 6**
Taxonomy, importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta upto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae;			
Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera. Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae.			
Module:7	**Insect Systematics II**	**8 hours**	**CO: 6**
Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera:Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae,Muscidae, Tephritidae.			
Module:8	**Contemporary Issues**	**2 hours**	**CO: 1**
Visit to an insect Museum / Lecture by Industrial Expert			
		Total Lecture hours:	**48**
List of Experiments			**CO:2,3, 5,6**
1.	Methods of collection and preservation of insects including immature stages		2.5 hours
2.	External features of Grasshopper / Blister beetle; Study of different types of insect antennae and legs		5 hours
3.	Study of types of mouthparts – biting and chewing, piercing and sucking, rasping and sucking, chewing and lapping, sponging and siphoning		2.5 hours
4.	Study of wing venation, types of wings and wing coupling mechanisms; Study of different types of insect larva and pupa		5 hours
5.	Dissection of digestive system in insects (Grasshopper)		2.5 hours
6.	Dissection of female and male reproductive systems in insects (Grasshopper)		2.5 hours
7.	Study of characters of Orders and their families of agricultural importance - Orthoptera, Dictyoptera, Odonata, Neuroptera, Isoptera and Lepidoptera		7.5 hours
8.	Study of characters of Orders and their families of agricultural importance - Thysanoptera, Hemiptera and its sub order Heteroptera, Coleoptera, Diptera and Hymenoptera		7.5 hours
9.	Sampling techniques for estimation of insect population and damage		2.5 hours
10.	Insecticides and their formulations. Pesticide appliances and their maintenance.		2.5 hours
		Total Laboratory Hours	**40**
Text Books			
1.	Chapman, R. F. 2012. Insects: Structure and Function. Ed by Simpson, S. J. and Douglas, A. C. Cambridge Univ. Press, UK.		

2.	Wigglesworth, V.B. 2013. Insect Physiology. Springer, Netherlands (Originally published by Chapman and Hall, London, 1974).
Reference Books	
1.	Timbhare, D.B. 2015. Modern Entomology, Himalaya Publishing House. India.
2.	Vasantharaj David, B. and Rama Murthy V.V. 2016. Elements of Economic Entomology, Popular Book Depot, Coimbatore, India.
3.	Dhaliwal, G.S. and Ramesh Arora. 2014. Integrated Pest Management: Concepts and Approaches, Kalyani Publishers, Ludhiana, India.
4.	Vasantharaj David, B and Aanathakrishnan, T.N. 2013. General and Applied Entomology. Tata McGraw-Hill Publishing House, New Delhi, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Fundamentals of Agricultural Extension Education	L	T	P	C
BAG1023		2	0	2	3
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Providing information on the concepts of agricultural extension education and development programmes offered in India
2. Imparting knowledge on rural development, leadership, technology transfer, extension teaching, agricultural journalism and effective communication through media
3. Discussing on extension programme monitoring and evaluation.

Expected Course Outcome: At the end of the course the student should be able to

1. Realize the necessity of agricultural extension for rural development
2. Acquire knowledge on extension systems in India
3. Devise plans for rural community development; plan and evaluate an extension programme
4. Transfer technology and innovations towards agricultural development
5. Develop interest in agricultural journalism
6. Disseminate information and technology through audio visual aids

Module:1	Extension education	4 hours	CO: 1

Meaning and definition of education and its types; meaning of extension education, definition, scope, process, objectives and principles. Meaning, process, principles and steps in extension programme planning and development.

Module:2	Indian extension systems, developments and new trends	6 hours	CO: 2

Extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme and Gurgaon Experiment) and post-independence era (Etawah Pilot Project andNilokheri Experiment). Agricultural development programmes launched by ICAR/ Government of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP and NAIP). Privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension and expert systems.

Module:3	Rural and Community Development	8 hours	CO: 3

Concept, meaning and definition of rural development and various rural development programmes launched by Government of India. Meaning, definition, concept, principles and philosophy of community development. Concept, definition and types of leaders in rural context. Meaning, concept, principles and functions of extension administration. Concept, definition, monitoring and evaluation of extension programmes.

Module:4	Teaching, communication and transfer of technology	8 hours	CO: 4

Extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and Social Media), media mix strategies. Meaning, definition, principles, functions and barriers of communication. Concept and models in technology transfer and capacity building of extension personnel.

Module:5	Journalism and disseminating innovation	4 hours	CO: 5

Agricultural journalism; Diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

Module:6	Contemporary Issues	2 hours	CO: 1

Lecture by Industrial Expert		
	Total Lecture hours:	**32**
List of Experiments		**CO: 3, 6**
1.	To get acquainted with university extension system	2.5 hours
2.	Group discussion- exercise; handling and use of audio visual equipments and digital camera and LCD projector	5 hours
3.	Preparation and use of AV aids	2.5 hours
4.	Preparation of extension literature – leaflet, booklet, folder, pamphlet news stories and success stories	2.5 hours
5.	Presentation skills exercise; micro teaching exercise	5 hours
6.	A visit to village to understand the problems being encountered by the villagers/ farmers	5 hours
7.	To study the organization and functioning of DRDA and other development departments at district level	5 hours
8.	Visit to a NGO and learning from their experience in rural development	5 hours
9.	Understanding PRA techniques and their application in village development planning	2.5 hours
10.	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	5 hours
	Total Laboratory Hours	**40**
Text Books		
1.	Satyanarayana, G. and S, M.H. 2012. Rural Development and Poverty Alleviation in India: Policies and Programmes. New Century Publications. India.	
2.	Gupta, K.R. 2010. Rural Development in India. Atlantic. India.	
Reference Books		
1.	Rao, N.G.P. and Perumal, N. and Ghosal, S.L. and Arora, S.K. 1997. Training for Agricultural Development: (study Commissioned by the Government of India). Allied Publishers and Manage. India.	
2.	Jana, B.L. 2014.Agricultural Journalism. AgroTech Publishing Academy. India.	
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test		
Recommended by Board of Studies	05-03-2019	
Approved by Academic Council	No.54	**Date** 14-03-2019

Course code	NSS/NCC/Physical Education & Yoga Practices	L	T	P	C
EXC1188/ EXC1189/ EXC1190		0	0	4	2
Pre-requisite	None	Syllabus version			

Course Objectives: The course is aimed at

1. Evoking social consciousness among students through various working together activities and constructive and creative social work
2. Imparting knowledge on executing democratic leadership, programme development and self-employment
3. Reducing the gap between the educated and uneducated and increase awareness and desire to help sections of society

Expected Course Outcome: At the end of the course the student should be able to

1. Infer physical and mental discipline
2. Practice the gained skills to stay physically fit
3. Develop stamina and improve health and hygiene
4. Improve inter personal skills and work well in a group
5. Develop self-confidence
6. Plan in achieving goals

EXC1188	NSS	Semester I, II, III and IV

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

Introduction and basic components of NSS: Orientation NSS programmes and activities, Understanding youth Community mobilization, Social harmony and national integration Volunteerism and shramdan, Citizenship, constitution and human rights Family and society Importance and role of youth ,Life competencies, Youth development programmes Health, hygiene and sanitation, Youth health, lifestyle, HIV AIDS and first aid Youth and yoga

Vocational skill development, Issues related environment Disaster management Entrepreneurship development, Formulation of production oriented project Documentation and data reporting Resource mobilization, Additional life skills, Activities directed by the Central and State Government, All the activities related to the National Service Scheme course is distributed under four different courses viz., National Service Scheme I, National Service Scheme II, National Service Scheme III and National Service Scheme IV each having one credit load. The entire four courses should be offered continuously for two years.

A student enrolled in NSS course should put in at least 60 hours of social work in different activities in a semester other than five regular one day camp in a year and one special camp for duration of 7 days at any semester break period in the two year. Different activities will include orientation lectures and practical works. Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction.

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

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

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

Understanding youth - Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change
Community mobilization - Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilisation involving youth-adult partnership
Social harmony and national integration - Indian history and culture, role of youth in nation building, conflict resolution and peace building
Volunteerism and shramdan - Indian tradition of volunteerism, its need, importance, motivation and constraints; shramdan as part of volunteerism
Citizenship, constitution and human rights - Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information
Family and society - Concept of family, community (PRIs and other community based organisations) and society

Semester II : National Service Scheme II
Importance and role of youth leadership - Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership
Life competencies - Definition and importance of life competencies, problem-solving and decision-making, inter personal communication
Youth development programmes - Development of youth programmes and policy at the national level, state level and voluntary sector; youth-focused and youth-led organisations
Health, hygiene and sanitation - Definition needs and scope of health education; role of food, nutrition, safe drinking water, water born diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programmes and reproductive health.
Youth health, lifestyle, HIV AIDS and first aid - Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid
Youth and yoga - History, philosophy, concept, myths and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method

Semester III : National Service Scheme III

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

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

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

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

Formulation of production oriented project- Planning, implementation, management and impact assessment of project

Documentation and data reporting - Collection and analysis of data, documentation and dissemination of project reports

Semester IV: National Service Scheme IV

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

Civil/self defence - Civil defence services, aims and objectives of civil defence; needs and training of self defence
Resource mobilisation - Writing a project proposal of self-fund units (SFUs) and its establishment
Additional life skills - Positive thinking, self-confidence and esteem, setting life goals and working to achieve them, management of stress including time management.

EXC1189	**NCC**	**Semester I and II**

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

Semester II: National Cadet Corps
Arms Drill- Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out.
Ground/take up arms, examine arms.
Shoulder from the order and vice-versa, present from the order and vice-versa.
Saluting at the shoulder at the halt and on the march. Short/long trail from the order and vice-versa.
Guard mounting, guard of honour, Platoon/Coy Drill.
Characteristics of rifle (.22/.303/SLR), ammunition, fire power, stripping, assembling, care, cleaning and sight setting.
Loading, cocking and unloading. The lying position and holding.
Trigger control and firing a shot. Range Procedure and safety precautions. Aiming and alteration of sight.
Theory of groups and snap shooting. Firing at moving targets. Miniature range firing.

Characteristics of Carbine and LMG.
. Introduction to map, scales and conventional signs. Topographical forms and technical terms.
. The grid system. Relief, contours and gradients. Cardinal points and finding north. Types of bearings and use of service protractor.
. Prismatic compass and its use. Setting a map, finding north and own position. Map to ground and ground to map.
. Knots and lashings, Camouflage and concealment, Explosives and IEDs.
. Field defenses obstacles, mines and mine lying. Bridging, waterman ship
. Field water supplies, tracks and their construction.
. Nuclear, Chemical and Biological Warfare (NCBW)
. Judging distance. Description of ground and indication of landmarks.
. Recognition and description of target. Observation and concealment. Field signals. Section formations.
. Fire control orders. Fire and movement. Movement with/without arms. Section battle drill.
. Types of communication, media, latest trends and developments.
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EXC1190	Physical Education and Yoga Practices	Semester I and II

Semester I: Physical Education and Yoga Practices

Teaching of skills of Football – demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit)
Teaching of different skills of Football – demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit)
Teaching of advance skills of Football – involvement of all the skills in game situation with teaching of rules of the game
Teaching of skills of Basketball – demonstration, practice of the skills, correction of skills, involvement in game situation
Teaching of skills of Basketball – demonstration, practice of the skills, involvement in game situation
Teaching of skills of Basketball – involvement of all the skills in game situation with teaching of rule of the game
Teaching of skills of Kabaddi – demonstration, practice of the skills, correction of skills, involvement in game situation
Teaching of skills of Kabaddi – demonstration, practice of the skills, correction of skills, involvement in game situation
Teaching of advance skills of Kabaddi – involvement of all the skills in game situation with teaching of rule of the game
. Teaching of skills of Ball Badminton – demonstration, practice of the skills, correction of skills, involvement in game situation
. Teaching of skills of Ball Badminton – involvement of all the skills in game situation with teaching of rule of the game
. Teaching of some of Asanas – demonstration, practice, correction and practice
. Teaching of some more of Asanas – demonstration, practice, correction and practice
. Teaching of skills of Table Tennis – demonstration, practice of skills, correction and practice and involvement in game situation
. Teaching of skills of Table Tennis – demonstration, practice of skills, correction and practice and involvement in game situation
. Teaching of skills of Table Tennis – involvement of all the skills in game situation with teaching of rule of the game

. Teaching – Meaning, Scope and importance of Physical Education . Teaching – Definition, Type of Tournaments . Teaching – Physical Fitness and Health Education . Construction and laying out of the track and field (*The girls will have Tennikoit and Throw Ball).
Semester II: Physical Education and Yoga Practices Teaching of skills of Hockey – demonstration practice of the skills and correction. Teaching of skills of Hockey – demonstration practice of the skills and correction. And involvement of skills in games situation Teaching of advance skills of Hockey – demonstration practice of the skills and correction. Involvement of all the skills in games situation with teaching of rules of the game Teaching of skills of Kho-Kho – demonstration practice of the skills and correction. Teaching of skills of Kho-Kho – demonstration practice of the skills and correction. Involvement of the skills in games situation Teaching of advance skills of Kho-Kho – demonstration practice of the skills and correction. Involvement of all the skills in games situation with teaching of rules of the game Teaching of different track events – demonstration practice of the skills and correction. Teaching of different track events – demonstration practice of the skills and correction. Teaching of different track events – demonstration practice of the skills and correction with competition among them. . Teaching of different field events – demonstration practice of the skills and correction. . Teaching of different field events – demonstration practice of the skills and correction. . Teaching of different field events – demonstration practice of the skills and correction. . Teaching of different field events – demonstration practice of the skills and correction with competition among them. . Teaching of different asanas – demonstration practice and correction. . Teaching of different asanas – demonstration practice and correction. . Teaching of different asanas – demonstration practice and correction. . Teaching of different asanas – demonstration practice and correction. . Teaching of weight training – demonstration practice and correction. . Teaching of circuit training – demonstration practice and correction. . Teaching of calisthenics – demonstration practice and correction. **Note: 1)** Compulsory Uniform: Half pants, Tee Shirts, Shoes and socks all white (Girls will have white Tee Shirt and Track pants) 2) The games mentioned in the practical may be inter changed depending on the season and facilities.

Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

II Year

Course code	Crop Production Technology –I (Kharif Crops)	L	T	P	C
BAG 2001		1	0	2	2
Pre-requisite	Fundamentals of Agronomy	Syllabus version			
BAG1013					

Course Objectives: The course is aimed at

1. Imparting the fundamentals of crop production technology of kharif crops
2. Demonstrating practical applications of crop production
3. Providing knowledge on the importance and practices followed in growing kharif crops

Expected Course Outcome: At the end of the course the student should be able to

1. Comprehend the fundamentals of crop production of cereals
2. Decide on the crops, fertilizers and irrigation measures for production of pulses
3. Plan for sustainable crop production of oilseeds
4. Explain the techniques involved in crop production of fibre and forage crops
5. Correlate parameters involved in crop cultivationand practice kharif crop cultivation

Module:1	Cereals	4 hours	CO: 1

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of rice, maize, sorghum, pearl millet and finger millet.

Module:2	Pulses	4 hours	CO: 2

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of pigeonpea, mungbean and urdbean.

Module:3	Oil seeds	4 hours	CO: 3

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of groundnut and soybean.

Module:4	Fibre crops and Forage crops	2 hours	CO: 4

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield ofcotton, jute, sorghum, cowpea, cluster bean and napier.

Module:5	Contemporary Issues	2 hours	CO: 5

Lecture by Industrial Expert

Total Lecture hours:	16

List of Experiments		CO: 5
1.	Rice nursery preparation	2.5 hours
2.	Transplanting of rice	2.5 hours
3.	Sowing of soybean, pigeonpea, mungbean, maize, groundnut and cotton	5 hours
4.	Effect of seed size on germination and seedling vigour of kharif season crops	2.5 hours
5.	Effect of sowing depth on germination of kharif crops	2.5 hours
6.	Identification of weeds in kharif season crops; Top dressing and foliar feeding of nutrients	5 hours
7.	Study of yield contributing characters and yield calculation of kharif season crops	5 hours
8.	Study of crop varieties and important agronomic experiments at experimental farm	5 hours
9.	Study of forage experiments, morphological description of kharif season crops	5 hours
10.	Visit to research centres of related crops.	5 hours
	Total Laboratory Hours	**40**

Text Book	
1.	Tomar, G.S.,S.K. TaunkandJ.L. Choudhary. 2011. Science of Crop Production PART-1 (Kharif Crops). Kushal Publications and Distributors, India.
2.	Rajendra Prasad. 2017.Textbook of field crops production, Volume 1 and 2 (Foodgrain crops & Commercial Crops). ICAR, India.

Reference Books	
1.	Joshi M. 2015. Textbook of Field Crops. Prentice Hall India Learning Private Limited, India.
2.	Reddy, S.R and ReddiRamu Y. 2016. Agronomy of Field Crops. 5th edition. Kalyani Publishers, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Fundaments of Plant Breeding	L	T	P	C
BAG1015		2	0	2	3
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Describing the importance of plant breeding
2. Imparting knowledge on means of exploiting plants through breeding
3. Introducing the role of biotechnology and IPR in crop improvement

Expected Course Outcome: At the end of the course the student should be able to

1. Understand how humans have flourished due to breeding and domestication of plants
2. Correlate the genetics behind breeding of crops
3. Comprehend breeding of crops
4. Exploit crops to express hybrid vigour
5. Realize the necessity of protecting farmers and breeders rights
6. Practice hybridisation and plan breeding experiments

Module:1	Introduction to Plant Breeding	4 hours	CO: 1

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Domestication, acclimatization and plant introduction. Centres of origin.

Module:2	Genetic basis	6 hours	CO: 2

Genetics in relation to plant breeding, modes of reproduction, apomixes, self-incompatibility, genetic consequences of male sterility and cultivar options. Components of genetic variation, heritability and genetic advance. Concepts of population genetics and Hardy-Weinberg Law.

Module:3	Breeding of pollinated and asexually propagated crops	8 hours	CO: 3

Mass and pure line selection, hybridization techniques and handling of segregating population. Multiline concept. Modes of selection. Population improvement Schemes: Ear to row method, Modified Ear to Row and recurrent selection schemes. Clonal selection and hybridization. Maintenance of breeding records and data collection.

Module:4	Heterosis	7 hours	CO: 4

Heterosis and inbreeding depression. Development of inbred lines, hybrids, composite and synthetic varieties. Wide hybridization and pre-breeding. Polyploidy in relation to plant breeding. Mutation breeding methods and uses. Breeding for important biotic and abiotic stresses.

Module:5	Biotechnology and IPR in Crop Improvement	5 hours	CO: 5

DNA markers and marker assisted selection. Participatory plant breeding. Intellectual Property Rights and patenting. Plant Breeders and & Farmer's Rights.

Module:6	Contemporary Issues	2 hours	CO: 4,5

Lecture by Industrial Expert

Total Lecture hours:	32
List of Experiments	CO: 6

1.	Plant Breeder's kit, Study of germplasm of various crops.	5 hours
2.	Study of floral structure of self-pollinated and cross pollinated crops.	5 hours
3.	Emasculation and hybridization techniques in self & cross pollinated crops.	5 hours
4.	Consequences of inbreeding on genetic structure of resulting populations.	5 hours
5.	Study of male sterility system.	5 hours
6.	Handling of segregation populations.	2.5 hours
7.	Methods of calculating mean, range, variance, standard deviation, heritability.	2.5 hours
8.	Designs used in plant breeding experiments, analysis of Randomized Block Design.	5 hours
9.	To work out the mode of pollination in a given crop and extent of natural out-crossing.	2.5 hours
10.	Prediction of performance of double cross hybrids.	2.5 hours
Total Laboratory Hours		**40**
Text Books		
1.	Singh, B.D. 2018. Plant Breeding principles and methods. Kalyani Publishers, India.	
2.	Phundan Singh. 2015. Essentials of Plant Breeding. Kalyani Publishers, India.	
Reference Books		
1.	George Acquaah. 2012. Principles of Plant Genetics and Breeding, 2nd Edition. Wiley-Blackwell, USA.	
2.	Yunbi Xu. 2012. Molecular Plant Breeding. CABI Publishing, UK.	
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test		
Recommended by Board of Studies	05-03-2019	
Approved by Academic Council	No.54	**Date** 14-03-2019

Course code	Agricultural Finance and Co-operation	L	T	P	C
BAG2010		2	0	2	3
Pre-requisite	Fundamentals of Agricultural Economics	Syllabus version			
BAG1017		1.0			

Course Objectives: The course is aimed at

1. Explaining the principles of agricultural finance and co-operation
2. Demonstrating the role of Indian institutions involved in farm financing
3. Outlining Indian co-operative credit movement and credit structures

Expected Course Outcome: At the end of the course the student should be able to

1. Explain on agricultural finance and credit.
2. Comprehend the role of sources involved in farm financing.
3. Assess financial statements and project reports
4. Describe the functionalities of co-operatives involved in farmers service
5. Clarify the role of national level cooperatives
6. Analyze the functions of a financial institute

Module:1	Agricultural Finance	6 hours	CO: 1

Meaning, scope, nature and significance. Credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need and classification. Credit analysis: 4 R's, and 3C's of credits.

Module:2	Sources of Agricultural finance	6 hours	CO: 2

Institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks. Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India.

Module:3	Agricultural credit	6 hours	CO: 3

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.

Module:4	Agricultural Co-operation	8 hours	CO: 4

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

Module:5	National level cooperatives	4 hours	CO: 5

Role of Indian Commerce Association, National Cooperative Union of India, National Cooperative Development Corporation and National Agricultural Cooperative Marketing Federation of India.

Module:6	Contemporary Issues	2 hours	CO: 1

Lecture by Industrial Expert

	Total Lecture hours:	**32**
List of Experiments		**CO: 6**
1.	Determination of the most profitable level of capital use. Optimum allocation of limited amount of capital among different enterprise.	5 hours
2.	Analysis of progress and performance of cooperatives using published data.	2.5 hours
3.	Analysis of progress and performance of commercial banks and RRBs using published data.	5 hours
4.	Visit to a commercial bank, cooperative bank and cooperative society to acquire firsthand knowledge of their management, schemes and procedures.	5 hours
5.	Estimation of credit requirement of farm business – A case study.	2.5 hours
6.	Preparation and analysis of balance sheet and income statement – A case study.	hours
7.	Appraisal of a loan proposal – A case study.	2.5 hours
8.	Techno-economic parameters for preparation of projects.	2.5 hours
9.	Preparation of Bankable projects for various agricultural products and its value added products.	5 hours
10.	Seminar on selected topics.	5 hours
	Total Laboratory Hours	**40**
Text Books		
1.	Subba Reddy, S and P. Raghu Ram. 2017. Agricultural Finance and Management. Oxford & IBH Publishing Company Private Ltd., New Delhi, India.	
2.	Bhagat, D. 2014. Textbook Of Agricultural Marketing And Co-operation. Neha Publishers & Distributors, India.	
Reference Books		
1.	Helyette Geman, 2015. Agricultural Finance: From Crops to Land, Water and Infrastructure (The Wiley Finance Series). Wiley Publishers, USA.	
2.	Charles B. Moss. 2013. Agricultural Finance. Routledge Company, UK.	
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test		
Recommended by Board of Studies	05-03-2019	
Approved by Academic Council	No.54	**Date** 14-03-2019

Course code	Agri-Informatics	L	T	P	C
BAG3006		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Describing computers and their usefulness in agriculture
2. Explaining the effectiveness of Information and Communications Technology in agriculture
3. Demonstrating new technologies which generate valuable information in agriculture

Expected Course Outcome: At the end of the course the student should be able to

1. Able to utilize operating systems like MS office and DBMS in agriculture
2. Comprehend programming languages
3. Use the internet for obtaining useful information regarding agriculture
4. Retrieve and generate information using geospatial technology
5. Relate contemporary ideas
6. Compute, create, operate and translate data using operating systems and IT tools

Module:1	Operating systems, data base management and WWW	4 hours	CO: 1

Operating Systems, definition and type. Applications of MSOffice for document creation and Editing. Data presentation, interpretation and graph creation. Statistical analysis, mathematical expressions, database, concepts and types. Uses of DBMS in Agriculture. World Wide Web (WWW): Concepts and components.

Module:2	Introduction to computer programming languages	4 hours	CO: 2

Programming languages, concepts and standard input/output operations.

Module:3	e-Agriculture	4 hours	CO: 3

Concepts and applications of e-agriculture and use of ICT in Agriculture. Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for agri-input management, smartphone Apps in Agriculture for farm advises market price and postharvest management.

Module:4	Geospatial technology and Decision support systems	3 hours	CO: 4

Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in agriculture. Agriculture Expert System, Soil Information Systems for supporting farm decisions. Preparation of contingent crop-planning using IT tools.

Module:5	Contemporary Issues	1 hour	CO: 5

Lecture by Industrial Expert

	Total Lecture hours:	**16**
List of Experiments		**CO: 6**
1.	Study of computer components, accessories and practice of important DOS commands.	2.5 hours
2.	Introduction of different operating systems such as windows, Unix/ Linux, creating files, folders and file management.	2.5 hours

3.	Use of MS-WORD and MS Power-point for creating, editing and presenting a scientific Document.	2.5 hours
4.	MS-EXCEL: Creating a spreadsheet; use of statistical tools; writing	5 hours
	expressions; creating graphs and analysis of scientific data.	
5.	MS-ACCESS: Creating database; preparing queries and reports; demonstration of agri-information system.	5 hours
6.	Introduction to World Wide Web (WWW); Introduction of programming languages	5 hours
7.	Hands on: Crop Simulation Models (CSM) such as DSSAT/Crop-Info/CropSyst/ Wofost	5 hours
8.	Computation of water and nutrient requirements of crop using CSM and IT tools.	5 hours
9.	Introduction of geospatial technology for generating valuable information for agriculture.	5 hours
10.	Hands on: decision Support system; Preparation of contingent crop planning.	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Mamta Rana D. Prasad. 2017. Agro-informatics. Bioscientific Publisher, India
2.	Vanitha, G and Kalpana, M. 2011. Agro-informatics. New India Publishing Agency, India.
Reference Books	
1.	Raju, K. V.,V. R. Hegde and Satish A. Hegde. 2018. Geospatial Technologies for Agriculture: Case Studies from India. Springer International Publishing, Switzerland.
2.	Chandan Kumar Panda, Anil Paswan and Siya Ram Singh. 2018. Advances in ICT in Agriculture. New Delhi Publisher, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Farm Machinery and Power	L	T	P	C
BAG1018		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed to

1. Explain the farm and tractor power used in agriculture
2. Demonstrate different farm implements and its uses in agriculture
3. Discuss the selection of farm implements and its cost benefit analysis

Expected Course Outcome: Upon completion, students will be able to

1. Identify and differentiate two stroke and four stroke I.C engines
2. Distinguish different components and systems of IC engines
3. Compare different tillage implements used for various agricultural purposes
4. Classify various farm implements and comprehend its calibration methods
5. Estimate the cost benefit economics of various farm implements
6. Experiment with different equipment used in agricultural fields from planting to harvesting

Module:1	Farm and tractor power	4 hours	CO: 1

Status of farm power in India, sources of farm power, I.C. engines, working principles of I.C. engines, comparison of two stroke and four stroke cycle engines. Study of different components of I.C. engine, I.C. engine terminology and solved problems.

Module:2	Systems of IC engines	6 hours	CO: 2

Air cleaning, cooling, lubrication, fuel supply and hydraulic control system of a tractor. Power transmission system: clutch, gear box, differential and final drive of a tractor. Tractor types. Cost analysis of tractor power and attached implement.

Module:3	Tillage implements	2 hours	CO: 3

Familiarization with primary and secondary tillage implement, implement for hill agriculture and implement for intercultural operations.

Module:4	Sowing, planting and harvesting equipment	3 hours	CO: 4

Familiarization with sowing and planting equipment. Calibration of a seed drill and solved examples. Familiarization with plant protection equipment. Familiarization with harvesting and threshing equipment.

Module:5	Contemporary Issues	1 hours	CO: 5

Lecture by Industrial Expert

	Total Lecture hours	16
List of Experiments		CO: 6
1.	Study of different components of I.C. engine	2.5 hours
2.	Study of air cleaning and cooling system of engine; Familiarization with clutch, transmission, differential and final drive of a tractor	5 hours

3.	Familiarization with brake, steering, lubrication , fuel supply system and hydraulic control system of engine	5 hours
4.	Learning of tractor driving	5 hours
5.	Familiarization with operation of power tiller; Implements for hill agriculture	2.5 hours
6.	Study of different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow	5 hours
7.	Familiarization with seedcum-fertilizer drills their seed metering	2.5 hours
	mechanism and calibration, planters and transplanter	
8.	Study of different types of sprayers and dusters	5 hours
9.	Familiarization with different inter-cultivation equipment	5 hours
10.	Study of harvesting and threshing machinery	2.5 hours
Total Laboratory Hours		**40**

Text Book	
1.	Sunil Mekala. 2017. Farm Machinery and Power. Random Publications, New Delhi.
2.	Jagadishwar Sahay, 2010. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi. ISBN: 978-818014044.
Reference Books	
1.	Ojha, T.P and A.M. Michael 2005. Principles of Agricultural Engineering. Vol-I. Jain Brothers, New Delhi. ISBN: 978-8186321638
2.	Srivastava, A.C., 1991. Elements of Farm Machinery. Oxford & IBH Publishing Co Pvt Ltd, New Delhi. ISBN: 978-8120405134
3.	Singh. T. P. 2016. Farm Machinery. PHI publishers, New Delhi.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Production Technology for Vegetables and Spices	L	T	P	C
BAG2023		1	0	2	2
Pre-requisite	Fundamentals of Horticulture	Syllabus version			
BAG1022		1.0			

Course Objectives: The course is aimed at

1. Demonstrating the fundamental production technology of vegetables
2. Imparting knowledge on production technology of spices
3. Imparting practical experience on production technology of vegetables and spices

Expected Course Outcomes: At the end of the course the student should be able to

1. Appreciate the importance of cultivating vegetables and spices
2. Demonstrate ideas on cultivating vegetables and spices
3. Understand the physiological disorders undermining the yield of vegetables and spices
4. Plan for commercial cultivation of vegetables and spices
5. Cultivate and demonstrate marketing of vegetables

Module: 1	Importance and scope of vegetables and spices	3 hours	CO: 1

Importance of vegetables and spices in human nutrition and national economy. Kitchen gardening. Brief description about origin, area, climate and soil.

Module: 2	Cultivation practices of vegetables and spices	4 hours	CO: 2

Improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield.

Module: 3	Physiological disorders of vegetables and spices	4 hours	CO: 3

Physiological disorders of important vegetables and spices: Tomato, Brinjal, Chilli, Capsicum, Cucumber, Melons, Gourds, Pumpkin, French bean, Peas; Cole crops such as Cabbage, Cauliflower and Knol-khol.

Module: 4	Physiological disorders of bulbs, tubers &leafy vegetables	4 hours	CO: 3

Physiological disorders of bulb crops such as Onion, Garlic; Root crops such as Carrot, Radish, Beetroot; Tuber crops such as Potato; Leafy vegetables such asAmaranth, Palak and Perennial vegetables.

Module: 5	Contemporary Issues	1 hour	CO: 4

Lecture by Industrial Expert

Total Lecture hours		16
List of Experiments		CO: 5
1.	Identification of vegetables and their seeds	2.5 hours
2.	Identification of spice crops and their seeds	2.5 hours
3.	Nursery raising	5 hours
4.	Direct seed sowing and transplanting	5 hours
5.	Study of morphological characters of different vegetables and spices	5 hours
6.	Fertilizers applications	2.5 hours
7.	Harvesting & preparation for market	5 hours
8.	Economics of vegetables cultivation	5 hours

9.	Economics of spices cultivation	5 hours
10.	Visit to commercial orchards	2.5 hours
	Total Laboratory Hours	**40**
Text Books		
1.	Thamburaj, S. and Narendra Singh. 2014. Textbook Of Vegetables Tubercrops& Spices. ICAR, New Delhi.	
2.	Bhat, K.L., 2016. Physiological disorders of vegetable crops. Daya Publishing House, India.	
Reference Books		
1.	BrijBala and Nikhil Sharma. 2011. Economics of off-season vegetables: Production and Marketing Costs, Returns and Price Spread. Lap Lambert Academic Publishing, Germany.	
2.	Selvakumar, R. 2014. A Textbook of Glaustas Olericulture. New Vishal Publications, India.	
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test		
Recommended by Board of Studies	05-03-2019	
Approved by Academic Council	No.54	**Date** 14-03-2019

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Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

Course code	Environmental Studies and Disaster Management	L	T	P	C
BAG2021		2	0	2	3
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Demonstrating fundamental principles of nature and problems associated with it.
2. Developing skills of managing natural calamities and/or disasters.
3. Defining current technologies used in environmental management.

Expected Course Outcome: At the end of the course the student should be able to

1. Summarize natural sources and state the need for conserving the resources
2. Understand the functions of ecosystems
3. Comprehend the importance of conserving species on earth
4. Delineate manmade disasters and plan towards sustainable development
5. Demonstrate knowledge acquired in natural disaster management
6. Assess disaster issues based on knowledge gained and field work and design remedies

Module:1	Natural Resources	7 hours	CO: 1

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

Module:2	Ecosystems	5 hours	CO: 2

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

Module:3	Biodiversity and its conservation	5 hours	CO: 3

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

Module:4	Environmental Pollution	8 hours	CO: 4
Definition, cause, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution and g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.Social Issues and the Environment: From unsustainable to sustainable development, urban problems related to energy, water conservation, and rain water harvesting and watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Program. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.			
Module:5	**Natural and manmade disasters and their management**	**5 hours**	**CO: 5**
Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves. Climatic change: global warming, sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Police and other organizations in disaster response.			
Module:6	**Contemporary Issues**	**2 hours**	**CO: 6**
Lecture by Industrial Expert			
		Total Lecture hours:	**32**

List of Experiments		**CO: 6**
1.	Analyzing case studies on Pollution	2.5 hours
2.	Field visit to a local area to document environmental assets like river/forest	2.5 hours
3.	Field visit to a local area to document environmental assets like grassland/hill/mountain	5 hours
4.	Analyzing case studies on management of environmental assests	5 hours
5.	Visit to a local polluted site-Urban / Rural	5 hours
6.	Visit to a local polluted site - Industrial / Agricultural	5 hours
7.	Analyzing case studies on management of polluted environments	2.5 hours
8.	Study of common plants, insects, birds	5 hours
9.	Study of simple ecosystems- pond, river	5 hours
10.	Study of simple ecosystems- hill slopes	2.5 hours
	Total Laboratory Hours	**40**
Text Books		

1.	Mani, N. 2017. Environment, Climate change and Disaster management. New Century publication, New Delhi, India.
2.	Bhattacharya, T. 2012. Disaster Science and management. Tata McGraw Hill Education private limited, New Delhi, India.
Reference Books	
1.	Meenakshi, P. 2012. Elements of Environmental Science and Engineering, Second Edition. PHI Learning Private Limited, New Delhi, India.
2.	Sulphy, M. M. and M. M. Safeer. 2017. Introduction to Environmental Management, Fourth edition. PHI Learning Private Limited, New Delhi, India.
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test	

Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Statistical Methods	L	T	P	C
MAT1010		1	0	2	2

Pre-requisite	None	Syllabus version
		1.0

Course Objectives: The course is aimed at

1. Explaining the role of statistics in agriculture
2. Imparting knowledge on collection, analysis and presentation of data
3. Interpreting simple agricultural experiments

Expected Course Outcome: After completing the course, the student should be able to

1. Present and analyze scientific data
2. Solve problems on probability
3. Interpret statistical test outcomes
4. Design and analyze experiments
5. Appreciate the applications of statistical methods in science and engineering
6. Apply relevant statistical analysis to experimental data

Module:1	Data presentation and analysis	2 hours	CO: 1

Introduction to Statistics and its Applications in Agriculture, Graphical Representation of Data, Measures of Central Tendency & Dispersion. Scatter plots.

Module:2	Probability & Distribution	4 hours	CO: 2

Definition of Probability, Addition and Multiplication Theorem (without proof). Simple Problems Based on Probability. Binomial & Poisson Distributions

Module:3	Statistical tests	4 hours	CO: 3

Definition of Correlation. Scatter diagram. Karl Pearson's coefficient of correlation. Linear Regression Equations. Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table.

Module:4	Analysis of Experimental Designs and sampling	5 hours	CO: 4

Design of Experiments – Introduction to Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.

Module:5	Contemporary Issues	1 hours	CO: 5

Lecture by Industrial Expert

	Total Lecture hours:	16
List of Experiments		CO: 6
1.	Graphical Representation of Data	2.5 hours
2.	Measures of Central Tendency (Ungrouped and grouped data) with	5 hours
	calculation of Quartiles, Deciles & Percentiles	

3.	Measures of Dispersion (Ungrouped and grouped Data)	5 hours
4.	Moments, Measures of Skewness & Kurtosis (Ungrouped Data and Grouped data).	5 hours
5.	Correlation & Regression Analysis.	5 hours
6.	One Sample and Two sample Fisher's t-test	5 hours
7.	Chi-Square test of Goodness of Fit. Chi-Square test of Independence of Attributes for 2 ×2 contingency table	5 hours
8.	Analysis of Variance One Way Classification	2.5 hours
9.	Analysis of Variance Two Way Classification	2.5 hours
10.	Selection of random sample using Simple Random Sampling	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Rangaswamy, R. 2016. A textbook of agricultural statistics. New Age International (P) Ltd., India.
2.	Gupta, B.N. 2015. Statistical Analysis. SBPD Publications, India.
Reference Books	
1.	Peck, R., C. Olsen and J.L. Devore. 2008. Introduction to Statistics and Data Analysis,5th edition. Brooks Cole Publishing Company, USA.
2.	Salkand, N.J. 2016. Statistics for People Who (Think They) Hate Statistics. 6th Edition. Sage Publications. India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Livestock and Poultry Management	L	T	P	C
BAG1027		3	0	2	4
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on poultry and animal husbandry management
2. Interpreting the usage of scientific techniques involved in rearing livestock and poultry
3. Stating the importance of breeds and designing nutrient based feeds

Expected Course Outcome : At the end of the course the student should be able to

1. Understand the importance of livestock in human welfare
2. Demonstrate knowledge on housing requirements for poultry and livestock
3. Handle the different life stages of livestock and select best breeds for growing
4. Design and ration feedstuffs for livestock
5. Mange and prevent the occurrence of livestock diseases
6. Rear livestock

Module:1	Importance of Livestock	6 hours	CO: 1

Livestock resources of India. Contribution of livestock to human community. Role of livestock in building farmers economy and the national economy. Reproduction in farm animals and poultry.

Module:2	Housing management	8 hours	CO: 2

Housing principles, space requirements for different species of livestock and poultry. Management of calves, growing heifers and milch animals. Management of sheep, goat and swine.

Module:3	Management of life stages	8 hours	CO: 3

Incubation and hatching. Brooding of chicks. Management of growers and layers.

Module:4	Breeds	8 hours	CO: 3

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

Module:5	Feedstuffs	8 hour	CO: 4

Digestion in livestock and poultry. Classification of feedstuffs. Proximate principles of feed. Nutrients and their functions.

Module:6	Feed rationing and supplements	hours	CO: 4

Feed ingredients for ration for livestock and poultry. Feed supplements and feed additives. Feeding of livestock and poultry.

Module:7	Animal Diseases and its precautions	8 hours	CO: 5

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

Module:8	Contemporary issues	2 hours	CO: 1

Lecture by Industrial Expert		
	Total Lecture hours:	**48**
List of Experiments		**CO: 6**
1.	External body parts of cattle, buffalo, sheep, goat, swine and poultry.	2.5 hours
2.	Handling and restraining of livestock: Identification methods of farm animals and poultry.	5 hours
3.	Visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records.	5 hours
4.	Judging of cattle, buffalo and poultry. Culling of livestock and poultry.	5 hours
5.	Planning and layout of housing for different types of livestock.	5 hours
6.	Computation of rations for livestock; Formulation of concentrate mixtures.	2.5 hours
7.	Clean milk production, milking methods.	2.5 hours
8.	Hatchery operations, incubation and hatching equipment. Management of chicks, growers and layers.	5 hours
9.	Debeaking, dusting and vaccination.	2.5 hours
10.	Economics of cattle, buffalo, sheep, goat, swine and poultry production.	5 hours
	Total Laboratory Hours	**40**
Text Books		
1.	Arun Kumar Tomar and Sukhvir Singh Tomar. 2016. Sustainable Livestock and Poultry Breeding. Daya Publishing House, New Delhi, India.	
2.	Pankaj Kumar Singh, Ravindra Kumar, Sanjay Kumar and Kaushalendra Kumar. 2015.Feed Supplements for Livestock and Poultry. Daya Publishing House, New Delhi, India.	
Reference Books		
1.	James R. Gillespie and Frank B Flanders. 2009. Modern Livestock and Poultry production, Eighth Edition. Cengage Learning. New Delhi, India.	
2.	Banerjee, G.C. 2018. A Textbook of Animal Husbandry, Fourth edition, Oxford and IBH Publishing, New Delhi, India.	
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test		
Recommended by Board of Studies	05-03-2019	
Approved by Academic Council	No.54 **Date**	14-03-2019

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

Course code	Crop Production Technology –II (Rabi Crops)	L	T	P	C
BAG 2002		1	0	2	2
Pre-requisite	Fundamentals of Agronomy	Syllabus version			
BAG1013					

Course Objectives: The course is aimed at

1. Imparting fundamentals of crop production technology of rabi crops
2. Demonstrating practical applications of crop production
3. Providing knowledge on the importance and practices followed in growing rabi crops

Expected Course Outcome: At the end of the course the student should be able to

1. Comprehend the fundamentals of crop production of rabi cereals
2. Decide on the crops, fertilizers and irrigation measures for crop production of pulses
3. Plan for sustainable crop production of oilseed and forage crops
4. Explain crop production of sugarcane, medicinal and aromatic plants
5. Correlate parameters involved in crop cultivation and practice rabi crop cultivation

Module:1	Cereals	4 hours	CO: 1

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of wheat and barley.

Module:2	Pulses	4 hours	CO: 2

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of chickpea, lentil and peas.

Module:3	Oil seeds and Forage crops	4 hours	CO: 3

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of rapeseed, mustard, sunflower, berseem, lucerne and oat.

Module:4	Sugarcane, medicinal and aromatic crops	2 hours	CO: 4

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of sugarcane, mentha, lemon grass and citronella.

Module:5	Contemporary Issues	2 hours	CO: 5

Lecture by Industrial Expert

	Total Lecture hours:	16

List of Experiments		CO: 5
1.	Sowing methods of wheat	5 hours
2.	Sowing methods of sugarcane	5 hours
3.	Identification of weeds in rabi season crops	5 hours
4.	Study of morphological characteristics of rabi crops	2.5 hours
5.	Study of yield contributing characters of rabi season crops	2.5 hours
6.	Yield and juice quality analysis of sugarcane	2.5 hours
7.	Study of important agronomic experiments of rabi crops at experimental farms	2.5 hours
8.	Study of *rabi* forage experiments	2.5 hours
9.	Oil extraction from medicinal crops	2.5 hours
10.	Visit to research stations of related crops	5 hours

			Total Laboratory Hours	**40**
Text Book				
1	Suresh Singh Tomar, Yagya Dev Mishra and Shailendra Singh Kushah. 2018. Production Technology of Rabi Crops. Biotech books, New Delhi, India.			
2.	Rajendra Prasad. 2017.Textbook of field crops production, Volume 1 and 2 (Foodgrain crops & Commercial Crops). ICAR, India.			
Reference Books				
1.	Joshi M. 2015. Textbook of Field Crops. Prentice Hall India Learning Private Limited, India.			
2.	Singh Chhidda, Singh P. and Singh R.. 2018. Modern techniques of raising field crops.2nd Edition. Oxford & IBH Publishing Co Pvt.Ltd.,New Delhi, India.			
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test				
Recommended by Board of Studies		05-03-2019		
Approved by Academic Council		No.54	**Date**	14-03-2019

Course code	Production technology for ornamental crops, MAP and Landscaping	L	T	P	C
BAG2020		1	0	2	2
Pre-requisite	Fundamentals of Horticulture	Syllabus version			
BAG1022		1.0			

Course Objectives: The course is aimed at

1. Explaining the principles of landscaping.
2. Imparting knowledge on the production technology of ornamental and medicinal plants.
3. Demonstrating practical applications of landscaping and producing ornamental and medicinal plants.

Expected Course Outcomes: At the end of the course the student should be able to

1. Appreciate the importance of landscaping and growing of medicinal and aromatic plants.
2. Understand the requirements for landscaping.
3. Plan and practice propagation of cut flowers.
4. Explain the values of cultivating medicinal plants.
5. Design landscapes and practice cultivation of medicinal and aromatic plants.

Module: 1	Importance and scope	2 hours	CO: 1

Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping.

Module: 2	Principles of Landscaping	4 hours	CO: 2

Basic principles of landscaping: Background, contrast, balance, open centre, repetition, rhythm and variety. Uses of trees, shrubs and climbers in landscape designing.

Module: 3	Production technology of cut flowers	4 hours	CO: 3

Production technology of important cut flowers like rose, gerbera, carnation, lilium and orchids under protected conditions and gladiolus, tuberose, chrysanthemum under open conditions. Package of practices for loose flowers like marigold and jasmine under open conditions.

Module: 4	Production technology of medicinal plants and Processing values	5 hours	CO: 4

Production technology of important medicinal plants like ashwagandha, asparagus, aloe, costus, Cinnamomum, periwinkle, isabgol and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium and vetiver. Processing and value addition in ornamental crops and MAPs produce.

Module: 5	Contemporary Issues	1 hours	CO: 1

Lecture by Industrial Expert

	Total Lecture hours:	16
List of Experiments		CO: 5
1.	Identification of ornamental plants	2.5 hours
2.	Identification of medicinal and aromatic plants	2.5 hours
3.	Nursery bed preparation and seed sowing	2.5 hours
4.	Training and pruning of ornamental plants	5 hours
5.	Planning and layout of garden	5 hours

6.	Bed preparation and planting of MAP; Protected structures–care and maintenance	5 hours
7.	Intercultural operations in flowers and MAP	2.5 hours
8.	Harvesting and post-harvest handling of cut and loose flowers.	5 hours
9.	Processing of MAP	5 hours
10.	Visit to commercial flower/MAP unit	5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Lakshmi Lal. 2018. Textbook of Production Technology for Ornamental Crops MAPs and Landscaping. Agrotech Publishing Academy, India.
2.	Balaji S. Kulkarni. 2016. Floriculture and Landscaping. Agro India publications, India.
Reference Books	
1.	Bose, T. K., L.J. Singh, M. K. Sadhu and T K Maity. 2015. Ornamental Plants and Garden Design in Tropics and Subtropics (2 Vols.). Astral International Ltd., India.
2.	Charles P. Griner, Colquitt County H.S., Moultrie, G.A. 2019. Floriculture: Designing and Merchandising, 4th edition. Cengage Learning, USA.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Renewable Energy and Green Technology	L	T	P	C
BAG1007		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed to

1. Discuss the importance of renewable energy and its sources
2. Demonstrate about different types of biogas plants and its uses
3. Explain the basics of solar energy, wind energy and their applications

Expected Course Outcome: Upon completion, students will be able to

1. Summarize the importance of renewable energy and its sources
2. Compare different biogas plants, its benefits, advantages and cost analysis
3. Discuss the importance of solar energy and their applications.
4. Explain the need of wind energy and energy components involved and their applications
5. Interpret merits and demerits of various renewable sources of energy
6. Design simple projects based on renewable energy systems

Module:1	Introduction to renewable energy and its sources	3 hours	CO: 1

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

Module:2	Biogas plants	5 hours	CO: 2

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

Module:3	Solar energy and its applications	4 hours	CO: 3

Introduction of solar energy, collection and their application. Familiarization with solar energy gadgets: solar cooker and solar water heater. Application of solar energy: solar drying, solar pond and solar distillation. Solar photovoltaic system and their application.

Module:4	Wind energy and its applications	3 hours	CO: 4

Introduction to wind energy and its applications. Wind turbines and wind farms.

Module:5	Contemporary Issues	1 hours	CO: 5

Lecture by expert

	Total Lecture hours	16

List of Experiments		CO: 6
1.	Familiarization with renewable energy gadgets.	2.5 hours
2.	Study of biogas plants and gasifiers	5 hours
3.	Study of production process of biodiesel	5 hours
4.	Study of briquetting machine, briquettes, and its sources	5 hours
5.	Production process of bio-fuels.	2.5 hours
6.	Familiarization with different solar energy gadgets.	5 hours
7.	Study of solar photovoltaic system: solar light, solar pumping, solar fencing.	2.5 hours

8.	Study of solar cooker and its components	5 hours
9.	Study solar drying system, solar distillation and solar pond	5 hours
10.	Visit to the local biogas plant	2.5 hours
	Total Laboratory Hours	**40**

Text Book	
1.	Singhal, B.L. 2016. Renewable Energy Sources and Management. Tech-Max Publication, Pune, India.
2.	David M. Buchla, Thomas E. Kissell, Thomas L. Floyd. 2017. Renewable Energy Systems. Pearson Education, UK.

Reference Books	
1.	Godfrey Boyle. 2012. Renewable Energy: Power for a sustainable future,3rd edition. Oxford university press, UK.
2.	Robert Ehrlich and Harold A. Geller.2017. Renewable Energy: A first course. CRC Press publishing company, USA.
3.	John Twidelland Tony Weir. 2005. Renewable Energy Resources,2nd Edition. Routledge company, UK.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Problematic Soils and their Management	L	T	P	C
BAG 2018		2	0	0	2
Pre-requisite	Fundamentals of Soil Science	Syllabus version			
BAG1020					

Course Objectives: The course is aimed at

1. Providing knowledge on soil and water quality for agricultural use
2. Describing constraints and management of problematic soils
3. Imparting knowledge on problematic soils through remote sensing and GIS

Expected Course Outcome: At the end of the course the student should be able to

1. Comprehend the scenario of waste land and problem soils in India
2. Understand reclamation of problematic soils
3. Acquire knowledge on water quality
4. State the role of remote sensing and GIS in diagnosis of problematic soils
5. Understand the remediation of soils under different agro-ecosystems
6. Explain management of problematic soils

Module:1	**Soil health**	**6 hours**	**CO: 1**
Soil quality and health. Distribution of waste land and problem soils in India and their categorization based on properties.			
Module:2	**Reclamation and management of Problematic soil**	**8 hours**	**CO: 2**
Reclamation and management of saline and sodic soils, acid soils, acid Sulphate soils, eroded and compacted soils, flooded soils and polluted soils.			
Module:3	**Water quality**	**6 hours**	**CO: 3**
Irrigation water: quality and standards, utilization of saline water in agriculture.			
Module:4	**Remote sensing and GIS**	**4 hours**	**CO: 4**
Remote sensing and GIS in diagnosis and management of problem soils.			
Module:5	**Land Capability**	**6 hours**	**CO: 5**
Land capability and classification. Land suitability classification. Problematic soils under different Agro-ecosystems. Multipurpose tree species, bio remediation of problematic soils through MPTs.			
Module:6	**Contemporary Issues**	**2 hours**	**CO: 6**
Lecture by Industrial Expert			
		Total Lecture hours:	**32**

Text Book

1	Weil, R. R and N.C. Brady. 2017. The Nature and Properties of Soils, 15th edition. Pearson, UK.
2.	Soil Science-An Introduction. 2015. Indian Society of Soil Science. India.

Reference Books

1.	Biswas. T.D and S.K. Mukherjee. 2017. Text book of Soil Science, 2nd edition. McGraw-Hill Education. USA.
2.	Das, D.K. 2015. Introductory soil science. 4th Edition. Kalyani Publisher, India.

3.	Mehra, R.K. 2006. Textbook of Soil Science. ICAR, New Delhi, India.		
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Production Technology for Fruit and Plantation Crops	L	T	P	C
BAG2024		1	0	2	2
Pre-requisite	Fundamentals of Horticulture	Syllabus version			
BAG1022		1.0			

Course Objectives: The course is aimed at

1. Demonstrating production technology of fruit crops.
2. Explaining the production technology of plantation crops.
3. Imparting practical experience on production technology of fruit and plantation crops.

Expected Course Outcomes: At the end of the course the student should be able to

1. Analyze the scope of cultivating a fruit or plantation crop
2. Define package of practices followed for tropical fruits
3. Comprehend technology involved in growing sub-tropical fruits
4. Define package of practices followed for minor fruits and plantation crops
5. Develop ones career interest in pomiculture and plantation crops
6. Design an orchard

Module: 1	Fruit and plantation crops-scope and importance	3 hours	CO: 1

Importance and scope of fruit and plantation crop industry in India. Nutritional, commercial, industrial and medicinal importance of fruit and plantation crops. Importance of rootstocks.

Module: 2	Production technology of tropical fruits	4 hours	CO: 2

Production technologies for the cultivation of major fruits: mango, banana, citrus, grape, guava, litchi, papaya and sapota. Soil, climate, planting, high density planting, nutrient and water management.Special cultural operations.Pests and diseases.Management practices.

Module: 3	Production technology of sub-tropical fruits	4 hours	CO: 3

Production technologies for the cultivation of major fruits: apple, pear, peach, walnut and almond. Soil, climate, planting, high density planting, nutrient and water management.Special cultural operations.Pests and diseases.Management practices.

Module: 4	Production technology of minor fruits and plantation crops	4 hours	CO: 4

Production technology of minor fruits: date, ber, pineapple, pomegranate, jackfruit, strawberry. Production technology of plantation crops: coconut, areca-nut, cashew, tea, coffee and rubber.

Module: 5	Contemporary Issues	1 hours	CO: 5

Lecture by Industrial Expert

	Total Lecture hours:	16
List of Experiments		CO: 6
1.	Seed propagation	2.5 hours
2.	Scarification and stratification of seeds	2.5 hours
3.	Propagation methods for fruits	5 hours
4.	Propagation methods for plantation crops	5 hours
5.	Description and identification of fruit	5 hours
6.	Preparation of plant bio regulators and their uses	5 hours
7.	Important pests	2.5 hours

8.	Diseases and physiological disorders of fruits	5 hours
9.	Diseases and physiological disorders of plantation crops	5 hours
10.	Visit to commercial orchards	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Prasad, S. and Raju L. Bhardwaj. 2015. Text book of production technology of fruit crops. Agrobios, India.
2.	Ponnuswami, V., M. Kumar, S., Ramesh Kumar and C. Krishnamoorthy. 2015. Text Book on Fruit & Plantation Crops. Narendra Publishing House, India.
Reference Books	
1.	Hartmann, H.T., D.E. Kester, F.T. Davies and R.L. Geneve. 2010. Plant Propagation: Principles and Practices, 8th edition. Pearson, U.K.
2.	Melvin Neil Westwood. 2009. Temperate-Zone Pomology: Physiology and Culture, 3rd edition. Timber Press, USA.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board ofStudies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Principles of Seed Technology	L	T	P	C
BAG 1016		1	0	4	3
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Demonstrating the fundamentals of seed technology
2. Extending the practical knowledge on seed production
3. Imparting knowledge on seed certification, processing, storage and marketing

Expected Course Outcome: At the end of the course the student should be able to

1. Comprehend seed production and seed quality
2. Demonstrate the concepts of seed certification, Seed Act and seed testing processes
3. Understand seed processing and seed storage techniques
4. State the norms of seed marketing in India.
5. Apply practical knowledge gained to commercially produce seeds and practice seed testing

Module:1	Seed Technology: Production and Quality	4 hours	CO: 1

Seed and seed technology: introduction, definition and importance. Deterioration causes of crop varieties and their control. Maintenance of genetic purity during seed production. Seed quality: definition, characters of good quality seed and different classes of seed. Foundation and certified seed production of important cereals, pulses, oilseeds, fodder and vegetables.

Module:2	Seed certification and Act	4 hours	CO: 2

Seed certification, phases of certification, procedure for seed certification and field inspection. Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983. Varietal Identification through grow out test and electrophoresis, molecular and biochemical test. Detection of genetically modified crops, transgene contamination in non-GM crops, GM crops and organic seed production.

Module:3	Seed processing and storage	4 hours	CO: 3

Seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing. Seed storage: general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage.

Module:4	Seed marketing	3 hours	CO: 4

Seed marketing: structure and organization, sales generation activities and promotional media. Factors affecting seed marketing and Role of WTO and OECD in seed marketing. Private and public sectors and their production and marketing strategies.

Module:5	Contemporary Issues	1 hour	CO: 1

Lecture by Industry Expert

	Total Lecture hours:	16
List of Experiments		CO: 5
1.	Seed production in major cereals: Wheat and Rice.	10 hours

2.	Seed production in major cereals: Maize, Sorghum, Bajra and Ragi.	10 hours
3.	Seed production in major pulses: Urd, Mung, Pigeonpea, Lentil, Gram, Field bean and pea.	10 hours
4.	Seed production in major oilseeds: Soybean, Sunflower, Rapeseed, Groundnut and Mustard.	10 hours
5.	Seed production in important vegetable crops.	10 hours
6.	Seed sampling and testing: Physical purity, germination and viability.	5 hours
7.	Seed and seedling vigour test.	5 hours
8.	Genetic purity test: Grow out test and electrophoresis.	5 hours
9.	Seed certification: Procedure, field inspection and preparation of field inspection report.	5 hours
10.	Visit to seed production farms, seed testing laboratories and seed processing plant.	10 hours
	Total Laboratory Hours	**80**

Text Books	
1.	Khare, D. 2019. Principles of Seed Technology. Scientific Publishers, New Delhi.
2.	Sen, S and Gosh N. 2018. Seed Science and Technology, Kalyani Publishers, India.
Reference Books	
1.	Gaur, S.C. 2012. A handbook of seed processing and marketing. Agrobios, India.
2.	Vanangamudi, K., S. Kavitha and K. Raja, 2017. Objective Seed Science and Technology, Scientific Publishers, New Delhi. India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Farming System and Sustainable Agriculture	L	T	P	C
BAG2017		1	0	0	1
Pre-requisite	Fundamentals of Agronomy	Syllabus version			
BAG1014		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on the types of farming systems
2. Describing cropping systems and state the importance of sustainable agriculture
3. Explaining integrated farming

Expected Course Outcome: At the end of the course the student should be able to

1. Interpret farming systems and its significance
2. Design an efficient cropping system
3. Demonstrate sustainability in agriculture
4. Propose integrated farming systems
5. Determine the efficiency of farming systems

Module:1	Farming System	3 hours	CO: 1

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

Module:2	Cropping system	4 hours	CO: 2

Cropping system and pattern, multiple cropping systems, efficient cropping system and their evaluation. Allied enterprises and their importance. Tools for determining production and efficiencies in cropping and farming system.

Module:3	Sustainable agriculture	4 hours	CO: 3

Sustainable agriculture - problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture, HEIA, LEIA, LEISA and its techniques for sustainability.

Module:4	Integrated farming system	4 hours	CO: 4

Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages, site-specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques. Resource cycling and flow of energy in a different farming system and environment.Visit of IFS model in different agro-climatic zones of nearby state's University/ institutes and farmers field.

Module:5	Contemporary Issues	1 hour	CO: 5

Lecture by Industrial Expert

Total Lecture hours:	16

Text Books

1. Kalhapure, A., Dhonde, M. and Shete, B. 2014. A Textbook of Farming System and Sustainable Agriculture. Universal Prakashan, Pune.
2. Reddy, S.R. 2018. Farming System and Sustainable Agriculture. Kalyani Publishers, India.

Reference Books			
1.	Behera, U.K. 2014. Text Book of Farming Systems. Scientific Publishers India, India.		
2.	Shawn JadrnicekandStephanie Jadrnicek. 2016. The Bio-Integrated Farm: A Revolutionary Permaculture-Based System Using Greenhouses, Ponds, Compost Piles, Aquaponics, Chickens, and More. Chelsea Green Publishing, USA.		
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Agricultural Marketing, Trade and Prices	L	T	P	C
BAG3007		2	0	2	3
Pre-requisite	Agricultural Finance and Co-operation	Syllabus version			
BAG2010		1.0			

Course Objectives: The course is aimed at

1. Outlining information on marketing strategies of agricultural commodities.
2. Illustrating price dynamics and the role of government in regulation of markets.
3. Describing International trade policies.

Expected Course Outcome: At the end of the course the student should be able to

1. Explain the importance of agricultural marketing
2. Comprehend marketing strategies of agricultural products
3. Understand efficient marketing and the role of government and public sectors in marketing
4. Interpret agricultural commodity prices and policies
5. Discuss trade at national and international level
6. Device plans for agricultural product marketing

Module:1	Agricultural Marketing – Nature and Scope	4 hours	CO: 1

Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation. Classification and characteristics of agricultural markets. Demand, supply and producer's surplus of agri-commodities.Nature and determinants of demand and supply of farm products.Producer's surplus–meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities.

Module:2	Product and its marketing strategies	6 hours	CO: 2

Meaning, stages in product life cycle, its characteristics and strategies in different stages. 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, merits and demerits. Marketing process and functions. Marketing process: concentration, dispersion and equalization. Exchange functions: buying and selling; physical functions: storage, transport and processing; facilitating functions: packaging, branding, grading, quality control and labeling (Agmark).

Module:3	Marketing Functionaries and Channels	8 hours	CO: 3

Types and importance of agencies involved in agricultural marketing; meaning, definition of marketing channel; number of channel levels; marketing channels for different farm products. Integration, efficiency, costs and price spread: meaning, definition, types of market integration; marketing efficiency, costs, margins, 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 institutes-CWC, SWC, FCI, CACP and DMI–their objectives, functions. Cooperative marketing in India. Risk in marketing and its types.

Module:4	Agricultural prices and policy	6 hours	CO: 4

Speculation and hedging; an overview of futures trading; agricultural prices and policy; meaning and functions of price; administered prices; need for agricultural price policy.

Module:5	**International Trade**	**6 hours**	**CO: 5**
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.			
Module:6	**Contemporary Issues**	**2 hours**	**CO: 1**
Lecture by Industrial Expert			
		Total Lecture hours:	**32**

List of Experiments		**CO: 6**
1.	Plotting and study of demand and supply curves and calculation of elasticities	2.5 hours
2.	Study of relationship between market arrivals and prices of some selected commodities	2.5 hours
3.	Computation of marketable and marketed surplus of important commodities	2.5 hours
4.	Study of price behaviour over time for some selected commodities; Construction of index numbers	5 hours
5.	Visit to a local market to study various marketing functions performed by different agencies and identification of marketing channels for selected commodities	5 hours
6.	Collection of data regarding marketing costs, margins and price spread and presentation of report in the class	5 hours
7.	Visit to NAFED to study their organization and functioning	5 hours
8.	Visit to SWC, CWC to study their organization and functioning	5 hours
9.	Visit to Cooperative Marketing Society to study their organization and functioning	5 hours
10.	Application of principles of comparative advantage of international trade	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Acharya S.S. and N.L.Agarwal. 2017. Agricultural Marketing in India, 6th edition. Oxford IBH Publishing Co. Pvt. Ltd. New Delhi, India.
2.	Bhagat, D. 2014. Textbook Of Agricultural Marketing And Co-operation. Neha Publishers & Distributors, India.
Reference Books	
1.	Raju, V.T and D.V.S. Rao.2017. Economics of Farm Production and Management. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India.
4.	Kym Anderson, 2016. Agricultural Trade, Policy Reforms, and Global Food Security. Palgrave Macmillan Publishing Company, USA.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

Course code	Introductory Agro-meteorology and Climate Change	L	T	P	C
BAG1024		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed to

1. Explain the importance of agro-meteorology and its uses in agricultural field
2. Discuss about climate change and its impact on agriculture.
3. Illustrate the relationship between crop and weather to predict various crop yields

Expected Course Outcome: Upon completion students will be able to

1. Appreciate the importance of weather variables in agriculture
2. Comprehend the role solar radiation in crop growth
3. Analyze various forms of precipitation
4. Interpret the role of weather hazards and climate change in crop growth
5. Understand the correlation between weather and agriculture
6. Measure weather parameters essential for crop growth

Module:1	Agro-meteorology and atmospheric variables	4 hours	CO: 1

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.

Module:2	Solar radiation and its components	6 hours	CO: 2

Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo, atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature.

Module:3	Energy balance and precipitation	2 hours	CO: 3

Energy balance of earth, atmospheric humidity, concept of saturation, vapour pressure, process of condensation, formation of dew, fog, mist, frost, cloud, precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail. Cloud formation and classification. Artificial rainmaking. Monsoon- mechanism and importance in Indian agriculture.

Module:4	Weather hazards and climate change	3 hours	CO: 4

Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave. Agriculture and weather relations, modifications of crop microclimate, climatic normals for crop and livestock production. Weather forecasting-types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national agriculture.			
Module:5	**Contemporary Issues**	**1 hour**	**CO: 5**
Lecture by expert			
	Total Lecture hours		**16**
List of Experiments			**CO: 6**
1.	Visit to agrometeorological observatory, study of site selection of observatory, exposure to instruments and weather data recording.		2.5 hours
2.	Measurement of total, shortwave and longwave radiation, and its estimation using Planck's intensity law		5 hours
3.	Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS.		5 hours
4.	Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis.		5 hours
5.	Measurement of soil temperature and computation of soil heat flux.		2.5 hours
6.	Determination of vapour pressure and relative humidity. Determination of dew point temperature.		5 hours
7.	Measurement of atmospheric pressure and analysis of atmospheric conditions.		2.5 hours
8.	Measurement of wind speed and wind direction, preparation of wind rose.		5 hours
9.	Measurement, tabulation and analysis of rain.		5 hours
10.	Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET.		2.5 hours
Total Laboratory Hours			**40**
Text Book			
1.	Chouhan, B.S., H.K. Sumeriyaand L.L. Somani. 2017. Introductory Agrometeorology and Climate Change. Bio-Green Books, India.		
2.	G.S.Mahi and P.K. Kingra. 2018. Fundamentals of Agrometeorology& Climate Change. Kalayani Publishers, India.		
Reference Books			
1.	S.R.Reddy. 2014. Introduction to Agriculture and Agrometeorology. Kalayani Publishers, India.		
2.	Latief. A, Raihana, H. K, Sabah. P, Syed. S. M. 2017. Experimental Agrometeorology: A practical manual. Springer international Publishing. USA.		
3.	Das, H.P.Agrometeorology in Extreme Events and Natural Disasters. BS publications, India.		
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved by Academic Council	No.54	**Date**	14-03-2019

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

Course code	Principles of Food Science and Nutrition, Food Safety and Standards	L	T	P	C
BAG1004		2	0	2	3
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Explaining students on the principles behind food science.
2. Creating awareness on the safety aspects of food and their industrial application.
3. Improving the ability of formulating new need based diet plans.

Expected Course Outcome: At the end of the course the student should be able to

1. Analyze food biochemically
2. Comprehend food nutrition, processing, spoilage and preservation
3. Assess food storage pertaining to safety and hygiene
4. Analyze stored food based on standards
5. Comprehend food regulatory laws
6. Test food scientifically as per standards in a laboratory

Module:1	Basic concepts of food science	6 hours	CO: 1

Concepts of Food Science-definitions, measurements, density, phase change, pH, osmosis, surface tension and colloidal systems. Food composition and chemistry-water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives and important reactions.

Module:2	Food microbiology, nutrition, preservation	6 hours	CO: 2

Food microbiology-bacteria, yeast, moulds, spoilage of fresh & processed foods and production of fermented foods. Principles and methods of food processing and preservation-use of heat, low temperature, chemicals, radiation and drying. Food and nutrition. Malnutrition-over and under nutrition. Nutritional disorders. Energy metabolism-carbohydrate, fat and proteins. Balanced and modified diets. Menu planning. New trends in food science and nutrition.

Module:3	Food safety and hygiene	7 hours	CO: 3

Food Safety-definition, importance, scope and factors affecting food safety. Hazards and Risks. Types of hazards-biological, chemical and physical hazards. Management of hazards-need. Control of parameters. Temperature control. Food storage. Product design. Introduction to hygiene and sanitation in food service establishments. Sources of contamination and their control. Waste Disposal. Pest and Rodent Control. Personnel Hygiene.

Module:4	Food safety management, laws and standards	6 hours	CO: 4

Food safety measures. Food safety management tools-basic concepts. PRPs, GHPs, GMPs, SSOPs. HACCP. ISO series. TQM-concept, need for quality, components of TQM and Kaizen. Risk analysis. Accreditation and auditing, Water analysis, Surface sanitation and personal hygiene.

Module:5	Food laws and standards	5 hour	CO: 5

Food laws and standards- Indian food regulatory regime, FSSA and Global Scenario CAC. Other laws and standards related to food. Recent concerns-new and emerging pathogens. Packaging, product labeling and nutritional labeling. Genetically modified foods\ transgenics. Organic foods. Newer approaches to food safety. Recent outbreaks. Indian and International standards for food products.

Module:6	**Contemporary Issues**	**2 hour**	**CO: 3,5**
Lecture by Industrial Expert			
		Total Lecture hours	**32**
List of Experiments			**CO: 6**
1.	Studies on enzymatic browning of fruits and vegetables		2.5 hours
2.	Water quality analysis, physico-chemical and microbiological.		5 hours
3.	Preparation of different types of media.		2.5 hours
4.	Microbiological Examination of different food samples		4hours
5.	Assessment of personal hygiene.		2.5 hours
6.	Assessment of surface sanitation by swab/rinse method.		5 hours
7.	Biochemical tests for identification of bacteria.		5 hours
8.	Scheme for the detection of food borne pathogens		5 hours
9.	Preparation of plans for Implementation of FSMS - HACCP, ISO: 22000.		5 hours
10.	Implementation of HACCP in a food industry		2.5 hours
		Total Laboratory Hours	**40**

Text Books	
1.	Srilakshmi . 2018. Food science. 7 th Edition. New age international publishers, New Delhi.
2.	Martin Ray Adams, Maurice O. Moss and Peter McClure. 2016. Food Microbiology. Royal society of chemistry, Cambridge, UK.
Reference Books	
1.	Avantina Sharma. 2017. Text book of food science and technology. 2nd edition, CBS Publishers & Distributors Pvt. Ltd, New Delhi.
2.	William C Frazier, Dennis C Westhoff and N M Vanitha. 2013. McGraw Hill education (India) Pvt. Ltd.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	05-03-2019		
Approved Academic Council	No.54	**Date**	14-03-2019

III year

Course code	Principles of Integrated Pest and Disease Management	L	T	P	C
BAG3001		2	0	2	3
Pre-requisite		Syllabus version			
BAG1019, BAG1021	Fundamentals of Plant Pathology and Fundamentals of Entomology	1.0			

Course Objectives: The course is aimed at

1. Describing the economic importance of pest and diseases and its effect on plants
2. Demonstrate the use of appropriate control and eradication methods
3. Recognizing effective and environmentally friendly methods to control pests and diseases

Expected Course Outcome: At the end of the course the student should be able to

1. Collect data on pest and disease attacks in a farmer's field
2. Calculate the threshold level of crop pests and diseases
3. Device crop pest and disease control measures
4. Recommend integrated pest and disease control measures
5. Diagnose, assess and practice integrated pest and disease management

Module:1	Scope and importance	8 hours	CO: 1

Identification of insect pest and disease categories in agricultural and horticultural crops. IPDM: Introduction to integrated pest and disease management, history, importance, concepts, principles and tools

Module:2	Risk analysis	8 hours	CO: 2

Economic importance of insect pests, diseases and risk analysis. Methods of detection and diagnosis of insect pest and diseases. Calculation and dynamics of economic injury level and importance of Economic threshold level of pest and diseases

Module:3	Control measures	6 hours	CO: 3

Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control of insects and diseases. Ecological management of crop environment. Introduction to conventional pesticides for the insect pests and disease management.

Module:4	Forecasting	4 hours	CO: 4

Survey surveillance and forecasting of insect pests and diseases. Development and validation of integrated pest and pathogen management modules.

Module:5	Integrated pest and disease management	4 hours	CO: 4

Implementation and impact of IPM (IPM module for Insect pest and disease. Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM programmes.

Module:6	Contemporary Issues	2 hours	CO: 4

Lecture by industrial expert

	Total Lecture hours:	32
List of Experiments		CO: 5
1.	Methods of diagnosis and detection of various insect pests in agricultural and horticultural crops	5 hours
2.	Methods of diagnosis and detection of various diseases in agricultural and horticultural crops	5 hours
3.	Methods of measurement of pest and disease affected crops. Assessment of	2.5 hours

	crop yield losses and calculations based on economics of IPM	
4.	Identification of biocontrol agents to control crop pests and diseases: predators and natural enemies	5 hours
5.	Mass multiplication of *Trichoderma, Pseudomona*s, *Trichogramma and NPV*	5 hours
6.	Identification and nature of damage of important insect pests and diseases and their management prospects at field level	5 hours
7.	Agroecosystem dynamics of a selected insect pest and disease	2.5 hours
8.	Assessment of preventive strategies for crop pests and diseases through conventional and IPM modules	2.5 hours
9.	Crop monitoring techniques to control pest and diseases	2.5 hours
10.	Awareness campaign at farmers' fields	5 hours
	Total Laboratory Hours	**40**

Text Book	
1.	Handbook of Integrated Pest Management. 2018. ICAR, Govt. of India.
2.	Mehrotra, R.S. and A. Aggarwal. 2017. Plant Pathology. 3rd Edition, Tata McGraw Hill Publishing Co Ltd., India.
Reference Books	
1.	Bhattacharya, U.K. 2014. Plant Pathology at a Glance. 1st Edition, Kalyani Publishers, India.
2.	Dharam P. Abrol and Uma Shankar. 2016. Integrated Pest Management: Principles and Practice. Reprint Edition. CABI Publishing, UK.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Manures, Fertilizers and Soil Fertility Management	L	T	P	C
BAG 2003		2	0	2	3
Pre-requisite		Syllabus version			
BAG1020	Fundamentals of Soil Science	1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on soil manures and fertilizers
2. Providing a clear understanding on nutrient application and its management
3. Describing basic concepts of soil fertility, soil chemistry and its response to plants

Expected Course Outcome: At the end of the course the student should be able to

1. Comprehend the utility of manures
2. Interpret the importance of varied forms of plant fertilizers
3. Interpret deficiency and toxicity symptoms of nutrients in plants
4. Describe fertility status of soil
5. Deduce fertilizer application methods based on plant and soil analysis
6. Estimate plant and soil nutrients and provide recommendations

Module:1	Organic manures	6 hours	CO: 1

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

Module:2	Chemical fertilizers	4 hours	CO: 2

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

Module:3	Plant Nutrients and uptake	8 hours	CO: 3

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 and factors affecting nutrient availability to plants.

Module:4	Soil nutrients	8 hours	CO: 4

Chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients. Soil fertility evaluation. Soil testing. Critical levels of different nutrients in soil.

Module:5	Soil and plant analysis	4 hours	CO: 5

Forms of nutrients in soil. Plant analysis and rapid plant tissue tests. Indicator plants. Methods of fertilizer recommendations to crops. Factors influencing nutrient use efficiency (NUE). Methods of nutrient application under rainfed and irrigated conditions.

Module:6	Contemporary Issues	2 hours	CO: 5

Lecture by industrial expert

	Total Lecture hours:	32

List of Experiments		CO: 6
1.	Introduction of analytical instruments and their principles, calibration and applications, Colorimetry and flame photometry.	2.5 hours
2.	Estimation of soil organic carbon, Estimation of alkaline hydrolysable N in soils.	5 hours
3.	Estimation of soil extractable P in soils.	2.5 hours

4.	Estimation of exchangeable K, Ca and Mg in soils	5 hours
5.	Estimation of soil extractable S in soils	5 hours
6.	Estimation of potassium in Muraite of Potash/Sulphate of Potash by flame photometer.	5 hours
7.	Estimation of DTPA extractable Zn in soils	5 hours
8.	Estimation of N in plants	5 hours
9.	Estimation of P in plants	2.5 hours
10.	Estimation of K in plants, Estimation of S in plants	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Ranjan Kumar Basak. 2016. Fertilizers: A Text Book. 4th edition, Kalyani publishers, India.
2.	Havlin, J.L., Tisdale, S.L., Nelson, W.L. and J.D. Beaton. 2016. Soil Fertility and Fertilizers. 8th edition, Pearson Education, India.
Reference Books	
1.	Dhyan Singh, P.K. Chhonkar and B.S. Dwivedi. 2015. Manual on soil, plant and water analysis. Westvill Publishing House, Indai.
2.	Soil Science: An Introduction. 2015. Indian Society of Soil Science (ISSS). India.
3.	Das, D.K. 2015. Introductory Soil Science. 4th edition, Kalyani Publishers, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test

Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Pests of crops and stored grains and their management	L	T	P	C
BAG2006		2	0	2	3
Pre-requisite		Syllabus version			
BAG1021	Fundamentals of Entomology	1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on pest management in agricultural and horticultural crops
2. Providing information on optimal insecticides application and fumigation practices
3. Demonstrating management of insect pests in stored grain ecosystems

Expected Course Outcome: At the end of the course the student should be able to

1. Identify major pests of field crops and comprehend their management practices
2. Acquire knowledge on pest management in fruit crops
3. Explain the methods of pest identification and their management in vegetables
4. Demonstrate damage symptoms caused by insect pests and their management in plantation, garden, narcotic, spice and condiment crops
5. Comprehend grain store management
6. Assess losses created due to insect pests in crops and recommend control measures

Module:1	Field crop pests and their management	6 hours	CO: 1

General account on nature and type of damage caused by different arthropods pests. Scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practices of other important arthropod pests of various field crops

Module:2	Fruit crop pests and their management	6 hours	CO: 2

Scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practices of other important arthropod pests of various fruit crops

Module:3	Vegetable crop pests and their management	6 hours	CO: 3

Scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practices of other important arthropod pests of various vegetable crops

Module:4	Pests of plantation, garden, narcotic, spice and condiment crops and their management	6 hours	CO: 4

Scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practices of other important arthropod pests of various plantation, garden, narcotic, spice and condiment crops

Module:5	Pests management in stored grain ecosystem	6 hours	CO: 5

Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain. Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management. Storage structure and methods of grain storage and fundamental principles of grain store management

Module:6	Contemporary Issues	2 hours	CO: 1

Lecture by industrial expert

	Total Lecture hours:	**32 hours**
List of Experiments		**CO: 6**
1.	Identification of different types of damage. Identification and study of life cycle and seasonal history of various insect pests attacking field crops and their produce	5 hours
2.	Identification of different types of damage. Identification and study of life cycle and seasonal history of various insect pests attacking vegetable crops and their produce	5 hours
3.	Identification of different types of damage. Identification and study of life cycle and seasonal history of various insect pests attacking fruit crops and their produce	5 hours
4.	Identification of different types of damage. Identification and study of life cycle and seasonal history of various insect pests attacking plantation, garden, narcotic, spice and condiment crops and their produce	5 hours
5.	Identification of insect pests and mites associated with stored grain	2.5 hours
6.	Determination of insect infestation by different methods. Assessment of losses due to insects	2.5 hours
7.	Calculations on the doses of insecticides application techniques. Fumigation of grain store / godown	5 hours
8.	Identification of rodents and birds and their control operations in godowns	2.5 hours
9.	Methods of grain sampling under storage condition and determination of moisture content of grain	2.5 hours
10.	Visit to nearest Food Corporation of India godowns. V**isit** to Indian Storage Management and Research Institute, Hapur and Quality Laboratory, Department of Food., Delhi **during study tour.**	5hours
	Total Laboratory Hours	**40 hours**

Text Books	
1.	Reddy, P.P. 2017. Insect, mite and vertebrate pests and their management in horticultural crops. Scientific Publishers, India.
2.	Regupathy, A. and R. Ayyasamy. 2016. A guide on crop pests. 6th edition, Namrutha Publications, India.
Reference Books	
1.	Bhargava, M.C., and K.C. Kumavat. 2010. Pests of stored grains and their management. New India Publishing Agency, India.
2.	Muthukrishnan, N., Ganapathy, N., Nalini, R., and R. Rajendran. 2005. Pest Management in horticultural crops. New Madura Publishers, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Diseases of Field and Horticultural Crops and their Management - I	L	T	P	C
BAG2007		2	0	2	3
Pre-requisite		Syllabus version			
BAG1019	Fundamentals of Plant Pathology	1.0			

Course Objectives: The course is aimed at

1.Imparting knowledge on major agricultural and horticultural diseases
2.Describing the disease causing organism and its mode of spread
3. Providing information on management of diseased crops

Expected Course Outcome: At the end of the course the student should be able to

1. Identify and manage major diseases of cereals and millets
2. Manage diseases of pulses and oilseeds
3. Understand the management practices of major diseases affecting vegetables
4. Recognise disease symptoms of fruit crops and plan control measures
5. Comprehend the disease management practices of plantation crops
6. Recommend management practices for major diseases of agricultural and horticultural crops

Module:1	Cereals and millets	8 hours	CO: 1

Symptoms, etiology, disease cycle and management of major diseases of rice: blast, brown spot, bacterial blight, sheath blight, false smut, khaira and tungro; maize: stalk rots, downy mildew, leaf spots; sorghum: smuts, grain mold and anthracnose; bajra: downy mildew and ergot and finger millet: blast and leaf spot

Module:2	Pulses and oilseeds	8 hours	CO: 2

Symptoms, etiology, disease cycle and management of major diseases of pigeonpea: Phytophthora blight, wilt and sterility mosaic; black and green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic; soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; groundnut: early, late leaf spots, wilt; and castor: Phytophthora blight

Module:3	Vegetables	8 hours	CO: 3

Symptoms, etiology, disease cycle and management of major diseases of cruciferous vegetables: Alternaria leaf spot and black rot; Brinjal: Phomopsis blight, fruit rot and Sclerotinia blight; Tomato: damping off, wilt, early and late blight, buck eye rot, leaf curl and mosaic; Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot and Colocasia: Phytophthora blight

Module:4	Fruit crops	3 hours	CO: 4

Symptoms, etiology, disease cycle and management of major diseases of Guava: wilt and anthracnose; Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top; Papaya: foot rot, leaf curl and mosaic, Pomegranate: bacterial blight;

Module:5	Plantation crops	3 hours	CO: 5

Symptoms, etiology, disease cycle and management of major diseases of major diseases of Coconut: wilt and bud rot; Tea: blister blight; Coffee: rust and Tobacco: black shank, black root rot and mosaic

Module:6	Contemporary Issues	2 hours	CO: 1

Lecture by industrial expert

Total Lecture hours:	32
List of Experiments	**CO: 6**

Study of symptoms and host-parasite relationship of:		
1.	Field level identification, diagnosis of symptoms and histopathological studies of major diseases of rice, maize and sorghum	5 hours
2.	Field level identification, diagnosis of symptoms and histopathological studies of major diseases of bajra and fingermillet	2.5 hours
3.	Field level identification, diagnosis of symptoms and histopathological studies of major diseases of groundnut, soybean and castor	5 hours
4.	Field level identification, diagnosis of symptoms and histopathological studies of pigeonpea, urdbean and mungbean	5 hours
5.	Field level identification, diagnosis of symptoms and histopathological studies of guava, banana, papaya and pomegranate	5 hours
6.	Field level identification, diagnosis of symptoms and histopathological studies of crucifers/brinjal/tomato/okra/beans/ginger/colacasia	5 hours
7.	Field level identification of diseases symptoms of coconut/coffee/tea/tobacco	2.5 hours
8.	Survey of major field crop disease incidences	2.5 hours
9.	Methods of fungicide and biocontrol applications, safety and calculation of spray concentrations.	2.5 hours
10.	Collection and preservation of 50 well mounted plant diseased specimens from varied crops for Herbarium	5 hours
	Total Laboratory Hours	**40**

Text Book	
1.	Japtag, G.P., D.N.Dhutraj and Utpal Dey. 2013. Diseases of horticulture crops and their management. Agrobios, India.
2.	Manoj kumar Kalita, 2014. Diseases of field crops and their management. Kalyani publishers, India.
Reference Books	
1.	Bhattacharya, U.K. 2014. Plant Pathology at a Glance. Kalyani Publishers, India.
2.	Narayanasamy, P. 2017. Microbial Plant Pathogens: Detection and Management in Seeds and Propagules. Wiley-Blackwell. New Jersey, USA.
3.	Mehrotra, R.S. and A. Aggarwal. 2017. Plant Pathology. 3rd Edition, Tata McGraw Hill Publishing Co Ltd., India.
4.	Singh, R.S. 2017. Plant Diseases, 10th edition, Medtech, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Crop Improvement – I (Kharif)	L	T	P	C
BAG2004		1	0	2	2
Pre-requisite		Syllabus version			
BAG1015	Fundamentals of Plant Breeding	1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on the use of genetic resources
2. Describing concepts of breeding crops based on objectives
3. Teaching hybrid seed production techniques and introducing to modern breeding concepts

Expected Course Outcome: At the end of the course the student should be able to

1. Infer the importance of plant genetic resources and utilize it in crop improvement
2. Design crop specific breeding methodology
3. Comprehend breeding methods specific to an objective
4. Describe hybrid seed production of various Kharif crops
5. Practice hybridisation and plant breeding

Module:1	Plant genetic resources	3 hours	CO: 1

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation.

Module:2	Plant breeding concepts	3 hours	CO: 2

Study of genetics of qualitative and quantitative characters. Important concepts of breeding self-pollinated, cross pollinated and vegetatively propagated kharif crops.

Module:3	Crop improvement	5 hours	CO: 3

Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality including physical, chemical and nutritional quality.

Module:4	Hybrid seed production and recent breeding concepts	4 hours	CO: 4

Hybrid seed production technology in Maize, Rice, Sorghum, Pearl millet and Pigeon pea. Ideotype concept and climate resilient crop varieties for future.

Module:5	Contemporary Issues	1 hour	CO: 4

Lecture by industrial expert

	Total Lecture hours:	16

List of Experiments		CO: 5
1.	Floral biology, emasculation and hybridization techniques in different crop species; *viz.*, Rice, Jute, Maize, Sorghum, Pearl millet and Ragi.	5 hours
2.	Floral biology, emasculation and hybridization techniques in different crop species; *viz.*, Urdbean, Mung bean, Soybean, Groundnut, Cowpea, Sesame and Castor.	5 hours
3.	Floral biology, emasculation and hybridization techniques in different crop species; *viz.*, Cotton, Tobacco, Brinjal, Okra and Cucurbitaceous crops.	5 hours
4.	Maintenance breeding of different kharif crops	2.5 hours
5.	Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods	5 hours
6.	Study of field techniques for seed and hybrid seeds production in Kharif crops	5 hours
7.	Estimation of heterosis, inbreeding depression and heritability.	2.5 hours

8.	Layout of field experiments.	2.5 hours
9.	Study of quality characters, donor parents for different characters.	2.5 hours
10.	Visit to seed production plots; Visit to AICRP plots of different field crops.	5 hours
	Total Laboratory Hours	**40**

Text Book	
1.	Singh, B.D. 2018. Plant breeding principles and methods. Kalyani Publishers, India.
2.	Vanangamudi, K and Vijayakumar, A. 2015. Hybrid Seed Production of Agronomic Crops. Agrobios, India.
Reference Books	
1.	Neto, R.F. and A. Borem. 2012. Plant breeding for abiotic stress tolerance. Springer-Verlag, Germany.
2.	Phundan Singh. 2015. Essentials of Plant Breeding. Kalyani Publishers, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Entrepreneurship Development, Business Communication and IPR	L	T	P	C
MGT1053		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Explaining entrepreneurship development
2. Imparting managerial and project planning skills
3. Describing IPR and plant variety protection in India

Expected Course Outcome: At the end of the course the student should be able to

1. Acquire knowledge on entrepreneurship development
2. Develop organizational, managerial, problem-solving and project planning skills
3. Analyze the types of intellectual property and legislations covering IPR in India
4. Acquire knowledge on protection of plant varieties and biological diversity
5. Comprehend agri-business projects, property and diversity protections

Module:1	Entrepreneurship	3 hours	CO: 1

Concept of entrepreneur and entrepreneurship development. Characteristics of entrepreneurs; SWOT Analysis & achievement motivation. Government policy and programs and institutions for entrepreneurship development. Impact of economic reforms on Agribusiness/Agri enterprises and entrepreneurial development process.

Module:2	Business management and project planning	5 hours	CO: 2

Business leadership skills. Developing organizational skill: controlling, supervising, problem solving, monitoring and evaluation. Developing managerial skills, business leadership skills: communication, direction and motivation skills and problem solving skills. Supply chain and total quality management. Project planning, formulation and report preparation. Financing of enterprise, opportunities for Agri entrepreneurship and rural enterprise.

Module:3	Intellectual Property Rights	4 hours	CO: 3

Introduction and meaning of intellectual property, brief introduction to GATT, WTO, TRIPs and WIPO, treaties for IPR protection: Madrid protocol, Berne Convention and Budapest treaty. Types of intellectual property and legislations covering IPR in India: Patents, copyrights, trademark, industrial design, geographical indications, integrated circuits and trade secrets. Patents Act 1970 and Patent system in India. Patentability, process and product patent, filing of patent, patent specification, patent claims, patent opposition and revocation, infringement, compulsory licensing, patent cooperation treaty, patent search and patent database.

Module:4	Protection of plant variety	3 hours	CO: 4

Origin and history including a brief introduction to UPOV for protection of plant varieties. Protection of plant varieties under UPOV and PPV & FR Act of India, plant breeders' rights, registration of plant varieties under PPV& FR Act 2001, breeders, researcher and farmers rights. Traditional knowledge-meaning and rights of TK holders. Convention on Biological Diversity and International treaty on plant genetic resources for food and agriculture (ITPGRFA). Indian Biological Diversity Act, 2002 and its salient features, access and benefit sharing.

Module:5	Contemporary Issues	1 hour	CO: 1

Lecture by industrial expert

Total Lecture hours:	16
List of Experiments	**CO: 5**

1.	Assessing entrepreneurial traits	2.5 hours
2.	Assessing problem solving skills and managerial skills	2.5 hours
3.	Assessing achievement motivation	2.5 hours
4.	Exercise in creativity, time audit through planning, monitoring and supervision.	2.5 hours
5.	Identification and selection of business idea	2.5 hours
6.	Preparation of business plan and proposal writing	5 hours
7.	Visit to entrepreneurship development institute to gain more knowledge on entrepreneurship training and development programs	5 hours
8.	Visit to agri enterprises and entrepreneurs	5 hours
9.	Visit to Intellectual Property Office to acquire knowledge about Indian Patent System	2.5 hours
10.	Visit to a biodiversity authority office to provide exposure on the use of biological resources and associated knowledge	5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Charantimath Poornima, M. 2018. Entrepreneurship Development and Small Business Enterprises. 3rd edition, Pearson Education, India.
2.	Ahuja, V.K. 2015. Intellectual Property Rights in India. Lexis Nexis, Vedams eBooks [P] Ltd., India.
Reference Books	
1.	Simon Down. 2010. Enterprise, Entrepreneurship and Small Business. SAGE Publications Ltd. India.
2.	Elizabeth Verkey. 2007. Law of Plant Varieties Protection. Eastern Book Company, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No.64	**Date**	16/12/2021

Course code	Geoinformatics, Nanotechnology and Precision Farming	L	T	P	C
BAG3004		1	0	2	2
Pre-requisite	Farming System & Sustainable Agriculture	Syllabus version			
BAG2017		1.0			

Course Objectives: The course is aimed at

1. Introducing techniques involved in precision agricultural farming
2. Explaining the role of geographic information system, global positioning system and remote sensing in precision farming
3. Imparting knowledge on the use of nanotechnology in improving farm productivity

Expected Course Outcome: At the end of the course the student should be able to

1. Define the role of remote sensing in precision agriculture
2. Demonstrate the knowledge gained on geographical information system
3. Comprehend simulation models on precision agriculture
4. Explain the role of nanotechnology in improving agriculture
5. Apply geoinformatics and nanotechnology in precision farming projects

Module:1	Precision agriculture	4 hours	CO: 1

Concepts and techniques; their issues and concerns for Indian agriculture; Crop discrimination and Yield monitoring; Remote sensing concepts and application in agriculture

Module:2	Geo-informatics	4 hours	CO: 2

Definition, concepts, tools, techniques and their use in precision agriculture. Soil mapping and fertilizer recommendation using geospatial technologies. Spatial data and their management in GIS

Module:3	Image processing and interpretation	4 hours	CO: 3

Global positioning system (GPS), components and its functions; Introduction to crop simulation models and their uses for optimization of agricultural inputs; STCR approach for precision agriculture

Module:4	Nanotechnology	3 hours	CO: 4

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

Module:5	Contemporary Issues	1 hour	CO: 1

Lecture by industrial expert

	Total Lecture hours:	16

List of Experiments		CO: 5
1.	Introduction to GIS software, spatial data creation and editing	2.5 hours
2.	Introduction to image processing software	5 hours
3.	Visual and digital interpretation of remote sensing images	2.5 hours
4.	Generation of spectral profiles of different objects	5 hours
5.	Supervised and unsupervised classification and acreage estimation.	5 hours
6.	Multispectral remote sensing for soil mapping. Creation of thematic layers of soil fertility based on GIS	5 hours
7.	Creation of productivity and management zones.	2.5 hours
8.	Fertilizers recommendations based of VRT and STCR techniques.	2.5 hours
9.	Crop stress (biotic/abiotic) monitoring using geospatial technology. Use of GPS for agricultural survey	5 hours

10.	Formulation, characterization and applications of nanoparticles in agriculture. Projects formulation and execution related to precision farming.	5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Reddy, S. R. 2017. Geoinformatics and Nanotechnology for Precision Farming. First edition. Kalyani Publishers, India.
2.	Guangxing Wang and Qihao Weng. 2013. Remote Sensing of Natural Resources. CRC Press, Taylor and Francis Group, USA.
Reference Books	
1.	David E. Clay and John F. Shanahan. 2011. GIS Application in Agriculture, Volume II. CRC Press, Taylor and Francis Group, LLC, USA.
2.	Francis J. Peirce and David Clay. 2007. GIS Applications in Agriculture. CRC Press, Taylor and Francis Group, LLC, USA.

Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Practical Crop Production-I (Kharif Crops)	L	T	P	C
BAG3002		0	0	0	2
Pre-requisite	Crop Production Technology - I	Syllabus version			
BAG2001		1.0			

Course Objectives: The course is aimed at

1. Planning and practicing cultivation of kharif crops
2. Imparting knowledge on integrated nutrient pest and disease management
3. Sharing knowledge on marketing of produce and calculating cost benefit ratio

Expected Course Outcome: At the end of the course the student should be able to

1. Plan and decide on growing a suitable kharif crop
2. Decide on the best cropping system that can be followed for a kharif season
3. Recommend package of practices for growing kharif crops
4. Practice kharif crop production through integrated management
5. Calculate cost benefit ratio based on cultivation and marketing expenses of a crop

Project

1.	Crop planning	2.5 hours	**CO: 1**
2.	Raising field crops in multiple cropping systems	2.5 hours	**CO: 2**
3.	Field preparation, seed treatment	2.5 hours	**CO: 3**
4.	Nursery raising and sowing	2.5 hours	**CO: 3**
5.	Nutrient, water and weed management	5 hours	**CO: 3**
6.	Management of insect-pests and diseases of crops	5 hours	**CO: 3**
7.	Harvesting, threshing, drying winnowing, storage, marketing of produce	5 hours	**CO: 3**
8.	Seed production, mechanization, resource conservation	5 hours	**CO: 3**
9.	Integrated nutrient, insect-pest and disease management technologies	5 hours	**CO: 4**
10.	Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students	5 hours	**CO: 5**
	Total project hours		**40**

Text Book

1. Tomar, G.S., S.K. Taunkand J.L. Choudhary. 2011. Science of Crop Production PART-1 (Kharif Crops). Kushal Publications and Distributors, India.
2. Rajendra Prasad. 2017. Textbook of field crops production, Volume 1 and 2 (Food grain crops & Commercial Crops). ICAR, India.

Reference Books

1. Joshi M. 2015. Textbook of Field Crops. Prentice Hall India Learning Private Limited, India.
2. Reddy, S.R and Reddi Ramu Y. 2016. Agronomy of Field Crops. 5th edition. Kalyani Publishers, India.

Mode of Evaluation: Assessments and Report

Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Rainfed Agriculture & Watershed Management	L	T	P	C
BAG3005		1	0	2	2
Pre-requisite	Farming System & Sustainable Agriculture	Syllabus version			
BAG2017		1.0			

Course Objectives: The course is aimed at

1. Explaining the problems faced in rainfed agricultural systems
2. Imparting knowledge on drought management strategies
3. Describing watershed management techniques

Expected Course Outcome: At the end of the course the student should be able to

1. Build knowledge on solving problems related to rainfed agriculture
2. Identify several drought management strategies
3. Plan crop and water management approaches to mitigate drought
4. Perceive the necessity and difficulties of watershed management
5. Recommend practices to be followed in rainfed farming systems

Module:1	Rainfed agriculture	5 hours	CO: 1

Introduction, types, history of rainfed agriculture and watershed in India. Problems and prospects of rainfed agriculture in India. Soil and climatic conditions prevalent in rainfed areas. Soil and water conservation techniques.

Module:2	Drought management	3 hours	CO: 2

Drought: types, the effect of water deficit on physio-morphological characteristics of the plants, crop adaptation, and mitigation of drought

Module:3	Crop and water management	4 hours	CO: 3

Water harvesting: importance, its techniques, efficient utilization of water through soil and crop management practices. Management of crops in rainfed areas. Contingent crop planning for aberrant weather conditions.

Module:4	Watershed management	3 hours	CO: 4

Concept, objective, principles, and components of watershed management. Factors affecting watershed management.

Module:5	Contemporary Issues	1 hour	CO: 1

Lecture by industrial expert

	Total Lecture hours:	16
List of Experiments		**CO: 5**
1.	Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons.	2.5 hours
2.	Studies on cropping pattern of different rainfed areas in the country.	5 hours
3.	Demarcation of the rainfed area on the map of India.	2.5 hours
4.	Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops.	5 hours
5.	Critical analysis of rainfall and possible drought period in the country, effective rainfall and its calculation.	5 hours
6.	Studies on cultural practices for mitigating moisture stress.	5 hours
7.	Characterization and delineation of the model watershed.	2.5 hours
8.	Field demonstration on soil and moisture conservation measures.	2.5 hours
9.	Field demonstration on the construction of water harvesting structures.	5 hours

10.	Visiting rainfed research station/watershed.	5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Subbareddy, G., Reddy, Y.V.R, Vittal, K.P.R, Thyagaraj, C.R., Ramakrishna, Y.S. and Somani, L.L. 2016. Dryland Agriculture. 2nd Edition, Agrotech Publishing Academy, India.
2.	Oswal. M.C. 2017. Watershed Management (for Dryland Agriculture). Associated Publishing Company. India.
Reference Books	
1.	Humberto Blanco-Canqui and Rattan Lal. 2008. Principles of Soil Conservation and Management. Atlantic Pub. & Distr. (P) Ltd., New Delhi, India.
2.	Singh, S.S. 2016. Crop management under rainfed and irrigated condition. Kalyani Publishers, India.

Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	64	**Date**	16/12/2021

Course code	Protected Cultivation and Secondary Agriculture	L	T	P	C
BAG1006		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed to

1. Explain the basics of protected cultivation and its significance in crop cultivation
2. Demonstrate about different types of greenhouse, its design and cost estimation.
3. Discuss about various drying methods and dryers for post-harvest processing of crops

Expected Course Outcome: At the end of the course the student should be able to

1. Summarize the scope and importance of greenhouse technology in improving crop production
2. Compare various types of greenhouses, its advantages and cost benefits
3. Elaborate on post-harvest processing techniques of various crops
4. Interpret and compare different drying methods and dryer types applicable for various crops
5. Explain on the uses of greenhouse pertaining to crop production and post-harvest processing

Module:1	Greenhouse technology	4 hours	CO: 1

Introduction, types of green houses, plant response to greenhouse environment, planning and design of greenhouses, design criteria of green house for cooling and heating purposes.

Module:2	Greenhouse equipments and cost analysis	6 hours	CO: 2

Greenhouse equipments, materials of construction for traditional and low-cost green houses. Irrigation systems used in greenhouses, typical applications, passive solar green house, hot air greenhouse heating systems and green house drying. Cost estimation and economic analysis.

Module:3	Post-harvest technology	2 hours	CO: 3

Important engineering properties such as physical, thermal, aero and hydrodynamic properties of cereals, pulses and oilseeds, their application in PHT equipment design and operation.

Module:4	Drying methods and dryer types	3 hours	CO: 4

Drying and dehydration, moisture measurement, EMC, drying theory, various drying methods, commercial grain dryer: deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, re-circulatory dryer and solar dryer. Material handling equipment, conveyer and elevators, their principle, working and selection.

Module:5	Contemporary Issues	1 hour	CO: 1

Lecture by industrial expert

	Total Lecture Hours	16

List of Experiments		CO: 5
1.	Study of different type of greenhouses based on shape.	2.5 hours
2.	Determine the rate of air exchange in an active summer winter cooling system.	5 hours
3.	Determination of drying rate of agricultural products inside green house.	5 hours
4.	Study of greenhouse equipment.	5 hours
5.	Visit to various Post Harvest Laboratories.	2.5 hours
6.	Determination of moisture content of various grains by oven drying moisture method.	5 hours
7.	Determination of moisture content of various grains by infrared moisture method.	2.5 hours
8.	Determination of engineering properties *viz.,* shape, size, bulk density and porosity of biomaterials.	5 hours

9.	Determination of moisture content of various grains by moisture meter.	5 hours
10.	Field visit to a seed processing plant.	2.5 hours
	Total Laboratory Hours	**40**

Text Book	
1.	Singh, B., Singh, B. Sabir, N and M. Hasan. 2014. Advances in Protected Cultivation, New India Publishing Agency, India.
2.	Amalendu Chakraverty and R. Paul Singh. 2016. Post-harvest technology and food process engineering. CRC press, USA.
Reference Books	
1.	Singh, D. K. and K.V. Peter. 2014. Protected Cultivation of Horticultural crops. New India Publishing Agency, India.
2.	David W. Reed. 1996. A Grower's Guide to Water, media and nutrition for green house crops. Ball publishing, USA.
3.	Sudheer, K.P. and V. Indira. 2007. Post-harvest technology of horticultural crops. New India publishing agency, India.

Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	64	**Date**	16/12/2021

Course code	Diseases of Field and Horticultural Crops and their Management - II	L	T	P	C
BAG2008		2	0	2	3
Pre-requisite	Fundamentals of Plant Pathology	Syllabus version			
BAG1019		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on major agricultural and horticultural diseases
2. Describing the disease causing organism and its mode of spread
3. Providing information on management of diseased crops

Expected Course Outcome: At the end of the course the student should be able to

1. Identify and manage major diseases of cereals and pulses
2. Manage diseases of cash crops and oilseeds
3. Understand the management practices of major diseases affecting vegetables
4. Recognise disease symptoms of spices and flower crops and plan control measures
5. Comprehend the disease management practices of fruit crops
6. Recommend management practices for major diseases of agricultural and horticultural crops

Module:1	Cereals and pulses	6 hours	CO: 1

Symptoms, etiology, disease cycle and management of major diseases of Wheat: rusts, loose smut, karnal bunt, powdery mildew, alternaria blight and ear cockle; Gram: wilt, grey mould and Ascochyta blight; Lentil: rust and wilt; Pea: downy mildew, powdery mildew and rust.

Module:2	Cash crops and oilseeds	8 hours	CO: 2

Symptoms, etiology, disease cycle and management of major diseases of Sugarcane: red rot, smut, wilt, grassy shoot, ratoon stunting and Pokkah Boeng; Cotton: anthracnose, vascular wilt, and black arm; Sunflower: Sclerotinia stem rot and Alternaria blight; Mustard: Alternaria blight, white rust, downy mildew and Sclerotinia stem rot.

Module:3	Vegetables	4 hours	CO: 3

Symptoms, etiology, disease cycle and management of major diseases of Potato: early and late blight, black scurf, leaf roll, and mosaic; Cucurbits: downy mildew, powdery mildew, wilt; Onion and garlic: purple blotch, and Stemphylium blight.

Module:4	Spices and flower crops	4 hours	CO: 4

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.

Module:5	Fruit crops	8 hours	CO: 5

Symptoms, etiology, disease cycle and management of major diseases of Mango: anthracnose, malformation, bacterial blight and powdery mildew; Citrus: canker and gummosis; Grape vine: downy mildew, powdery mildew and anthracnose; Apple: scab, powdery mildew, fire blight and crown gall; Peach: leaf curl; Strawberry: leaf spot.

Module:6	Contemporary Issues	2 hours	CO: 1

Lecture by industrial expert

Total Lecture hours:	**32**

List of Experiments		CO: 6
1.	Field level identification, diagnosis of symptoms and histopathological studies of major diseases of wheat, gram, lentil and pea	5 hours
2.	Field level identification, diagnosis of symptoms and histopathological studies of major diseases of sugarcane and cotton	5 hours

3.	Field level identification, diagnosis of symptoms and histopathological studies of major diseases of sunflower and mustard	5 hours
4.	Field level identification, diagnosis of symptoms and histopathological studies of potato, cucurbits, onion and garlic	5 hours
5.	Field level identification, diagnosis of symptoms and histopathological studies of chillies, turmeric, coriander, marigold and rose	2.5 hours
6.	Field level identification, diagnosis of symptoms and histopathological studies of mango, citrus and grape vine	5 hours
7.	Field level identification of diseases symptoms of apple/peach/strawberry	2.5 hours
8.	Survey of major field crop disease incidences	2.5 hours
9.	Methods of fungicide and biocontrol applications, safety and calculation of spray concentrations.	2.5 hours
10.	Collection and preservation of 50 well mounted plant diseased specimens from varied crops for Herbarium	5 hours
	Total Laboratory Hours	**40**

Text Book	
1.	Japtag, G.P., D.N.Dhutraj and Utpal Dey. 2013. Diseases of horticulture crops and their management. Agrobios, India.
2.	Manoj kumar Kalita, 2014. Diseases of field crops and their management. Kalyani publishers, India.
Reference Books	
1.	Bhattacharya, U.K. 2014. Plant Pathology at a Glance. Kalyani Publishers, India.
2.	Narayanasamy, P. 2017. Microbial Plant Pathogens: Detection and Management in Seeds and Propagules. Wiley-Blackwell. New Jersey, USA.
3.	Mehrotra, R.S. and A. Aggarwal. 2017. Plant Pathology. 3rd Edition, Tata McGraw Hill Publishing Co Ltd., India.
4.	Singh, R.S. 2017. Plant Diseases, 10th edition, Medtech, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Post-Harvest Management and Value Addition of Fruits and Vegetables	L	T	P	C
BAG2022		1	0	2	2
Pre-requisite	Fundamentals of Horticulture	Syllabus version			
BAG1022		1.0			

Course Objectives: The course is aimed at

1. Describing the role of post-harvest technology in extending shelf life of agricultural produces
2. Improving the knowledge and need on value addition in agro-processing
3. Developing hands on training on processing of different fruits and vegetable products

Expected Course Outcome: At the end of the course the student should be able to

1. Discuss on the importance of post-harvest management of crops
2. Analyze effective methods of storage of the harvested produce
3. Define processing and value addition of harvested crop produces
4. Formulate and describe packaging of value added products from fruits and vegetables
5. Develop entrepreneur skills and discover ideas to process fruits and vegetables

Module:1	Post-harvest processing	2 hours	CO: 1

Importance of post-harvest processing of fruits and vegetables, extent and possible factors of post- harvest losses

Module:2	Pre-harvesting and storage	5 hours	CO: 2

Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Harvesting and field handling; Methods of storage-precooling, ZECC, cold storage, controlled atmosphere storage, modified atmospheric storage and hypobaric storage.

Module:3	Value addition	5 hours	CO: 3

Concept of value addition; Principles and methods of preservation; Intermediate moisture food-Jam, jelly, marmalade, preserve, candy-concepts and standards; Fermented and non-fermented beverages. Tomato products-concepts and standards.

Module:4	Processing and packaging	3 hours	CO: 4

Drying/Dehydration of fruits and vegetables-concept and methods, osmotic drying. Canning-concepts and standards, packaging of products

Module:5	Contemporary Issues	1 hour	CO: 5

Lecture by industrial expert

	Total Lecture hours	16
List of Experiments		**CO: 5**
1.	Applications of different types of packaging, containers for shelf life extension.	2.5 hours
2.	Effect of temperature on shelf life and quality of produce.	5 hours
3.	Demonstration of chilling and freezing injury in vegetables and fruits.	2.5 hours
4.	Extraction and preservation of pulps and juices.	5 hours
5.	Preparation of fruit jams and jellies.	5 hours
6.	Preparation of RTS, nectar and squash.	5 hours
7.	Preparation of osmotically dried products, fruit bar and candy	2.5 hours
8.	Preparation of tomato sauce, ketchup and canned products	5 hours
9.	Quality evaluation of products- physico-chemical and sensory.	5 hours

10.	Visit to processing unit/ industry	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Hosahalli S. Ramaswamy. 2014. Post-harvest Technologies of Fruits and Vegetables. DEStceh Pubilcaitons Inc., USA.
2	Srivastava, RP and Kumar, Sanjeev. 2017. Fruits and Vegetable Preservation Principles and Practices. 3rd Edition.CBS Publishers & Distributors, India.
Reference Books	
1.	Jagadish Chandra Jana., Tanmay Kumar Koley., Arghya Mani., Chandan Karak., Dipak Kumar Murmu. 2018. Advances in post harvest management, processing and value addition of horticultural crops-Part 2: Vegetables, spices and plantation crops. Today and Tomorrow's Printers and Publishers, India.
2.	Nirmal Sinha., Jiwan Sidhu Jozsef Barta, James Wu. and M. Pilar Cano. 2012. Handbook of Fruits and Fruit Processing. 2nd Edition, John Wiley & Sons, Ltd. Publication, USA.
3.	Nirmal Sinha, Y. H. Hui, E. Özgül Evranuz, Muhammad Siddiq and Jasim Ahmed. 2010. Handbook of Vegetables and Vegetable Processing. Wiley Blackwell, USA.

Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code BAG2019	Management of Beneficial Insects	L	T	P	C
		1	0	2	2
Pre-requisite	Fundamentals of Entomology	Syllabus version			
BAG1021		1.0			

Course Objectives: The course is aimed at

1. Instructing on production techniques involved in beekeeping and silkworm rearing
2. Describing lac products and production techniques
3. Imparting knowledge on biological control of insect pests using natural enemies.

Expected Course Outcome: At the end of the course the student should be able to

1. Acquire knowledge on honeybee species and apiary management
2. Understand mulberry cultivation and silkworm rearing techniques
3. Comprehend lac culture and their products
4. Acquire knowledge on biological control of insect pests
5. Recommend package of practices for rearing honeybee, silkworm and lac

Module:1	Beekeeping	4 hours	CO: 1

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

Module:2	Sericulture	5 hours	CO: 2

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

Module:3	Lac culture	2 hours	CO: 3

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

Module:4	Biological control of insect pests	4 hours	CO: 4

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.

Module:5	Contemporary Issues	1 hour	CO: 1

Lecture by industrial expert

	Total Lecture hours:	16 hours

List of Experiments		CO: 5
1.	Honey bee species, castes of bees	5 hours
2.	Bee keeping appliances and seasonal management	2.5 hours
3.	Bee pasturage, bee foraging and communication	2.5 hours
4.	Types of silkworm, voltinism and biology of silkworm	5 hours
5.	Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves	5 hours
6.	Species of lac insect, host plant identification	2.5 hours
7.	Identification of other important pollinators, weed killers and scavengers	5 hours

8.	Visit to research/training institutions devoted to beekeeping, sericulture and lac culture	5 hours
9.	Visit to research/training institutions devoted to natural enemies	5 hours
10.	Identification and techniques for mass multiplication of natural enemies	2.5 hours
	Total Laboratory Hours	**40 hours**

Text Books	
1.	Srivastava, K.P. and G.S. Dhaliwal. 2013. A text book of applied entomology, Volume 2. Kalyani Publishers, India.
2.	Ragumoorthy, K.N., M.R. Srinivasan, V. Balasubramanian and N. Natarajan. 2016. Principles of Applied Entomology, Ae Publications. India.
Reference Books	
1.	David V. Alford. 2019. Beneficial Insects. CRC Press, USA.
2.	Opender Koul and G.S. Dhaliwal. 2019. Predators and Parasitoids. CRC Press, USA.
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test	

Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No.64	**Date**	16/12/2021

Course code	Crop Improvement – II (Rabi)	L	T	P	C
BAG2005		1	0	2	2
Pre-requisite		Syllabus version			
BAG1015	Fundamentals of Plant Breeding	1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on the use of genetic resources
2. Describing concepts of breeding crops based on objectives
3. Teaching hybrid seed production techniques and introducing to modern breeding concepts

Expected Course Outcome: At the end of the course the student should be able to

1. Infer the importance of plant genetic resources and utilize it in crop improvement
2. Design crop specific breeding methodology
3. Comprehend breeding methods specific to an objective
4. Describe hybrid seed production of various rabi crops
5. Practice hybridisation and plant breeding

Module:1	Plant genetic resources	3 hours	CO: 1

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation.

Module:2	Plant breeding concepts	3 hours	CO: 2

Study of genetics of qualitative and quantitative characters. Important concepts of breeding self-pollinated, cross pollinated and vegetatively propagated rabi crops.

Module:3	Crop improvement	5 hours	CO: 3

Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality including physical, chemical and nutritional quality.

Module:4	Hybrid seed production and recent breeding concepts	4 hours	CO: 4

Hybrid seed production technology of rabi crops. Ideotype concept and climate resilient crop varieties for future.

Module:5	Contemporary Issues	1 hour	CO: 4

Lecture by industrial expert

	Total Lecture hours:	16
List of Experiments		**CO: 5**
1.	Floral biology, emasculation and hybridization techniques in different crop species; *viz.*, Wheat, Oat and Barley	5 hours
2.	Floral biology, emasculation and hybridization techniques in different crop species; *viz.*, Chickpea, Lentil, Field pea, Rajma and Horse gram	5 hours
3.	Floral biology, emasculation and hybridization techniques in different crop species; *viz.*, Rapeseed Mustard, Sunflower and Safflower	5 hours
4.	Floral biology, emasculation and hybridization techniques in different crop species; *viz.*, Potato, Berseem. Sugarcane, Tomato, Chilli and Onion	5 hours
5.	Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods	2.5 hours
6.	Study of field techniques for seed and hybrid seeds production in rabi crops	5 hours
7.	Estimation of heterosis, inbreeding depression and heritability.	2.5 hours
8.	Layout of field experiments.	2.5 hours

9.	Study of quality characters, donor parents for different characters.	2.5 hours
10.	Visit to seed production plots; Visit to AICRP plots of different field crops.	5 hours
Total Laboratory Hours		**40**
Text Books		
1.	Singh, B.D. 2018. Plant breeding principles and methods. Kalyani Publishers, India.	
2.	Vanangamudi, K and Vijayakumar, A. 2015. Hybrid Seed Production of Agronomic Crops. Agrobios, India.	
Reference Books		
1.	Neto, R.F. and A. Borem. 2012. Plant breeding for abiotic stress tolerance. Springer-Verlag, Germany.	
2.	Phundan Singh. 2015. Essentials of Plant Breeding. Kalyani Publishers, India.	

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Practical Crop Production-II (Rabi Crops)	L	T	P	C
BAG3003		0	0	0	2
Pre-requisite	Crop Production Technology - II	Syllabus version			
BAG2002		1.0			

Course Objectives: The course is aimed at

1. Planning and practicing cultivation of rabi crops
2. Imparting knowledge on integrated nutrient pest and disease management
3. Sharing knowledge on marketing of produce and calculating cost benefit ratio

Expected Course Outcome: At the end of the course the student should be able to

1. Plan and decide on growing a suitable rabi crop
2. Decide on the best cropping system that can be followed for a rabi season
3. Recommend package of practices for growing rabi crops
4. Practice rabi crop production through integrated management
5. Calculate cost benefit ratio based on cultivation and marketing expenses of a crop

Project

1.	Crop planning	2.5 hours	**CO: 1**
2.	Raising field crops in multiple cropping systems	2.5 hours	**CO: 2**
3.	Field preparation, seed treatment	2.5 hours	**CO: 3**
4.	Nursery raising and sowing	2.5 hours	**CO: 3**
5.	Nutrient, water and weed management	5 hours	**CO: 3**
6.	Management of insect-pests and diseases of crops	5 hours	**CO: 3**
7.	Harvesting, threshing, drying winnowing, storage and marketing of produce	5 hours	**CO: 3**
8.	Seed production, mechanization, resource conservation	5 hours	**CO: 3**
9.	Integrated nutrient, insect-pest and disease management technologies	5 hours	**CO: 4**
10.	Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students	5 hours	**CO: 5**
	Total project hours		**40**

Text Book

1. Suresh Singh Tomar, Yagya Dev Mishra and Shailendra Singh Kushah. 2018. Production Technology of Rabi Crops. Biotech books, India.
2. Rajendra Prasad. 2017. Textbook of field crops production, Volume 1 and 2 (Food grain crops & Commercial Crops). ICAR, India.

Reference Books

1. Joshi M. 2015. Textbook of Field Crops. Prentice Hall India Learning Private Limited, India.
2. Chhidda, S., Singh P. and Singh R.. 2020. Modern techniques of raising field crops. 2nd Revised Edition. Oxford & IBH Publishing Co Pvt. Ltd., India.

Mode of Evaluation: Assessments and Report

Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Principles of Organic Farming	L	T	P	C
BAG1008		1	0	2	2
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on the scope and concepts of organic farming in India
2. Discussing on indigenous weed, pest, disease and nutrient management for organic farming
3. Educating students on the certification and marketing of organic farm produces

Expected Course Outcome: At the end of the course the student should be able to

1. Analyze the scope of organic farming
2. Recommend varieties suitable for organic farming
3. Comprehend management practices suitable for organic farming
4. Understand processing and marketing of organic products
5. Develop entrepreneur skills and ideas to practice organic farming

Module:1	Scope	2 hours	CO: 1

Organic farming, principles and its scope in India; Initiatives taken by central and state Government, NGO's and other organizations for promotion of organic agriculture.

Module:2	Concepts and crop selection	5 hours	CO: 2

Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; Choice of crops and varieties in organic farming.

Module:3	Management	5 hours	CO: 3

Fundamentals of insect, pest, disease and weed management under organic mode of production; Operational structure of National Programme for Organic Production (NPOP)

Module:4	Certification and marketing	3 hours	CO: 4

Certification process and standards of organic farming; Processing, leveling, economic considerations and viability, marketing and export potential of organic products.

Module:5	Contemporary Issues	1 hour	CO: 5

Lecture by industrial expert

	Total Lecture hours	**16**
List of Experiments		**CO: 5**
1.	Organic farms visit to study the various components and their utilization	5 hours
2.	Preparation of enrich compost and vermicompost	5 hours
3.	Preparation of bio-fertilizers/bio-inoculants	5 hours
4.	Quality analysis of vermicompost and bio-fertilizers/bio-inoculants	5 hours
5.	Indigenous technology knowledge (ITK) for nutrient management	2.5 hours
6.	ITK for insect and pest disease management	5 hours
7.	ITK for weed management	2.5 hours
8.	Cost estimation of organic production system	5 hours
9.	Post-harvest management	2.5 hours
10.	Quality aspect, grading, packaging and handling.	2.5 hours
	Total Laboratory Hours	**40**

Text Books

1. Sarath Chandran, Unni M.R and Sabu Thomas. 2018. Organic farming. Woodhead

	Publishing, UK.
2	Reddy, S.R.2017. Principles of organic farming. Kalyani publishers, India.
Reference Books	
1.	Ranjan Kumar Biswas. 2014. Organic farming in India. New Delhi Publishers, India.
2.	Peter Fossel. 2014. Organic Farming: How to Raise, Certify, and Market Organic Crops and Livestock. Reprint edition, Voyageur Press, USA.

Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	Date	16/12/2021

Course code	Farm Management Production and Resource Economics	L	T	P	C
BAG3008		1	0	2	2
Pre-requisite	Agricultural Finance and Co-operation	Syllabus version			
BAG2010		1.0			

Course Objectives: The course is aimed at

1. Discussing the principles of farm management and production economics
2. Explaining farm business management
3. Imparting knowledge on risks in agricultural production and management of resources

Expected Course Outcome: At the end of the course the student should be able to

1. Explain the importance of farm management in agriculture
2. Comprehend the benefits and cost involved in farm management
3. Analyze farm business
4. Devise plans to overcome risks and manage farm resources
5. Manage a farm

Module:1	Principles and nature of farm management	5 hours	CO: 1

Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factor determining types and size of farms. Principles of farm management: concept of production function and its type, use of production function in decision-making on a farm, factor-product, factor-factor and product product relationship, law of equi-marginal/or principles of opportunity cost and law of comparative advantage.

Module:2	Cost and Income	2 hours	CO: 2

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.

Module:3	Business management	4 hours	CO: 3

Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting-linear programming, appraisal of farm resources, selection of crops and livestock's enterprises.

Module:4	Risk, Insurance and resource economics	4 hours	CO: 4

Concept of risk and uncertainty occurrence in agriculture production, nature and sources of risks and its management strategies**.** Crop, livestock, machinery insurance, weather based crop insurance-features and determinants of compensation. Concepts of resource economics, differences between NRE and agricultural economics. Unique properties of natural resources. Positive and negative externalities in agriculture, inefficiency and welfare loss and solutions. Important issues in economics and management of common property resources of land, water, pasture and forest resources.

Module:5	Contemporary Issues	1 hours	CO: 5

Lecture by industrial expert

Total Lecture hours:	16

List of Experiments		CO: 5
1.	Preparation of farm layout	2.5 hours

2.	Determination of cost of fencing of a farm	2.5 hours
3.	Computation of depreciation cost of farm assets	2.5 hours
4.	Application of equi-marginal returns/opportunity cost principle in allocation of farm resources	5 hours
5.	Determination of most profitable level of inputs use in a farm production process.	5 hours
6.	Determination of least cost combination of inputs.	5 hours
7.	Selection of most profitable enterprise combination.	5 hours
8.	Application of cost principles including CACP concepts in the estimation of cost of crop and livestock enterprises.	5 hours
9.	Preparation of farm plan and budget, farm records and accounts and profit and loss accounts.	5 hours
10.	Collection and analysis of data on various resources in India.	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Ronald D. Kay, William M. Edwards, and Patricia A Duffy. 2015. Farm Management. 8th edition. McGraw–Hill Education, USA.
2.	Raju, V.T and D.V.S. Rao.2017. Economics of Farm Production and Management. Oxford and IBH Publishing Co. Pvt. Ltd., India.
Reference Books	
1.	Andrew Barkley and Paul W. Barkley. 2013. Principles of Agricultural Economics. Routledge, Taylor and Francis Group, New York, USA.
2.	Amarjit Singh, A.N. Sadhu and Jasbir Singh. 2016. Fundamentals of Agricultural Economics. Himalaya Publishing House, India.
3.	Subba Reddy, S and P. Raghu Ram. 2017. Agricultural Finance and Management. Oxford & IBH Publishing Company Private Ltd., New Delhi, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Micro propagation Technologies	L	T	P	C
BAG1002		1	0	4	3
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Describing the importance of plant tissue culture
2. Imparting knowledge on the applications and commercial importance of *in vitro* propagation
3. Introducing the role of tissue culture in plant breeding

Expected Course Outcome: At the end of the course the student should be able to

1. Understand how *in vitro* culture originated and appreciate its applications
2. Comprehend the various types of plant tissue culture and its importance
3. Demonstrate mass multiplication of micropropagules
4. Apply tissue culture techniques in crop improvement
5. Examine the demands of the plant tissue culture industry
6. Practice plant tissue culture techniques and become an entrepreneur

Module:1	Introduction	4 hours	CO: 1

History - Origin and chronology of important developments in plant tissue culture, advantages and limitations of plant tissue culture; Source and role of macro nutrients, micro nutrients, plant growth regulators, carbon source, vitamins, supplements and gelling agents.

Module:2	Types of cultures and their importance	3 hours	CO: 2

Totipotency and plasticity; Explant; Culture types: Seed, embryo, callus, protoplast, leaf, nodal, root, shoot, embryo and microspore cultures; Cell and cell suspension cultures and production of secondary metabolites

Module:3	Micropropagation and Organogenesis	3 hours	CO: 3

Stages of micropropagation; Axillary bud proliferation and culture, Shoot tip and meristem culture; Direct and indirect organogenesis; Somatic embryogenesis; Regeneration and Hardening

Module:4	Scope in crop improvement	4 hours	CO: 4

Somaclonal variation; Germplasm conservation and cryopreservation; Haploid and polyploid plant development; Somatic hybridisation; *In vitro* pollination, embryo rescue and wide hybridization; Synthetic seed; Propagation of transformed explant/callus; Screening for stress

Module:5	Contemporary Issues	2 hours	CO: 5

Lecture by industrial expert

Total Lecture hours:		16
List of Experiments		CO: 6
1.	Identification and use of equipment in tissue culture laboratory; Study on the design and structure of a plant tissue culture laboratory and greenhouse	8 hours
2.	Nutrition media composition - Hoagland solution, Murashige and Skoog's, Gamborg's, Nitsch's and White's media for varied cultures	4 hours
3.	Sterilization techniques for media, containers and small instruments	4 hours
4.	Sterilization techniques for explants	4 hours
5.	Preparation of stocks and working solution; Preparation of working medium	8 hours
6.	Culturing of explants: Seeds, shoot tip and single node and sub-culturing	8 hours
7.	Callus induction; Micropropagation	8 hours
8.	Induction of somatic embryos; Cell suspension culture	8 hours

9.	Regeneration of whole plants from different explants	8 hours
10.	Primary and secondary hardening procedures	4 hours
Total Laboratory Hours		**64**
Text Books		
1.	Razdan, M.K. 2019. Introduction to Plant Tissue Culture. 3rd Edition, Oxford and IBH Publishing, India.	
2.	Gamborg, O.L. and G.C. Phillips. 2005. Plant cell, tissue and organ culture: fundamental methods. Narosa Publishing House, India.	
Reference Books		
1.	Roberta Smith. 2013. Plant tissue culture: Techniques and experiments. Third edition. Academic Press, Elsevier Inc., USA.	
2.	Chawla, H.S. 2008. Plant biotechnology: laboratory manual for plant biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd., India.	
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test		
Recommended by Board of Studies	10/02/2020	
Approved by Academic Council	No.64	**Date** 16/12/2021

Course code	Landscaping	L	T	P	C
BAG1003		2	0	2	3
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Demonstrating the scope of landscaping.
2. Imparting knowledge on propagation and maintenance of plants involved in landscaping
3. Demonstrating designing and maintenance of landscapes

Expected Course Outcomes: At the end of the course students should be able to

1. Understand the basic principles and importance of landscaping
2. Select and propagate plants suitable for landscaping
3. Propagate and manage pot plants
4. Contribute to improve bio-aesthetic landscaping architecture in urban and rural areas
5. Manage bonsai and lawns
6. Develop and design sustainable landscapes

Module: 1	Scope of landscaping	8 hours	CO: 1

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 and gardens for special purposes.

Module: 2	Selection and propagation of plants	8 hours	CO: 2

Trees: selection, propagation, planting schemes and canopy management; Shrubs and herbaceous perennials: selection, propagation, planting schemes and architecture; Climber and creepers: importance, selection, propagation and planting; Annuals: selection, propagation and planting scheme; Other garden plants: palms, ferns, grasses and cacti succulents.

Module: 3	Pot plant management	2 hours	CO: 3

Pot plants: selection, arrangement and management.

Module: 4	Bio-aesthetic landscaping	8 hours	CO: 4

Bio-aesthetic planning: definition, need and planning. Landscaping of urban and rural areas. Peri-urban landscaping. Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries and institutions.

Module: 5	Bonsai, Lawn and CAD	4 hours	CO: 5

Bonsai: principles and management. Lawn: establishment and maintenance. Computer aided design application.

Module: 6	Contemporary Issues	2 hours	CO: 2, 4

Lecture by industrial expert

	Total Lecture hours:	**32**
List of Experiments		**CO: 6**
1.	Identification of trees, shrubs, annuals, pot plants	5 hours
2.	Propagation of trees, shrubs and annuals	5 hours
3.	Care and maintenance of plants, potting and repotting	2.5 hours
4.	Identification of tools and implements used in landscape design, training and pruning of plants for special effects	5 hours
5.	Lawn establishment and maintenance	2.5 hours
6.	Layout of formal gardens, informal gardens	5 hours

7.	Special type of gardens: sunken garden, terrace garden and rock garden	5 hours
8.	Designing of conservatory and lathe house	5 hours
9.	Use of computer software	2.5 hours
10.	Visit to important gardens/ parks/ institutes	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Robert H, Jamie L. 2014. Landscape Architecture-An Introduction. Laurence king publishing. UK.
2.	Jack E Ingels, Alissa S Smith. 2018. Landscaping principles and practices. 8th edition, Cengage Learning, USA.
Reference Books	
1.	Taisuke Ooshima and John Stallings. 2013. Bonsai for Beginners Book: Your Daily Guide for Bonsai Tree Care, Selection, Growing, Tools and Fundamental Bonsai Basics. Lightning Source Inc., USA.
2.	Piet Oudolf and Henk Gerritsen. 2019. Planting the Natural Garden. Timber Press, USA.

Mode of Evaluation: Assignments, Quiz, Continuous assessment tests and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	64	**Date**	16/12/2021

Course code	Agricultural Journalism	L	T	P	C
BAG1005		2	0	2	3
Pre-requisite	None	Syllabus version			
		1.0			

Course Objectives: The course is aimed at

1. Explaining the importance of journalism in agricultural extension
2. Demonstrating how communication media can be utilized in presenting readable agricultural stories
3. Developing skills in editing, copy reading, headline and title writing, proofreading and lay outing.

Expected Course Outcome: At the end of the course the student should be able to

1. Acquire knowledge on agricultural journalism
2. Comprehend the kinds and functions of newspapers and magazines
3. Analyze the various types of agricultural stories
4. Analyze the readability of different news stories published in newspapers and magazines
5. Develop skills in Copy reading, headline and title writing, proofreading and lay outing
6. Practice agricultural journalism

Module:1	Agricultural Journalism	6 hours	CO: 1

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.

Module:2	Newspapers and magazines	6 hours	CO: 2

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.

Module:3	Agricultural story and Information	6 hours	CO: 3

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

Module:4	Readability measures	8 hours	CO: 4

Writing the story: Organizing the material, treatment of the story, writing the news lead and the body and readability measures. Illustrating agricultural stories: Use of photographs, use of artwork-graphs, charts and maps and writing captions.

Module:5	Editorial mechanics	4 hours	CO: 5

Copy reading, headline and title writing, proofreading and lay outing.

Module:6	Contemporary Issues	2 hours	CO: 1

Lecture by industrial expert

	Total Lecture hours:	32

List of Experiments		CO: 6
1.	Practice in interviewing	5 hours
2.	Covering agricultural events	5 hours
3.	Abstracting stories from research and scientific materials and from wire	5 hours

	services	
4.	Writing different types of agricultural stories	5 hours
5.	Selecting pictures and artwork for the agricultural story	2.5 hours
6.	Practice in editing, copy reading, headline and title writing	2.5 hours
7.	Practice in proofreading and lay outing	2.5 hours
8.	Testing copy with a readability formula	2.5 hours
9.	Visit to a publishing office to comprehend the art of news editing and broadcasting	5 hours
10.	Visit to a Radio/TV station to comprehend the art of news editing and broadcasting	5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Singh, A K. 2014. Agricultural Extension and Farm Journalism, Agrobios, India.
2.	Bhaskaran C. 2008. Farm Journalism and Media Management, Agrotech Publishing Academy, India.
Reference Books	
1.	Jana, B.L. 2014. Agricultural Journalism. Agrotech Publishing Academy, India.
2.	Shahzad Ahmad. 2006. Art of Modern Journalism. Anmol Publications Pvt. Ltd., India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Agrochemicals	L	T	P	C
BAG2011		2	0	2	3
Pre-requisite	Fundamentals of Agronomy	Syllabus version			
BAG1013		1.0			

Course Objectives: The course is aimed at

1. Understanding the role of agrochemicals in agriculture and its effect on environment
2. Imparting knowledge on herbicides, fungicides, insecticides, fertilizers and its applications
3. Emphasising the use of right dose of agrochemicals for sustainable agriculture

Expected Course Outcome: At the end of the course the student should be able to

1. Infer the importance of agrochemicals for sustainable agriculture
2. Acquire knowledge on herbicides and fungicides
3. Classify and know the role of insecticides
4. Analyze fertilizers application related to crop growth
5. Acquire knowledge on mixed and complex fertilizers
6. Recommend dosage of agrochemicals for farms

.

Module:1	Introduction to agrochemicals	2 hours	CO: 1

Type and role of agrochemicals in agriculture. Effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture. Management of agrochemicals for sustainable agriculture.

Module:2	Herbicides and fungicides	8 hours	CO: 2

Herbicides-major classes, properties and important herbicides. Fate of herbicides. Classification of fungicides. Inorganic fungicides: characteristics, preparation and use of sulfur and copper. Mode of action of Bordeaux mixture and copper oxychloride. Organic fungicides, mode of action of Dithiocarbamates, characteristics, preparation and use of Zineb and Maneb. Systemic fungicides, characteristics and use of Benomyl, Carboxin, Oxycarboxin, Metalaxyl and Carbendazim,

Module:3	Insecticides	8 hours	CO: 3

Introduction and classification of insecticides, inorganic and organic insecticides. Organochlorine, Organophosphates, Carbamates, Synthetic pyrethroids, Neonicotinoids and Biorationals. Insecticide Act and rules. Insecticides banned, withdrawn and restricted for use. Fate of insecticides in soil and plant. IGRs, biopesticides, reduced risk insecticides, botanicals, plant and animal systemic insecticides, their characteristics and uses. Plant bio-pesticides for ecological agriculture. Bio-insect repellent.

Module:4	Fertilizers	6 hours	CO: 4

Fertilizers and their importance. Nitrogenous fertilizers: feedstocks and manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride and urea. Slow release N fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate, preparation of bone meal and basic slag. Potassic fertilizers: natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate.

Module:5	Mixed and complex fertilizers	6 hours	CO: 5

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

Module:6	Contemporary Issues	2 hours	CO: 1

Lecture by industrial expert		
	Total Lecture hours:	**32**
List of Experiments		**CO: 6**
1.	Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances.	2.5 hours
2.	Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer.	5 hours
3.	Calculation of doses of insecticides to be used. To study and identify various formulations of insecticide available kin market.	2.5 hours
4.	Estimation of nitrogen in Urea.	5 hours
5.	Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate.	5 hours
6.	Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer.	5 hours
7.	Determination of copper content in copper oxychloride.	5 hours
8.	Determination of sulphur content in sulphur fungicide.	5 hours
9.	Determination of thiram content.	2.5 hours
10.	Determination of ziram content.	2.5 hours
	Total Laboratory Hours	**40**
Text Books		
1.	Ranjan Kumar Basak. 2016. Fertilizers: A Text Book. Kalyani publishers, India.	
2.	Amitava Rakshit, Priyankar Raha and Nirmal De. 2015. Manures fertilizers and pesticides-Theory and applications. CBS Publishers and Distributors Pvt. Ltd., India.	
Reference Books		
1.	Parameshwar Hegde, H. 2009. Textbook of Agro-Chemistry. Discovery Publishing Pvt. Ltd., India.	
2.	Yawalkar, K.S ., J.P. Agarwal and S. Bokde. 2012. Manures and fertilizers. 12th edition, Jain publishing, India.	
3.	Himadri Panda. 2018. The Complete Technology Book on Herbicides, Fungicides, Nematicides, Weedicides and other Agro Chemicals with Formulations. EIRI, India.	
Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test		
Recommended by Board of Studies	10/02/2020	
Approved by Academic Council	No. 64	**Date** 16/12/2021

Course code	Weed Management	L	T	P	C
BAG 2012		2	0	2	3
Pre-requisite	Fundamentals of Agronomy	Syllabus version			
BAG1013		1.0			

Course Objectives: The course is aimed at

1. Identifying major weeds affecting farming ecosystems
2. Imparting knowledge on organic and inorganic herbicides
3. Introducing solutions to manage herbicide resistance

Expected Course Outcome: At the end of the course the student should be able to

1. Gain knowledge on weeds affecting ecosystems
2. Explain the mode of action of herbicides
3. Understand the role of allelochemicals and the applications of bio-herbicides
4. Analyse herbicide compatibility
5. Cite ways of overcoming herbicide resistance
6. Recommend weed management strategies

Module:1	Weeds	6 hours	CO: 1

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

Module:2	Herbicides	6 hours	CO: 2

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

Module:3	Allelopathy and bio-herbicides	4 hours	CO: 3

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

Module:4	Herbicide compatibility	4 hours	CO: 4

Concept of herbicide mixture and utility in agriculture. Herbicide compatibility with agro-chemicals and their application. Integration of herbicides with non-chemical methods of weed management.

Module:5	Herbicide Resistance	4 hours	CO: 5

Herbicide resistance, mechanisms and herbicide resistance testing. Strategies for managing herbicide resistance.

Module:6	Contemporary issues	2 hours	CO: 5

Lecture by industrial expert

	Total Lecture hours:	32

List of Experiments		CO: 6
1.	Techniques of weed preservation	2.5 hours
2.	Weed identification and their losses study	5 hours
3.	Biology of important weeds	5 hours
4.	Study of herbicide formulations and mixture of herbicide.	5 hours
5.	Herbicide and agrochemicals study	5 hours
6.	Shift of weed flora study in long term experiments	5 hours
7.	Study of methods of herbicide application	5 hours
8.	Spraying equipment	2.5 hours

9.	Calculations of herbicide doses	2.5 hours
10.	Weed control efficiency and weed index	2.5 hours
	Total Laboratory Hours	**40**

Text Book	
1.	Jaya Kumar, R. and R. Jaganathan. 2016. Weed Science Principles, Kalyani Publishers, India.
2.	Gupta, O.P. 2011. Weed management principles and practices. Agrobios, India.
Reference Books	
1.	Rao, V. S. 2018. Principles of weed science. 3rd edition, CBS Publishers and Distributors, India.
2.	Zahid A. Cheema, Muhammad Farooq and Abdul Wahid. 2013. Allelopathy: Current Trends and Future Applications. Springer. Researchco Book Centre, India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Protected cultivation	L	T	P	C
BAG2013		2	0	2	3
Pre-requisite	Fundamentals of Horticulture	Syllabus version			
BAG1022		1.0			

Course Objectives: The course is aimed at

1. Describing the importance of protected cultivation
2. Imparting knowledge on designing and managing greenhouses
3. Providing knowledge on protected cultivation of horticultural and economically important crops

Expected Course Outcomes: At the end of the course students should be able to

1. Understand the importance of protected cultivation
2. Design and manage greenhouses for protected cultivation
3. Manage soil, nutrients and irrigation systems under protected cultivation
4. Gain knowledge on cultivation and propagation of plants in a greenhouse
5. Plan, manage and propagate crops under protected cultivation for commercial purposes

Module: 1	Scope	2 hours	CO: 1

Importance and scope of protected cultivation. Status of protected cultivation in India and throughout the world.

Module: 2	Greenhouse design	6 hours	CO: 2

Types of protected structure based on site and climate. Cladding material involved in greenhouse/poly house. Greenhouse design, environment control, artificial lights and automation.

Module: 3	Greenhouse management	6 hours	CO: 3

Soil preparation and management. Substrate management. Types of benches and containers. Irrigation and fertigation management.

Module: 4	Greenhouse cultivation	8 hours	CO: 4

Propagation and production of quality planting material of horticultural crops. Greenhouse cultivation of important horticultural crops–rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lilium, tulip, tomato, bell pepper, cucumber, strawberry and pot plants.

Module: 5	Protected cultivation of economical crops	8 hours	CO: 4

Cultivation of economically important medicinal and aromatic plants. Off-season production of flowers and vegetables. Insect pest and disease management.

Module: 6	Contemporary Issues	2 hours	CO: 2,3

Lecture by industrial expert

	Total Lecture hours:	32

List of Experiments		CO: 5
1.	Raising of seedlings and saplings under protected conditions	5 hours
2.	Use of protrays in quality planting material production	5 hours
3.	Bed preparation	5 hours
4.	Planting of crop for production	5 hours
5.	Inter cultural operations	5 hours
6.	Soil EC measurement	2.5 hours
7.	Soil pH measurement	2.5 hours
8.	Regulation of irrigation and fertilizers through drip	5 hours

9.	Regulation of irrigation and fertilizers through fogging	2.5 hours
10.	Regulation of irrigation and fertilizers through misting	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency, India.
2.	Reddy P. Parvatha. 2016. Sustainable crop protection under protected cultivation. Springer, Singapore.
3.	Amit Deogirikar. 2019. A Text Book on Protected Cultivation and Secondary Agriculture. Rajlaxmi Prakashan, Aurangabad, India.
Reference Books	
1.	Singh, B., B. Singh, N. Sabir and M Hasan. 2014. Advances in protected cultivation. New India Publishing Agency, India.
2.	Joe J. Hanan. 1997. Greenhouses: Advanced Technology for protected horticulture. CRC Press. USA

Mode of Evaluation: Assignments, Quiz, Continuous assessment tests and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	64	**Date**	16/12/2021

Course code	Hi-tech. Horticulture	L	T	P	C
BAG2014		2	0	2	3
Pre-requisite	Fundamentals of Horticulture	Syllabus version			
BAG1022		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on advanced techniques in horticulture.
2. Describing the techniques involved in protected and precision farming
3. Developing practical skills pertaining to Hi-tech horticulture

Expected Course Outcomes: At the end of the course students should be able to

1. Appreciate the scope of hi-tech horticulture.
2. Comprehend modern techniques involved in micropropagation, nursery and field management.
3. Acquire a detailed knowledge on protected horticulture
4. Manage water, nutrients and space involving modern techniques
5. Apply and suggest precision farming techniques for horticulture
6. Recommend hi-tech horticultural technologies for crop improvement

Module: 1	Importance	6 hours	CO: 1

Hi-tech. Horticulture: Introduction and importance; Poly house, vertical, roof top and organic farming; Technology based landscaping; Hydroponic systems; Plant factories.

Module: 2	Modern techniques	6 hours	CO: 2

Nursery management and mechanization. Modern field preparation and planting methods. Micro propagation of horticultural crops.

Module: 3	Protected horticulture	6 hours	CO: 3

Protected cultivation: advantages, controlled conditions, methods, techniques and integrated management of nutrients, pests and diseases.

Module: 4	Water, nutrient and space management	6 hours	CO: 4

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

Module: 5	Precision farming	6 hours	CO: 5

Components of precision farming: Remote sensing, Geographical Information System (GIS), Differential Geo-positioning System (DGPS) and Variable Rate applicator (VRA). Application of precision farming in horticultural crops-fruits, vegetables and ornamental crops. Mechanized harvesting of produce.

Module: 6	Contemporary Issues	2 hours	CO: 3, 5

Lecture by industrial expert

	Total Lecture hours:	32

List of Experiments		CO: 6
1.	Types of polyhouses	2.5 hours
2.	Types of shade net houses	2.5 hours
3.	Intercultural operations	5 hours
4.	Tool and equipment identification and application	5 hours
5.	Micropropagation	5 hours
6.	Nursery-protrays	5 hours
7.	Micro-irrigation	2.5 hours

8.	EC, pH based fertilizer scheduling	2.5 hours
9.	Canopy management	2.5 hours
10.	Visit to hi-tech orchard/industry	5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Chandan Singh, A., Jitendrs Kumar and D K Singh. 2017. Hi-tech horticulture nursery management. S.K. Book Agency, India.
2.	Prasad, S., D. Singh and R.L. Baradwaj. 2010.. Hi-tech horticulture. Agrobios, India.
Reference Books	
1.	Pedersen, Søren Marcus, Lind and Kim Martin. 2017. Precision Agriculture: Technology and Economic Perspectives. Springer, Berlin, Germany.
2.	Nancy Ross. 2018. Hydroponics: The complete guide to hydroponics for Beginners. Publish Drive; Publish Drive edition.
3.	Joe J. Hanan. 1997. Greenhouses: Advanced Technology for protected horticulture. CRC Press. USA.

Mode of Evaluation: Assignments, Quiz, Continuous assessment tests and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	64	**Date**	16/12/2021

Course code	Commercial Plant Breeding	L	T	P	C
BAG2015		1	0	4	3
Pre-requisite	Fundamentals of Plant Breeding	Syllabus version			
BAG1015		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on commercial hybrid seed production
2. Applying biotechnological techniques to conventional plant breeding
3. Describing the norms involved in testing and release of crop varieties in India

Expected Course Outcome: At the end of the course the student should be able to

1. Understand the concepts of producing a male sterile, maintainer and restorer line.
2. Define hybrid seed production techniques across field crops
3. Choose plant biotechnological tools and IPR to promote crop improvement
4. State the norms involved in crop variety release and seed production
5. Practice hybridisation and plant breeding

Module:1	Hybrid development	3 hours	CO: 1

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.

Module:2	Hybrid seed production	5 hours	CO: 2

Genetic purity test of commercial hybrids. Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea and Brassica. Quality seed production of vegetable crops under open and protected environment.

Module:3	Biotechnology and IPR	5 hours	CO: 3

Alternative strategies for the development of line and cultivars: haploid inducer, tissue culture techniques and biotechnological tools. IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FR Act.

Module:4	Variety release and seed production	2 hours	CO: 4

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.

Module:5	Contemporary Issues	1 hour	CO: 4

Lecture by Industrial Expert

	Total Lecture hours:	16

List of Experiments		CO: 5
1.	Floral biology of self and cross pollinated species; Selfing and crossing techniques.	4 hours
2.	Techniques of seed production in self and cross pollinated crops using A/B/R and two line system.	8 hours
3.	Learning techniques in hybrid seed production using male-sterility in field crops.	8 hours
4.	Understanding the difficulties in hybrid seed production. Tools and techniques for optimizing hybrid seed production.	4 hours
5.	Concept of rouging in seed production plot. Concept of line, its multiplication and purification in hybrid seed production.	4 hours
6.	Role of pollinators in hybrid seed production. Hybrid seed production techniques in sorghum, pearl millet, maize, rice, rapeseed-mustard, sunflower,	16 hours

	castor, pigeon pea, cotton and vegetable crops.	
7.	Sampling and analytical procedures for purity testing and detection of spurious seed.	4 hours
8.	Seed drying and storage structure in quality seed management.	4 hours
9.	Screening techniques during seed processing-grading and packaging.	4 hours
10.	Visit to public private seed production and processing plants.	8 hours
	Total Laboratory Hours	**64**
Text Books		
1.	Singh, B.D. 2018. Plant breeding principles and methods. Kalyani Publishers, India.	
2.	Vanangamudi, K and Vijayakumar, A. 2015. Hybrid Seed Production of Agronomic Crops. Agrobios, India.	
Reference Books		
1.	Phundan Singh. 2011. IPR and Plant Breeders rights. New Vishal Publications, India.	
2.	Aluízio Borém Roberto Fritsche-Neto. 2014. Biotechnology and Plant Breeding. Applications and Approaches for Developing Improved Cultivars. Academic Press, USA.	

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	System simulation and Agro-advisory	L	T	P	C
BAG2016		2	0	2	3
Pre-requisite	Introductory Agro-meteorology & Climate Change	Syllabus version			
BAG1024		1.0			

Course Objectives: The course is aimed to

1. Demonstrate the role of crop models in studying soil, plant and water relationship
2. Discuss about different types of crop growth models to forecast crop yields
3. Outline the preparation of agro advisory bulletin based on weather forecast and its use

Expected Course Outcome: Upon completion students will be able to

1. Illustrate crop model concepts and soil-plant-atmospheric continuum
2. Summarize the importance of crop growth models to increase crop production
3. Develop yield models for different crops to predict yield
4. Comprehend weather forecasting
5. Explain about various simulation models for preparation of agro advisories
6. Make use of crop models and statistical approaches to predict yield of crops, forecast pests and diseases and prepare agro-advisories

Module:1	System approach and crop models	6 hours	CO: 1

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

Module:2	Crop growth models and validation	8 hours	CO: 2

Evaluation of crop responses to weather elements; Elementary crop growth models; Calibration, validation, verification and sensitivity analysis.

Module:3	Crop production estimation under limited conditions	6 hours	CO: 3

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.

Module:4	Weather forecasting	6 hours	CO: 4

Weather forecasting, types, methods, tools, techniques and forecast verification. Value added weather forecast, ITK for weather forecast and its validity. Crop-weather calendars.

Module:5	Agro-advisory and simulation	4 hours	CO: 5

Preparation of agro-advisory bulletin based on weather forecast. Use of crop simulation model for preparation of agro-advisory and its effective dissemination.

Module:6	Contemporary Issues	2 hours	CO: 5

Lecture by industrial expert

Total Lecture hours	32

List of Experiments		CO: 6
1.	Preparation of crop weather calendars.	2.5 hours
2.	Preparation of agro-advisories based on weather forecast using various approaches and synoptic charts.	5 hours
3.	Working with statistical and simulation models for crop growth.	5 hours
4.	Crop yield forecasting models, potential and achievable production.	5 hours
5.	Insect forecasting models for crop protection.	2.5 hours

6.	Crop disease forecasting models for effective control measures.	5 hours
7.	Simulation with limitations of water and nutrient management options.	2.5 hours
8.	Sensitivity analysis of varying weather and crop management practices.	5 hours
9.	Use of statistical approaches in data analysis and preparation of historical, past and present meteorological data for medium range weather forecast.	5 hours
10.	Feedback from the farmers about agro-advisory.	2.5 hours
	Total Laboratory Hours	**40**

Text Book	
1.	Mahi, G.S. and P.K. Kingra. 2018. Fundamentals of agrometeorology and climate change. Kalayani Publishers, India.
2.	Daniel. W, David. M, James W.J and Francois. B. 2014. Working with Dynamic Crop Models: Methods, Tools and Examples for Agriculture and Environment. 3rd edition, Academic press. USA.
Reference Books	
1.	Das, H.P. 2012. Agrometeorology in Extreme Events and Natural Disasters. CRS Press, BS publications, India.
2.	S.R.Reddy. 2014. Introduction to Agriculture and Agrometeorology. Kalayani Publishers, India.
3.	Goudriaan, J., H.H. Van Laar. 1994. Modelling Potential Crop Growth Processes: Textbook with Exercises. Springer, Netherlands.

Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	64	**Date**	16/12/2021

Course code	Agribusiness Management	L	T	P	C
BAG4001		2	0	2	3
Pre-requisite	Agricultural Marketing Trade & Prices	Syllabus version			
BAG3007		1.0			

Course Objectives: The course is aimed at

1. Explaining the importance of agribusiness and transformation of agriculture into agribusiness
2. Demonstrating the procedures of setting up and management of agro-based industries
3. Outlining the various activities and linkages in agri-value chain management

Expected Course Outcome: At the end of the course the student should be able to

1. Acquire knowledge on transforming agriculture into agribusiness.
2. Comprehend the procedures of setting up of agro-based industries
3. Analyse the various activities and linkages in agri-value chain and the business environment
4. Assess the capital, financial and marketing management of agribusiness
5. Develop skills in project formulation, appraisal and evaluation
6. Do agribusiness

Module:1	Agribusiness	6 hours	CO: 1

Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Importance of agribusiness in the Indian economy and New Agricultural Policy.

Module:2	Agro-based industries	6 hours	CO: 2

Distinctive features, importance and needs of agro-based industries. Classification of industries and types of agro based industries. Institutional arrangement, procedures to set up agro-based industries. Constraints in establishing agro-based industries.

Module:3	Agri-Value chain	6 hours	CO: 3

Understanding primary and support activities and their linkages. Business environment: PEST & SWOT analysis. Management functions: Roles and activities and organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, strategies, polices procedures, rules, programs and budget. Components of a business plan. Steps in planning and implementation. Organization staffing, directing and motivation. Ordering, leading, supervision, communications and control.

Module:4	Capital, finance and marketing Management	8 hours	CO: 4

Capital management and management of agribusiness. Financial statements and their importance. Marketing management: segmentation, targeting and positioning. Marketing mix and marketing strategies. Consumer behaviour analysis. Product Life Cycle (PLC). Sales and distribution management. Pricing policy and various pricing methods.

Module:5	Project appraisal and evaluation	4 hours	CO: 5

Project management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project appraisal and evaluation techniques.

Module:6	Contemporary Issues	2 hours	CO: 1

Lecture by industrial expert

	Total Lecture hours:	**32**
List of Experiments		**CO: 6**
1.	Visit to agri-input markets - seed, fertilizers, pesticides firms to acquire firsthand knowledge on the firm's capital, finance and marketing management	5 hours

2.	Study of output markets: grains, fruits, vegetables and flowers	2.5 hours
3.	Study of product markets, retails trade commodity trading and value-added products.	5 hours
4.	Study of financing institutions - cooperative, commercial banks, RRBs, Agribusiness Finance Limited and NABARD	5 hours
5.	Preparations of projects and feasibility reports for agribusiness entrepreneur.	2.5 hours
6.	Appraisal/evaluation techniques of identifying viable project and non-discounting techniques.	5 hours
7.	Case study of agro-based industries	2.5 hours
8.	Trend and growth rate of prices of agricultural commodities	2.5 hours
9.	Net present worth technique, internal rate of return for selection of viable project.	5 hours
10.	Seminar on selected topics.	5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Subba Reddy, S and P. Raghu Ram. 2018. Agricultural Finance and Management. Oxford & IBH Publishing Company Private Ltd., India.
2.	Freddie L. Barnard, John C. Foltz, and Elizabeth A. Yeager. 2016. Agribusiness Management. 5th edition, Routledge. UK.
Reference Books	
1.	Peter Barry and Paul Ellinger. 2011. Financial Management in Agriculture. 7th edition, Pearson. UK.
2.	Ronald Kay and William Edwards and Patricia Duffy. 2015. Farm Management. 8th edition, McGraw-Hill Education, USA.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No.64	**Date**	16/12/2021

Course code	Biopesticides and Biofertilizers	L	T	P	C
BAG4002		2	0	2	3
Pre-requisite	Principles of integrated pest and disease management	Syllabus version			
BAG3001		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on mass production techniques of biopesticides and biofertilizers
2. Describing the mode of action of biopesticides and biofertilizers
3. Demonstrating the practical applications of biopesticides and biofertilizers

Expected Course Outcome: At the end of the course the student should be able to

1. Acquire knowledge on scope and importance of biopesticides
2. Demonstrate mass production and application technology of biopesticides
3. Comprehend the types of biofertilizers and their characteristics features
4. Explain the mechanism and mass production of biofertilizers
5. Demonstrate the different methods of biofertilizer application
6. Mass produce biopesticides and biofertilizers

Module:1	Scope of biopesticides	6 hours	CO: 1

History and concept of biopesticides. Importance, scope and potential of biopesticides. Definitions, concepts and classification of biopesticides - pathogen, botanical pesticides, and biorationales. Botanicals and their uses.

Module:2	Mass production and application of biopesticides	6 hours	CO: 2

Mass production technology of bio-pesticides. Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes. Methods of application of biopesticides. Methods of quality control and techniques of biopesticides. Impediments and limitation in production and use of biopesticide.

Module:3	Characteristics of biofertilizers	6 hours	CO: 3

Biofertilizers - introduction, status and scope. Structure and characteristic features of bacterial biofertilizers - *Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium* and *Frankia*. Cyanobacterial biofertilizers- *Anabaena*, *Nostoc* and *Hapalosiphon.* Fungal biofertilizers - AM mycorrhiza and ectomycorhiza.

Module:4	Mechanism and production technology of biofertilizers	8 hours	CO: 4

Nitrogen fixation - free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilization and phosphate mobilization. K solubilization. Production technology: strain selection, sterilization, growth, fermentation, mass production of carrier based and liquid biofertiizers. FCO specifications and quality control of biofertilizers.

Module:5	Application and quality control of biofertilizers	4 hours	CO: 5

Application technology for seeds, seedlings, tubers and sets. Biofertilizers - storage, shelf life, quality control and marketing. Factors influencing the efficacy of biofertilizers.

Module:6	Contemporary Issues	2 hours	CO: 6

Lecture by industrial expert

	Total Lecture hours:	32
List of Experiments		CO: 6
1.	Isolation and purification of *Trichoderma, Pseudomonas, Bacillus, Beauveria* and *Metarhizium* sp.	5 hours
2.	Mass production of *Trichoderma, Pseudomonas, Bacillus, Beauveria* and	5 hours

	Metarhizium, sp.	
3.	Identification of important botanicals	2.5 hours
4.	Visit to biopesticide laboratory	2.5 hours
5.	Field visit to explore naturally infected cadavers and identification of entomopathogenic entities in field condition.	5 hours
6.	Quality control of biopesticides.	2.5 hours
7.	Isolation and purification of Azospirllum, Azotobacter, Rhizobium, P-solubilizers and cyanobacteria.	5 hours
8.	Mass multiplication and inoculum production of biofertilizers.	5 hours
9.	Isolation of Arbuscular Mycorrhizal fungi – wet sieving method and sucrose gradient method	5 hours
10.	Mass production of AM inoculants.	2.5 hours
	Total Laboratory Hours	**40**

Text Books	
1.	Sahayaraj, K. 2014. Basic and applied aspects of biopesticides. Springer, India.
2.	Giri, B., Prasad, R., Wu, Q.S. and A. Varma. 2019. Biofertilizers for Sustainable Agriculture and Environment. Springer International Publishing, Germany.
Reference Books	
1.	Ignacimuthu, S., and A. Sen. 2001. Microbials in insect pest management. Science Publishers, India.
2.	Panda, H. and D. Hota. 2007. Biofertilizers and organic farming. Gene-Tech Books. India.

Mode of Evaluation: Assignments, Quiz, Continuous assessments and Final assessment test			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No.64	**Date**	16/12/2021

IV year

VII Semester	
BAG4099	**Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)**
Pre-requisite	**None**

Course Objectives: The course is aimed at

1. Imparting real time agricultural education at the farmers' fields
2. Educating the students on the role of Universities, Research Stations, Agricultural Departments, Krishi Vigyan Kendras, Plant Clinics in benefitting the farmers through its extension services
3. Offering an Agro-Industrial attachment programme to learn on how an agro-industry functions

Expected Course Outcome: At the end of the course the student should be able to

1. Appreciate the importance of undergoing a practical rural agricultural education programme
2. Recommend and solve farmers problems faced during crop production
3. Comprehend extension activities and know how technology gets transferred from lab to land
4. Advise farmers to undergo soil and water testing and apply recommended dose of fertilizers and grow suitable crops based on their farm's soil and water health
5. Manage an agro-industry
6. Prepare and present agricultural reports

Criteria	Activities	No. of weeks	CO	Credit Hours
a.	General orientation & On campus training by different faculties	**1**	**1**	**14**
b.	Village attachment	**8**	**2**	
	Unit attachment in Univ./ College. KVK/ Research Station Attachment	**5**	**3**	
c.	Plant clinic	**2**	**4**	**02**
	Agro-Industrial Attachment	**3**	**5**	**04**
d.	Project Report Preparation, Presentation and Evaluation	**1**	**6**	
Total weeks and credits for RAWE & AIA		**20**		**20**

Agro- Industrial Attachment: The students would be attached with the agro-industries for a period of **3 weeks** to get an experience of the industrial environment and working**.**

RAWE Component-I

Village Attachment Training Programme

Sl. No.	Activity	Duration
1	Orientation and Survey of Village	1 week
2	Agronomical Interventions	1 week
3	Plant Protection Interventions	1 week
4	Soil Improvement Interventions	1 week
5	Fruit and Vegetable production interventions	1 week
6	Food Processing and Storage interventions	1 week

7	Animal Production Interventions	1 week
8	Extension and Transfer of Technology activities	1 week

RAWE Component –II

Agro Industrial Attachment

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

Activities and Tasks during Agro-Industrial Attachment Programme

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

VIII Semester

BAG4003	**Experiential Learning Programme: Module I** Production Technology for Bioagents and Biofertilizer/ Seed Production and Technology/ Mushroom Cultivation Technology/ Soil, Plant, Water and Seed Testing/ Commercial Beekeeping/ Poultry Production Technology	**0+10**
BAG4004	**Experiential Learning Programme: Module II** Commercial Horticulture/ Floriculture and Landscaping/ Food Processing/ Agriculture Waste Management/ Organic Production Technology/ Commercial Sericulture	**0+10**
TOTAL CREDITS		**20**

Evaluation of Experiential Learning Programme/ HOT

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

Course code	Production Technology for Bioagents and Biofertilizer	L	T	P	C
BAG4003		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Providing insight into bioagents, biofertilizers and biopesticides
2. Developing skills for commercial production of bioagents, biofertilizers and biopesticides
3. Motivating students to become entrepreneurs

Expected Course Outcome: At the end of the course the student should be able to

1. Identify commercially important bioagents and biofertilizers for mass production
2. Isolate and culture biofertilizers
3. Commercially produce biofertilizers suitable for varied environments
4. Culture bioagents and biopesticides and mass produce them
5. Follow the steps involved in quality control of bioagents and biofertilizers

Project

1.	Types and importance of biofertilizers, biopesticides and bioagents in agriculture and organic farming systems.	4 hours	**CO: 1**
2.	Classification of biofertilizers used in biofertilizers production. Preparation of media used for isolation and culturing of biofertilizers: Jensen's agar, NFb medium, Yeast extract manitol agar, BGA-medium and Pikovaskaya's medium.	12 hours	**CO: 2**
3.	Isolation of Rhizobium from root nodules; Isolation of Azotobacter from rhizosphere of cereal crops, Beijernickia, Acetobacter from soil, Azospirillium from roots of graminaceous plants, BGA from soil, Mycorrhizae from the roots, Phosphate solubilizing and Sulphur oxidizing microorganisms, ion chealators, potash mobilizers, organic matter decomposers and their isolation in pure culture form.	20 hours	**CO: 2**
4.	Production of commercial biofertilizers Rhizobium, Azotobacter, Azospirillum and Acetobacter: selection of efficient strains, carriers and their sterilization, mother culture preparation, mass multiplication using shake culture method, mixing of culture and carriers and preparation of packets. Production of carrier based and grain based phosphate solubilizing biofertilizers.	20 hours	**CO: 3**
5.	Methods of mass multiplication of BGA and Azolla. A large scale production of decomposting cultures. VAM : growth on Guinea grass roots and observations for root colonization. Preparation of VAM inoculum. Methods of application of Rhizobium, Azotobacter, Azospirillum and phosphate solubilizing biofertilizers. Methods of application of Azolla and blue green algal biofertilizers in paddy farming. Production of compost cultures.	20 hours	**CO: 3**
6.	ISI standards. Estimating the viable bacterial count in carrier based biofertilizers. Storage of biofertilizer packets. Preparation of plan of biofertilizer production unit and proposal of loan.	16 hours	**CO: 5**
7.	Mass production of Trichogramma, Cryptolaemus, Crysoperla.	16 hours	**CO: 4**
8.	Mass production of HaNPV and EPN.	16 hours	**CO: 4**
9.	Importance of Verticillium, Beauveria, Metarhizium, Nomuraea, Paecilomyces, *Hirsutella lthompsoni*, Trichoderma, Pseudomonas, Bacillus and organic matter decomposers. Testing of quality	20 hours	**CO: 4,5**

	parameters and standardization of biopesticides.		
10.	Visit to certified biocontrol and biofertilizer production units	16 hours	**CO: 5**
	Total project hours		**160**

Text Book	
1.	Sahayaraj, K. 2014. Basic and applied aspects of biopesticides. Springer, India.
2.	Giri, B., Prasad, R., Wu, Q.S. and A. Varma. 2019. Biofertilizers for Sustainable Agriculture and Environment. Springer International Publishing, Germany.
Reference Books	
1.	Ignacimuthu, S., and A. Sen. 2001. Microbials in insect pest management. Science Publishers, India.
2.	Panda, H. and D. Hota. 2007. Biofertilizers and organic farming. Gene-Tech Books. India.
3.	Md. Arshad Anwer. 2017. Biopesticides and Bioagents: Novel Tools for Pest Management. Apple Academic Press, USA.

Mode of Evaluation: Assessments and Report			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Seed Production and Technology	L	T	P	C
BAG4003		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Demonstrating the basic principles involved in seed production technology
2. Imparting knowledge on seed health testing and cultivar identification
3. Extending knowledge on all aspects of controlling seed quality in the field

Expected Course Outcome: At the end of the course the student should be able to

1. Realize the biology and analyse physical and chemical properties of varied forms of crop seeds
2. Recognize seed-borne pathogens and adapt appropriate control measures
3. Identify cultivars and undergo genetic purity testing
4. Comprehend seed certification standards
5. Inspect seed production fields
6. Market certified seeds and comprehend updates in seed production technology

Project

1.	Floral biology of monocots and dicots. Types of monocot and dicot embryos. External and internal structures of monocot and dicot seeds. Seed coat structure, preparation of seed albums and identification.	12 hours	**CO: 1**
2.	Proximate analysis of chemical composition of seed. Kinetics of seed imbibition and solute leakage. Seed invigoration and priming treatments. Accelerated ageing and controlled deterioration tests. Enzymatic activities and respiration during germination and effect of accelerated ageing. Identification and handling of instruments used in seed testing laboratory. Physical purity analysis of samples of different crops. Estimation of seed moisture content-oven method. Seed dormancy breaking methods	20 hours	**CO: 1**
3.	Requirements for conducting germination test, specifications and proper use of different substrata for germination. Seed germination testing in different agri-horticultural crops. Seedling evaluation. Vigour and viability testing methods. Tetrazolium test in different crops. Seed and seedling vigour tests applicable in various crops.	12 hours	**CO: 1**
4.	Economic importance of seed pathology in seed industry and plant quarantine, terminologies, important seed transmitted pathogens, seed microbes and their mode of action. Detection techniques and identification of common seed borne pathogens and quantification of infection percentage. Detection of seed borne fungi, bacteria and viruses. Identification of storage fungi, control of seed borne diseases and seed treatment methods. Seed health testing for designated diseases-blotter, agar and embryo count methods. Testing coated/pelleted seeds.	20 hours	**CO: 2**
5.	Species and cultivar identification. Genetic purity testing by chemical, biochemical and molecular methods.	12 hours	**CO: 3**
6.	Certification standards for self and cross pollinated and vegetatively propagated crops. Planning and management of different classes of seeds for self and cross pollinated crops.	16 hours	**CO: 4**
7.	General procedure of seed certification. Identification of weed and other crop seeds as per specific crops. Field inspection at different stages of a crop and observations recorded on contaminants and	24 hours	**CO: 4**

	reporting of results. Inspection and sampling at harvesting/threshing, processing and after processing for seed law enforcement. Testing physical purity, germination and moisture. Specifications for tags and labels to be used for certification purpose. Grow-out tests for pre and post-harvest quality control. Visits to regulatory seed testing laboratory, including plant quarantine lab and seed certification agency.		
8.	Planning of seed production, requirements for different classes of seeds in field crops-unit area and rate. Seed production in cross pollinated crops with special reference to land, isolation, planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony. Supplementary pollination, pollen storage, hand emasculation and pollination in cotton, detasseling in corn and identification of rogues and pollen shedders. Pollen collection, storage, viability and stigma receptivity. Gametocide application and visits to seed production plots.	20 hours	**CO: 5**
9.	Importance and promotion of quality seed, formal and informal seed supply systems. Basic concepts of marketing with special reference to seed. Importance and scope of seed industry in India, major constraints in seed industry, seed sector role of seed association, federation in seed trade, demand and supply of seed. Statutory requirements in seed business including research and development, estimation of cost of seed production, marketing costs and margins of seeds of different crops, case studies to compare public and private sectors in different conditions, impact analysis., seed pricing, cost benefit ratio and economic feasibility of seed industry.	20 hours	**CO: 6**
10.	Lectures by industrial experts on global seed market-update, recent seed production technologies, seed production issues and food safety.	8 hours	**CO: 6**
	Total project hours		**160**

Text Book	
1.	Khare, D and M.S. Bhale. 2019. Principles of Seed Technology. Scientific Publishers, New Delhi.
2.	Agarwal, R.L.2017. Seed Technology. Oxford & IBH Publishing Co Pvt. Ltd, New Delhi, India.
Reference Books	
1.	Gaur, S.C. 2012. A handbook of seed processing and marketing. Agrobios, India.
2.	Vanangamudi, K., S. Kavitha and K. Raja, 2016. A handbook of Seed Science and Technology, Agrobios, India.

Mode of Evaluation: Assessments and Report			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Mushroom cultivation technology	L	T	P	C
BAG4003		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Providing knowledge on commercial cultivation and marketing of mushrooms
2. Identifying cheaper recycled products to produce mushrooms
3. Demonstrating mushroom cultivation technology as a commercial business practice for farmers to ensure socio-economical and nutritional security and motivate students to become entrepreneurs.

Expected Course Outcome: At the end of the course the student should be able to

1. Identify edible, poisonous and medicinal mushrooms
2. Prepare media for pure culture of edible mushroom species and their long term preservation
3. Suggest mushroom farm layouts and substrates for cultivation
4. Demonstrate the cultivation practices for milky, oyster, button and paddy straw mushrooms
5. Manage pests and pathogens affecting mushrooms.
6. Market mushrooms profitably

Project

1.	Important mushrooms grown in India. Survey, identification, study of morphology and collection of edible mushrooms – button, oyster, paddy straw and milky mushrooms. Medicinal mushrooms- *Ganoderma.*	12 hours	**CO: 1**
2.	Poisonous mushroom and mushroom poisoning, protoplasmic poisons, neurological effects, gastro-intestinal irritants and Disulfiram like constituents. Diagnostic biochemical methods for mushroom poisoning. Guidelines for avoiding poisonous mushrooms.	16 hours	**CO: 1**
3.	Sterilization techniques – heat, moist heat, dry heat, radiation, filtration and chemical agents. Different culture media preparations. Preparation of media to isolate pure cultures of identified mushrooms. Isolation of edible fungi from the mushroom sporophore by tissue culture techniques. Preparation of mother spawn and bed spawn for oyster, paddy straw, button and milky mushrooms.	16 hours	**CO: 2**
4.	Mushroom farm layout – mushroom sheds for oyster, paddy straw, button and milky mushrooms including spawn running room and cropping room. Preparation of different substrates – coir pith, compost, vermicompost, sorghum leaves, maize leaves to cultivate mushrooms.	20 hours	**CO: 3**
5.	Paddy straw mushroom cultivation – raised bed method, hollow, cylindrical method, twisted rope method and modified cage method.	16 hours	**CO: 4**
6.	Cultivation of oyster mushroom – bed cultivation, soil bed cultivation, log piece cultivation, container system of cultivation and harvesting.	16 hours	**CO: 4**
7.	Cultivation of button mushroom – compost formulation and methods of composting; long and short term method; casing of compost, cropping and harvesting.	16 hours	**CO: 4**
8.	Cultivation of milky mushroom – Pasteurization, Spawning and spawn running, casing and cropping.	16 hours	**CO: 4**
9.	Pests, pathogens and their management –Sciarid flies, Phorids, Spring tails, mites, nematodes, bacterial and fungal diseases. Preparation of botanical extracts to control pest and diseases.	16 hours	**CO: 5**
10.	Nutritional and calorific value of edible mushrooms. Preparation of	16 hours	**CO: 6**

	recipes with oyster, paddy straw, button and milky mushrooms. Economics of mushroom cultivation and project preparation. Marketing strategies. Visit to mushroom farms.		
	Total project hours		**160**

Text Book	
1.	Suman, B.C. and V. P. Sharma. 2007. Mushroom cultivation in India. Daya Publishing House, India.
2.	Kalač, Pavel. 2016. Edible Mushrooms: Chemical Composition and Nutritional Value. Academic Press, USA.
3.	EIRI Board. 2007. Hand Book Of Mushroom Cultivation, Processing and Packaging, Engineers India Research Institute. India.
Reference Books	
1.	*Tradd Cotter. 2014. Organic Mushroom Farming and Mycoremediation: Simple to Advanced and Experimental Techniques for Indoor and Outdoor Cultivation. Chelsea Green Publishing. USA.*
2.	*Dinesh Chandra, A. and D. Muralikrishnan. 2019. Medicinal Mushrooms: Recent Progress in Research and Development. Springer, Singapore.*
3.	Pandey, R. K. and S. K. Ghosh. 1999. A handbook of mushroom cultivation, Emkay Publications, India.
4.	Kuo, Michael. 2007. 100 Edible Mushrooms. University of Michigan Press. USA.

Mode of Evaluation: Assessments and Report			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Soil, Plant, Water and Seed Testing	L	T	P	C
BAG4003		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on lab establishment for soil, plant, water and seed testing
2. Providing deeper understanding on nutrient application, its management and recommendations
3. Extending the practical knowledge on soil, plant, water and seed testing

Expected Course Outcome: At the end of the course the student should be able to

1. Plan and design a soil, plant, water and seed testing laboratory
2. Comprehend the working principles behind analytical instruments involved in testing samples
3. Analyze the nutrient status of soil samples and recommend judicious application of fertilizers
4. Analyze the nutrient status of plant samples
5. Determine the suitability of irrigation water
6. Comprehend the procedures involved in seed testing and certification

Project

1.	Establishment of soil, plant, water and seed testing lab-layout design, financial structure of soil, plant and water testing lab per annum, laboratory safety, quality control and standardization procedures.	16 hours	**CO: 1**
2.	Analytical instruments, principles, calibration and applications -pH meter, EC meter, spectrophotometer, flame photometer and AAS.	16 hours	**CO: 2**
3.	Sampling of soil - objectives, procedure and precautions. Determination of moisture content of soil. Determination of bulk and particle densities of soil. Determination of texture of soil - particle size analysis.	16 hours	**CO: 3**
4.	Determination of soil microbial biomass carbon. Determination of biological activity of soil by dehydrogenase assay.	8 hours	**CO: 3**
5.	Estimation of CEC and exchangeable sodium in soil. Standardization of solutions and reagents. Estimation of pH, EC, organic carbon, available N, P, K, S & micronutrients in soil. Use of soil testing kit for major and micronutrient analysis. Interpretation of analytical data - pH, EC, organic carbon, N, P, K, S and micronutrients: Fe, Mn, Zn, Cu, B and nutrient index. Fertilizer recommendation.	20 hours	**CO: 3**
6.	Plant sampling and sample preparation for analysis-digestion of plant material. Sampling stages and plant part to be sampled. Estimation of N, P, K, S and micro nutrients: Fe, Mn, Zn, Cu and B from plant sample. Rapid plant tissue test for N, P, and K. Quantitative rating of plant analysis data and interpretation of results. Critical nutrient concentration and critical nutrient ranges.	20 hours	**CO: 4**
7.	Determination of EC and pH of irrigation water. Determination of cations: Ca, Mg, Na and K of irrigation water. Determination of anions: CO_3, HCO_3 and Cl of irrigation water. Computation of SAR and RSC. Determination of COD and BOD of effluent water. Quality criteria, classification and suitability of irrigation water and water quality index	16 hours	**CO: 5**
8.	Seed sampling and physical purity test; Germination and viability test; Seedling vigour test; Genetic purity test- grow out test and electrophoresis.	16 hours	**CO: 6**

9.	Procedure of seed certification; Field inspection and preparation of field inspection report. Visit to seed production farms and seed processing plants.	16 hours	**CO: 6**
10.	Lecture by industrial experts. Visit to soil, plant, water and seed testing laboratories.	16 hours	**CO:3,4,5**
		Total project hours	**160**

Text Book	
1.	International Rules for Seed Testing. 2020. International Seed Testing Association-ISTA, Switzerland.
2.	Dhyan Singh, P.K. Chhonkar and B.S. Dwivedi. 2015. Manual On Soil, Plant And Water Analysis. Westville Publishing House. India.
Reference Books	
1.	Sabry Gobran Elias, Lawrence O. Copeland, Miller B McDonald and Riad Z. Baalbak. 2012. Seed Testing: Principles and Practices. Michigan State University Press, USA.
2.	George Estefan, Rolf Sommer, and John Ryan. 2013. Methods of Soil, Plant, and Water Analysis: A manual for the West Asia and North Africa Region: Third Edition. International Center for Agricultural Research in the Dry Areas, Beirut, Lebanon. ICARDA@cgiar.org www.icarda.org

Mode of Evaluation: Assessments and Report			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Commercial Beekeeping	L	T	P	C
BAG4003		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Developing students as entrepreneurs of beekeeping
2. Enriching knowledge in apiary management
3. Providing information on producing best byproducts from honey

Expected Course Outcome: At the end of the course the student should be able to

1. Classify different bee species and identify the best species for cultivation
2. Procure apiary tools
3. Understand the biology of bees
4. Construct and manage bee colonies
5. Identify the pests and diseases of honey bee.
6. Prepare a bankable project on honey bee rearing and their byproducts

Project

1.	Different species of honey bees. Types of bee hives. Bee species suitable for farming.	16 hours	**CO: 1**
2.	Bee keeping equipment and apiary tools.	12 hours	**CO: 2**
3.	Caste system, biology of bees and life history. Jobs of worker bees, doings of a drone and queen bee. Swarming and communication among bees.	20 hours	**CO: 3**
4.	Requirements of a colony, foraging, bee pasturage and flora. Factors influencing field activity.	20 hours	**CO: 4**
5.	Placement of colonies, managing bee colonies, combining two colonies, dividing and multiplying colonies. Bee poisoning.	20 hours	**CO: 4**
6.	Examining the colony, handling the queen, feeding the bees in a colony, manipulation of bees for honey production, extraction of honey, migratory beekeeping and seasonal management	20 hours	**CO: 4**
7.	Larval diseases and diseases of worker bees. Pests and enemies of bee colonies	12 hours	**CO: 5**
8.	Chemical composition of honey and their by-products. Role of FAO in quality assessment. Project preparation for bee keeping.	20 hours	**CO: 6**
9.	Lecture by Industry experts.	4 hours	**CO: 6**
10.	Visit to beekeeping units.	16 hours	**CO: 4**
	Total project hours		**160**

Text Book

1. Abrol D.P. 2010. Beekeeping – A comprehensive guide to bees and beekeeping. Scientific Publishers, India.
2. Jayashree, K. V., C. S. Tharadevi and N. Arumugam 2014. Apiculture. Saras Publication, India.

Reference Books

1. Kim Flottum. 2011. Better Beekeeping: The Ultimate Guide to Keeping Stronger Colonies and Healthier, More Productive Bees. Quarry Books, USA.
2. Atwal, A.S. 2000. Essentials of beekeeping and Pollination. Kalyani Publishers, India.

Mode of Evaluation: Assessments and Report

Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Poultry Production Technology	L	T	P	C
BAG4003		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on various aspects of poultry production and management
2. Interpreting the usage of scientific techniques and principles involved in rearing poultry
3. Stating the importance of healthy flock and furnishing skills on poultry product and by-product processing

Expected Course Outcome: At the end of the course the student should be able to

1. Comprehend the concepts of poultry rearing and realize the scope of poultry farming
2. Manage a hatchery
3. Supervise healthy and uniform flock of poultry
4. Sell by-products, utilize and dispose waste from a poultry farm
5. Recommend poultry business and marketing strategies
6. Understand the emerging trends and challenges in poultry industry

Project

1.	Significance of poultry production. Poultry rearing–backyard system, semi-intensive system, intensive system: deep litter, slat system, wire floor, cage houses and raised platform cage houses. Cages; flat deck, Californian cages, "A" type cages, tier cages and furnished cages. Environmentally controlled houses, floor space, watering and feeding. Space requirements for different age groups and rearing conditions.	16 hours	**CO: 1**
2.	Selection of site and location of poultry farm – importance of poultry housing and equipment. Feeder and drinker-pipeline, automatic drinker and nipple drinker arrangements. Principles of housing-location and basic principles of construction. Shed dimension measurement and area calculation, different shed designs and layout and poultry shed housing materials	16 hours	**CO: 1**
3.	Hatchery: layout, design and location. Single and multistage incubators. Methods of incubation. Incubation periods. Physical factors and requirements for incubating eggs–temperature, humidity, gaseous environment, position and turning of eggs. Collection, selection, cleaning, sanitation and storage of hatching eggs. Setting, candling, transfer, hatching, pedigree hatching, chicks pull out, grading, packing and chick dispatch. In-ovo and in-hatch vaccinations and medications.	20 hours	**CO: 2**
4.	Layer farm: System of layer farming, economic traits, pre-laying and laying management. Feeding types, layers in cages, Slat, Slat cum deep litter and deep litter houses – male and female management. Pre-peak, Peak and Post-peak laying period management, watering and lighting. Culling of unproductive birds, moulting, forced moulting, monitoring egg production curve and record keeping. Flock uniformity. Seasonal management of layer birds.	20 hours	**CO: 3**
5.	Broiler farm: calculating FCR, EEF, CFCR, day gain, mean age and cost of production. Broiler production parameters. Breeder farm: brooding and growing, cost of production/ bird, cost of production Vs. egg returns, mortality %, livability %, FCR for eggs, HD %, HE %, HHHE %, HHE %, Egg mass, CPP, and visual control system (VCS). Maintaining poultry farms with healthy flocks and usage of biosecurity	20 hours	**CO: 3**

	system.		
6.	System of feeding: restricted and controlled, use of additives and non-additives, enzymes, probiotics, prebiotics and antibiotics, herbs and performance enhancers and utilization of non-conventional feedstuff. Organic chicken and lean meat production technology.	12 hours	**CO: 3**
7.	Broiler duck production, management of broiler quail and goose. Disease management, processing and products.	8 hours	**CO: 3**
8.	By-products. Egg formation, structure, quality, size, preservation, processing, grading and packaging. Poultry meat: chemical and nutritive value, composition, flavor, tenderness, meat processing, carcass yield and characteristics. Ready-to-Cook and Ready-to-Eat chicken. Waste utility: Design and layout of rendering plant. Manure and biogas generation from hatchery and slaughter house waste. Dead bird disposal and disposal of diseased birds. Bio-hazards of poultry waste.	16 hours	**CO: 4**
9.	Poultry business, economics, marketing and prospects in India. Broiler performance indices. Food Laws and Regulations in Poultry Foods. Role of cooperative, public and private sectors in marketing. Improving processing, delivery systems and channels in marketing. Stock market, export and import in poultry sector.	16 hours	**CO: 5**
10.	Heat resistant breeds to suit different climatic regions. Climatic factors affecting poultry production in housed conditions and their management. Weather forecasting. Visit to commercial poultry farms. Lecture by industrial experts on recent developments in poultry farming.	16 hours	**CO: 6**
	Total project hours		**160**

Text Book

1.	Ensmiger. M. E., 2015. Poultry Science. 3rd Edition. CBS Publishers and Distributors, India.
2.	Sreenivasaiah., P. V., 2015. Textbook of Poultry Science. 1st Edition. Write & Print Publications, New Delhi, India.

Reference Books

1.	Honnappagol, S.S., S. C. Biradar, and K.M. Gadre.2014. Broiler Farming and Management. Jaypee Brothers Medical Publishers Private Limited, India.
2.	Donald, D.Bell. and Weaver D. William Jr., 2002. Commercial Chicken Meat and Egg Production. 5th Edition. Kluwer Academic Publishers, India.

Mode of Evaluation: Assessments and Report

Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Commercial Horticulture	L	T	P	C
BAG4004		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on propagation of commercial horticultural crops
2. Demonstrating business opportunities based on the advances in the field of horticulture
3. Describing processing, marketing and commercialization of horticultural products

Expected Course Outcome: At the end of the course the student should be able to

1. Understand propagation, and post-harvest handling of fruits
2. Understand nursery production and marketing of ornamentals
3. Should be able to cultivate vegetables under protected cultivation
4. Should be able to cultivate flowers under protected cultivation
5. Plan and execute processing and marketing of horticultural crops
6. Comprehend and follow the current advances in horticulture and exploit the techniques

Project

1.	Propagation of fruit crops: Raising of rootstocks, grafting and budding of rootstocks, management of grafted plants and plant certification. Postharvest handling, value addition, packaging, marketing and quality control.	16 hours	**CO: 1**
2.	Nursery production of ornamentals: Production of plantlets, production of potted plants, management, maintenance, sale and marketing.	12 hours	**CO: 2**
3.	Protected cultivation of vegetables: Nursery raising, procurement, transplanting, management and maintenance of the crop; Postharvest handling and value addition, quality control and marketing.	16 hours	**CO: 3**
4.	Protected cultivation of flowers: Nursery raising, procurement, transplanting, management and maintenance of the crop; Postharvest handling, quality control and marketing.	16 hours	**CO: 4**
5.	Planning and execution of a market survey, preparation of processing schedule, preparation of project module based on market information.	16 hours	**CO: 5**
6.	Calculation of capital costs, source of finance, assessment of working capital requirements and other financial aspects.	16 hours	**CO: 5**
7.	Identification of sources for procurement of raw material, production and quality analysis of fruits and vegetables products at commercial scale. Packaging, labelling, pricing and marketing of horticultural products. Current trends, opportunities and constraints in the export market. IPR in horticulture.	20 hours	**CO: 5**
8.	Advances in micropropagation of horticultural crops and their management. Present status, problems and future potential of medicinal and aromatic plants.	16 hours	**CO: 6**
9.	Advances in commercial landscape designing, designing of kitchen and rooftop gardens. Organic farming. Survey of commercial horticultural products.	16 hours	**CO: 6**
10.	Lecture by industrial experts on recent advances in commercializing horticulture. Visit to advanced commercial horticultural farms.	16 hours	**CO: 6**
	Total project hours		**160**

Text Book

1. Amit Deogirikar. 2019. A Text Book on Protected Cultivation and Secondary Agriculture.

	Rajlaxmi Prakashan, Aurangabad, India.		
2.	Patel, N.L., S.L. Chawla and T.R. Ahlawat. 2015. Commercial Horticulture. New India Publishing Agency, India.		
Reference Books			
1.	Various. 2010. Commercial Horticulture - With Chapters on Vegetable Production and Commercial Fruits Growing. Read Books, Canada.		
2.	Kunal Mitra. 2008. Commercial production of horticultural crops. Oxford Book Company, India		
Mode of Evaluation: Assessments and Report			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Floriculture and Landscaping	L	T	P	C
BAG4004		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Describing production technology and benefits of commercially important flowers
2. Imparting knowledge on designing landscapes
3. Teaching marketing strategies associated with floriculture and landscaping

Expected Course Outcome: At the end of the course the student should be able to

1. Understand the mechanism of flowering
2. Know to produce commercially important flowers
3. Exploit the uses of flowers based on market needs
4. Comprehend advanced techniques in floriculture.
5. Market flowers.
6. Design landscape architecture

Project

1.	Floral structure and value of commercially important flowers. Mechanism and factors controlling flowering.	8 hours	**CO: 1**
2.	Requirements for commercial flower production - preparation of land and layout, propagation, production and management of commercial flowers. Harvesting and postharvest handling of produce.	20 hours	**CO: 2**
3.	Bedding plants production for floriculture. Foliage plants or houseplants. Cut cultivated greens and cut flowers. Other flower crops.	16 hours	**CO: 2**
4.	Dry flower production - identification of suitable species, drying, packaging and forwarding techniques. Arrangement and composition of flowers. Making of bouquets, button hole, wreath, veni and gajras, car and marriage palaces.	16 hours	**CO: 3**
5.	Protected cultivation of commercially important flowers. Integrated nutrient, water, pest and disease management employed in floriculture. Micropropagation, hydroponics and its economic considerations.	16 hours	**CO: 4**
6.	Marketing of produce, cost analysis, institutional management, visit to flower growing areas and export houses.	16 hours	**CO: 5**
7.	Planning and designing, site analysis, selection and use of plant material for landscaping. Formal and informal garden, features, styles, principles and elements of landscaping. Preparation of landscape plans of home gardens, farm complexes, public parks, institutions, high ways, dams and avenues.	20 hours	**CO: 6**
8.	Selection and propagation of plants suitable for creating landscapes. Pot plant management.	16 hours	**CO: 6**
9.	Making of lawns. Maintenance of Bonsai. Use of software in landscaping.	16 hours	**CO: 6**
10.	Visits and attachment to commercial landscaping architectural firms	16 hours	**CO: 6**
	Total project hours		**160**

Text Book

1. Sing, A.K. and A Sisodia. 2017. Text Book of Floriculture and Landscaping. New Publishing agency, India.
2. Prasad, S., D. Singh and U. Kumar. 2019. Commercial Floriculture. 2nd edition. Agrobios, India.

Reference Books			
1.	Tim W. 2015. The fundamentals of Landscape Architecture. 2nd revised edition. Fairchild Books. United Kingdom.		
2.	Desh Raj. 2015. Objectives of Floriculture and Landscaping. Kalyani Publishers, India.		
3.	Robert, H. and L. Jamie. 2014. Landscape Architecture - An Introduction. Laurence king publishing. London, United Kingdom.		
Mode of Evaluation: Assessments and Report			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Food processing	L	T	P	C
BAG4004		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Developing analytical and entrepreneurial skills in food processing
2. Providing hands on experience in processing food products
3. Describing business strategies involved in running a food processing industry

Expected Course Outcome: At the end of the course the student should be able to

1. Analyse the marketability of a food product
2. Comprehend project proposals of a food processing industry
3. Prepare a project proposal for running a value added food product industry
4. Understand sales strategies of a food processing industry
5. Should be able to manage and initiate a food product enterprise

Project

1.	Identification of the product to be manufactured, market survey, analysis of the existing status of the identified product and targeted market and customer.	12 hours	**CO: 1**
2.	Processing of fruits, preparation of pulp, juices, RTS, squash and nectars from the seasonal fruits. Preparation of project proposal with supply chain of inputs, personnel plan, production plan and finance plan. Processed fruit products. Innovativeness and creativity. Quality assessment. Maintenance of production records.	20 hours	**CO: 2**
3.	Processing of seasonal vegetables for sauces and ketchup. Preparation of project proposal with supply chain of inputs, personnel plan, production plan and finance plan. Processed vegetable products. Innovativeness and creativity. Quality assessment. Maintenance of production records.	20 hours	**CO: 2**
4.	Processing of value added products. Preparation of jam, jelly and marmalade. Preparation of the project proposal with supply chain of inputs, personnel plan, production plan and finance plan. Value added products. Innovativeness and Creativity. Quality assessment. Maintenance of production records.	20 hours	**CO: 3**
5.	Processing of bakery products. Preparation of bread, biscuit and cookies. Preparation of project proposal with supply chain of inputs, personnel plan, production plan and finance plan. Bakery products. Innovativeness and Creativity. Quality assessment. Maintenance of production records.	20 hours	**CO: 2**
6.	Processing of milk, poultry and meat products. Preparation of project proposal with supply chain of inputs, personnel plan, production plan and finance plan. Value added products. Innovativeness and Creativity. Quality assessment. Maintenance of production records.	20 hours	**CO: 2**
7.	Sales strategy, assessment of sales performance and payback period.	12 hours	**CO: 4**
8.	Detailed project report on setting up of enterprise in the selected areas of product manufacture and evaluation.	16 hours	**CO: 5**
9.	Lecture by industrial experts on food processing, testing, quality, safety and standards, regulations and nutritional quality assessment.	8 hours	**CO: 5**
10.	Visit to food processing industries.	12 hours	**CO: 5**

	Total project hours			**160**
Text Book				
1.	Hosahalli S. Ramaswamy. 2014. Post-harvest Technologies of Fruits and Vegetables. DEStceh Pubilcaitons Inc., USA.			
2.	Fellows, P.J. 2016. Food Processing Technology: Principles and Practice. 4th edition. Woodhead Publishing. UK.			
3.	Ramesh C. Chandan, Arun Kilara and Nagendra Shah. 2008. Dairy Processing and Quality Assurance. Wiley-Blackwell, USA.			
Reference Books				
1.	Jagadish Chandra Jana., Tanmay Kumar Koley., Arghya Mani., Chandan Karak., Dipak Kumar Murmu. 2018. Advances in post harvest management, processing and value addition of horticultural crops-Part 2: Vegetables, spices and plantation crops. Today and Tomorrow's Printers and Publishers, India.			
2.	Chavan, U.D. and J.V. Patil. 2013. Industrial Processing of Fruits and Vegetables. Daya Publishing House, India.			
3.	Fidel Toldrá. 2010. Handbook of Meat Processing. Blackwell Publishing, USA.			
Mode of Evaluation: Assessments and Report				
Recommended by Board of Studies	10/02/2020			
Approved by Academic Council	No. 64	**Date**	16/12/2021	

Course code	Agriculture Waste Management	L	T	P	C
BAG4004		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on recycling and management of different agricultural waste
2. Demonstrating integrated agricultural waste management
3. Sharing knowledge on methods of conversion of waste into farm inputs

Expected Course Outcome: At the end of the course the student should be able to

1. Gain knowledge on agricultural wastes and decide on techniques to convert waste to inputs
2. Practice varied composting techniques of agricultural waste
3. Recommend processes to recycle agricultural wastes
4. Manage and utilize animal waste
5. Comprehend management of waste from food processing industries
6. Understand sludge and waste water treatment and its applications

Project

1.	Agricultural wastes: Solid, liquid and gaseous wastes from field, livestock and agro-industries.	4 hours	**CO: 1**
2.	Aerobic waste treatment: Activated sludge, rotatory drum, aerated lagoons and fluidized bed reactor. Visit to an aerobic treatment plant.	20 hours	**CO: 1**
3.	Anaerobic waste treatment: hydrolysis, acidogenesis, acetogenesis, methanogenesis and anaerobic lagoons. Visit to an anaerobic treatment plant.	20 hours	**CO: 1**
4.	Composting: pit method, heap method. Compostable and uncompostable inputs. Coir composting.	12 hours	**CO: 2**
5.	Vermicomposting: Earth worms that can be effectively used for converting compost to soil conditioners. Production of vermicompost and vermicasts. Integrating composting and vermicomposting.	20 hours	**CO: 2**
6.	Bioremediation. Biofuel production from waste including biodiesel and bioethanol. Mushroom cultivation and biofertilizer preparation **using farm residues.** Integrated waste treatment with algal cultivation. **Pulp and paper production from plant waste.**	16 hours	**CO: 3**
7.	Silage making: converting green fodder into silages, forages that can be used, fermentation, hylage and silage effluent treatments.	16 hours	**CO: 3**
8.	Animal husbandry and poultry wastes: manure, biogas, fish feed, leather and nutrients from bones.	16 hours	**CO: 4**
9.	Food processing waste: management of dairy processing, fruits and vegetable processing and oil and fat processing wastes.	20 hours	**CO: 5**
10.	Municipal and industrial sludge management. Wastewater application systems.	16 hours	**CO: 6**
	Total project hours		**160**

Text Book

1. Camille N. Foster. 2015. Agricultural Wastes: Characteristics, Types and Management (Waste and Waste Management). Nova Science Publishers Inc. UK.
2. Zainul Akmar Zakaria. 2018. Sustainable Technologies for the Management of Agricultural Wastes. Springer, Singapore.

Reference Books

1. Dinesh K. Maheshwari. 2014. Composting for Sustainable Agriculture (Sustainable

	Development and Biodiversity). Springer international publishing. Switzerland.
2.	Joshi, V.K. and S. K. Sharma 2011. Food Processing Waste Management: Treatment and Utilization Technology. New India Publishing Agency, India.

Mode of Evaluation: Assessments and Report			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Organic production technology	L	T	P	C
BAG4004		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on indigenous and scientific techniques involved in organic farming
2. Demonstrating integrated organic farming
3. Sharing knowledge on certification and marketing of organic produce

Expected Course Outcome: At the end of the course the student should be able to

1. Comprehend the principles and components of organic farming
2. Practice biological soil enrichment
3. Produce biological plant nutrient mixtures
4. Recommend indigenous pest and disease management practices
5. Manage an integrated organic farm
6. Market and utilize products and by-products of an profitable organic farm

Project

1.	Organic farming: Importance, scope, principles, perspectives and concepts. Components of organic production of agricultural and horticultural crops. Organic ecosystems. Organic farms visit to study the various components and their utilization	20 hours	**CO: 1**
2.	Soil biological approaches for sustainable agriculture: Crop rotation, mixed cropping, mulching, soil solarization and raising green manure crops.	12 hours	**CO: 2**
3.	Bio-inoculants: Production and use of BGA, Azolla, Rhizobium, Azotobacter, Azospirillum, phosphate solubilizing bacteria and vesicular arbuscular mycorrhiza.	16 hours	**CO: 2**
4.	Indigenous technology knowledge for nutrient and weed management. Production and uses of Panchagavya and Dasagavya.	12 hours	**CO: 3**
5.	Mass multiplication of Trichoderma and Pseudomonas to control important soil borne diseases. Biopesticides, pheromones, plant medicinal extracts as insect repellents, trap crops, bird perches, setting of light traps and practice of traditional methods to control insect pests and diseases.	20 hours	**CO: 4**
6.	Practice integrated organic farming: farm design, land preparation, raising suitable **agricultural crops,** horticultural crops, medicinal and aromatic plants, forage crops, **tree species** according to the soil type, **and production of livestock and birds. Integrated nutrient, p**est, disease and weed management.	20 hours	**CO: 5**
7.	Post-harvest management. Grading, packaging and handling.	12hours	**CO: 6**
8.	Residue management: Mushroom cultivation**, farmyard manure,** Composting, coir composting, **vermicomposting, biogas production and green manuring.**	16 hours	**CO: 6**
9.	Working out the cost:benefit ratio and comparing the ratio between organically and inorganically grown crops.	12 hours	**CO: 6**
10.	Operational structure of National Programme for Organic Production (NPOP). Minimum Pre-requisites as NPOP. Importance of AGMARK in organic production. Quality considerations, certification of organic products, labelling, accreditation, marketing and export potential of	20 hours	**CO: 6**

	organic products.		
	Total project hours		**160**

Text Book	
1.	Reddy. S.R. 2017. Principles of organic farming. Kalyani publishers, India
2.	Sarath Chandran, Unni M.R and Sabu Thomas. 2018. Organic farming. Woodhead Publishing, UK.
3.	Tarafdar, J.C., Tripathi, K.P. and Kumar, M., 2012. Organic Agriculture. Scientific Publishers, India.
Reference Books	
1.	Ranjan Kumar Biswas. 2014. Organic farming in India. New Delhi Publishers, India.
2.	Peter Fossel. 2014. Organic Farming: How to Raise, Certify, and Market Organic Crops and Livestock. Reprint edition, Voyageur Press, USA.
3.	Palaniappan, S.P. and Annadurai, K., 2018. Organic Farming Theory & Practice. Scientific publishers, India.

Mode of Evaluation: Assessments and Report			
Recommended by Board of Studies	10/02/2020		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Commercial Sericulture	L	T	P	C
BAG4004		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Providing practical experience in silkworm rearing
2. Imparting knowledge in mulberry cultivation
3. Demonstrating production of silk

Expected Course Outcome: At the end of the course the student should be able to

1. Practice production of mulberry
2. Procure and rear silkworms.
3. Design and manage a Chawki garden
4. Manufacture good quality silk
5. Manage pest and diseases affecting silkworms.
6. Project sericulture farming as a profitable business

Project

1.	Mulberry: Area, distribution, popular varieties, climatic and soil requirements. Nursery – Selection of planting material, bed preparation, planting, propagation and management.	20 hours	**CO: 1**
2.	Mulberry main field preparation: Manuring, Planting, Irrigation and Weeding. Intercropping, training and pruning. Shoot harvest, pruning transportation and preservation. Farm machinery implements.	20 hours	**CO: 1**
3.	Authorized silkworm races: crossbreeds and bivoltine. Rearing house planning and maintenance. Disinfestation of rearing appliances. Agencies involved in egg production. Procurement, transportation, preservation, incubation, black boxing and hatching. Rearing of chawki worms.	20 hours	**CO: 2**
4.	Chawki garden maintenance and management. Late age rearing. Moulting care, spinning care and harvesting. Calculation of effective rate of rearing. Transporting and marketing of cocoons. Visit to chawki rearing units.	20 hours	**CO: 3**
5.	Physical and commercial properties of silk and cocoon. Cocoon sorting. Silk reeling, re-reeling, skein preparation and packing. Eri silk spinning and methods. Sampling and testing procedure for winding, size, strength test condition cohesion and seriplane test. Standards for grading raw silk. Visit to silk reeling units.	20 hours	**CO: 4**
6.	Bacterial and fungal diseases of silkworm. Predators of silkworm.	8 hours	**CO: 5**
7.	Economics of mulberry production and management. Economics of rearing silkworms.	12 hours	**CO: 6**
8.	Project preparation for establishing late age rearing centres.	12 hours	**CO: 6**
9.	Large scale sericulture farming and contract farming.	12 hours	**CO: 6**
10.	Lecture by industrial experts and visits to cocoon markets.	16 hours	**CO: 6**
	Total project hours		**160**

Text Book

1. Sehgal, P.K. 2017. Text book of sericulture, apiculture and entomology. Kalyani Publishers, India.
2. Singh, R.N. and B. Saratchandra. 2011. Sericultural entomology. APH Publishing Corporation. India.

Reference Books				
1.	Panda, H. 2010. The Complete Book on Textile Processing and Silk Reeling Technology. Asia Pacific Business Press Inc., India.			
2.	Charles Valentine Riley. 2018. The Mulberry Silk-Worm: Being a Manual of Instructions in Silk Culture, Classic Reprint. Forgotten Books, UK.			
3.	Patnaik, R.K. 2013. Sericulture Manual. Biotech Books, India.			
Mode of Evaluation: Assessments and Report				
Recommended by Board of Studies		10/02/2020		
Approved by Academic Council		No. 64	**Date**	16/12/2021

Course code	Regenerative Agriculture	L	T	P	C
BAG4003		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives:

1. Explain the practice of agro-ecology.
2. Summarize learning tools and techniques to enhance carbon sequestration and mitigate climate change.
3. Develop the undergraduate agricultural students to become consultants on the practice of regenerative agriculture.

Expected Course Outcome:

1. Understand the concepts of regenerative agriculture.
2. Design regenerative agriculture for varied settings.
3. Describe different regenerative techniques.
4. Correlate the parameters involved in assessment of regenerative agriculture.
5. Articulate the benefits of regenerative agriculture to the farmers.
6. Use the regenerative agricultural concepts in real world sites.

Project

1.	Introduction-Evolution of the concept of regenerative agriculture; Core principles of regenerative agriculture; Allied agricultural practices; Relevance of regenerative agriculture to sustainable development goals; Scientific deliberations of proponents and opponents of regenerative agriculture.	5 hours
2.	Designs-Perspectives of capital resources; Evaluation of biotic and abiotic factors of the study sites; Design Principles-zone and sector planning; Comprehensive regenerative customized designs for varied sites - Natural habitats in agricultural-urban backyards, peri-urban allotments or rural homesteading; Restructuring existing designs; Flexible designs for adaptive regenerative agricultural sites.	15 hours
3.	Regeneration Techniques - Basic underlying patterns of natural phenomena; Regenerative soil practices - soil moisture retention strategies, role of soil adjuvants, soil vaccines, maintenance and enhancement of soil food web; Strategies for carbon sequestration -agro-biodiversity - land use diversification, polycultures and perennial cropping strategies, high field border density, living fences, hedgerows, zero or minimal tilling, multi-species cover crops, diverse crop rotation, strip-intercropping, wind breaks, silvopasture, multi-strata agro-forestry; regenerative grazing management - adaptive multi-paddock (AMP) grazing, rotational grazing; Tools to monitor carbon sequestrations; measures for water collection, Water retention basin with waterproofing, integrated water management systems, Riparian buffers and water breaks; Forests garden; Food Sheds; Livestock integration; Fodder banks; Outdoor living barns; Adaptive management techniques for resources cycling, community dynamics, increasing trophic networks and habitat diversity, self-regulating measures; Innovative practices for decision-making under uncertainty; Ecological infrastructures to increase ecological resilience; Global indigenous regenerative systems and practices.	30 hours
4.	Indicators of Regenerative Agriculture - Evaluation of indicators for social and economic equity, food security, conservation of biodiversity, and provision of ecosystem services gains and reductions in resource consumption; Economic resilience, viability of farming community; Regenerative enterprise ecosystem; Regenerative producer web; Appraisal of multi-capital flows and investments; Bottlenecks in evaluation criteria	10 hours

5.	Dissemination of regenerative agriculture to farmers - Strategies adopted to make regenerative agriculture as an eco-movement; Regenerative agriculture in India - Case studies	5 hours
6.	Quality Assessment - relevance; Components - baseline requirements, documentation of compliance of soil health, land management, carbon sequestration, animal welfare, labor worker fairness; Supply chain guidelines; International and National agencies involved; Issues in certifications.	15 hours
7.	Learn by observing - Field visits to experience regenerative agricultural practices in different farming systems	20 hours
8.	Discussions with practitioners of regenerative agriculture	10 hours
9.	Learn by doing – Hands-on implementation of concepts of regenerative agriculture	30 hours
10.	Pilot plot studies in VIT farm/community project	20 hours
	Total project hours	**160**

Text Books	
1.	**Regenerative Agriculture - What's Missing? What Do We Still Need to Know? 2021. David Dent and Boris Boincean (Editors), ISBN 978-3-030-72224-1. Springer Nature, Switzerland AG.**
2.	**Eric Toensmeier. 2016. The Carbon Farming Solution: A Global Toolkit of Perennial Crops and Regenerative Agriculture Practices for Climate Change Mitigation and Food Security. Chelsea Green Publishing, Vermount, USA.**
Reference Book and Materials	
1.	Allan Savory and Jody Butterfield. 2016. Holistic Management – A Commonsense Revolution to Restore Our Environment (Third Edition), Island Press, Washington,DC
2.	Scientific literature, Popular articles, Videos.
Mode of Evaluation: Assessments and Report	

Recommended by Board of Studies	29/10/2021		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Entomoremediation	L	T	P	C
BAG4003		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Identification and mass production of insects involved in entomoremediation
2. Enriching knowledge on utilization of insects to degrade waste materials
3. Providing information on producing best byproducts such as livestock feed

Expected Course Outcome: At the end of the course the student should be able to

1. Identify and mass produce insects that can be used in biomass management
2. Identify and mass produce insects that can accumulate heavy metals
3. Identify and mass produce insects that can help in degradation of plastics
4. Practice novel techniques for mass multiplication of insects at low cost
5. Evaluate the nutritional and anti-nutritional parameters of the insects
6. Develop promising products such as poultry or fish feed

Project

1.	Identification of major insects commonly being used in biomass management.	16 hours
2.	Identification of major insects commonly being used in heavy metals degradation.	12 hours
3.	Identification of major insects commonly being used in plastic degradation.	20 hours
4.	Mass multiplication of Black soldier fly, *Hermetia ilucens* using biowastes.	20 hours
5.	Mass multiplication of wax moth, *Galleria mellonella* using different substrates.	20 hours
6.	Mass multiplication of meal worm, *Tenebrio mollitor* using different substrates.	20 hours
7.	Experiments on analysing the nutritional and anti-nutritional parameters.	12 hours
8.	Development of various products benefitting the farmers and society.	20 hours
9.	Lecture by Industry experts.	4 hours
10.	Visit to insect rearing units.	16 hours
	Total project hours	**160**

Text Book

1. A. Rakshit, M.Parihar, B.Sarkar, H. B. Singh and L. F. Fraceto. 2021. Bioremediation Science From Theory to Practice. CRC Press, USA.
2. A. van Huis and J.K. Tomberlin. 2017. Insects as food and feed: from production to consumption. ISBN: 978-90-8686-296-2.

Reference Books

1. Martin Alexander. 1999. Biodegradation and Bioremediation 2nd Edition. Elsevier Science Publishing Co Inc.
2. R. B. King, John K. Sheldon and G. M. Long. 2019. Practical Environmental Bioremediation The Field Guide, Second Edition. CRC press, USA

Mode of Evaluation: Assessments and Report

Recommended by Board of Studies	29/10/21		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Bioremediation	L	T	P	C
BAG4003		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial	Syllabus version			
BAG4099	Attachment (RAWE & AIA)	1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on importance of microbes in bioremediation of polluted area
2. Describing the physiology of the microbes and their metabolism
3. Explaining morphology, vegetative, reproductive structures and resting structures of fungi, bacteria and other microbes used in bioremediation

Expected Course Outcome: At the end of the course the student should be able to

1. Recognize the importance and scope of bioremediation and analyze the causes and factors leading to remediation pathway
2. Classify microbes taxonomically for designing effective remediation strategies
3. Differentiate microbes based on morphology, vegetative, reproductive and resting structures
4. Relate metabolic pathway, cycles and physiology of microbes
5. Describe physiology of microbes and the strategies for bioremediation

Project

1.	Microbes for bioremediation. Essential characteristics of microbes for bioremediation, microbial adaptation for adverse conditions, microbes involved in bioremediation and metabolic process involved in bioremediation.	4 hours
2.	Bacteria versus fungi for bioremediation. Microbial interaction for bioremediation optimizations. Factors affecting bioremediation. Bioremediation mechanisms and limitations.	12 hours
3.	Bioremediation techniques-*In situ* and *Ex situ* techniques. Characterization of essential factors for bioremediation.	20 hours
4.	Strategies for the improvement of bioremediation techniques, physical, chemical and biological parameters.	20 hours
5.	Molecular techniques in the analysis of contaminated sites and successful bioremediation projects.	20 hours
6.	Bioremediation of contaminants-organic wastes, nature of organic compounds, decomposition of organic matter, mineralization and immobilization, microbes involved in decomposition, anaerobic decomposition of organic matter, humus and lignin.	16 hours
7.	Environmental impact of fertilizers and treatment of domestic sewage. Bioremediation of inorganic compounds and mixed contaminants. Phytoremediation of contaminants.	16 hours
8.	Effluents and sewage analyses-introduction, sample preparation, physical characteristics, chemical characteristics/constituents, organic constituents and inorganic constituents. Bacterial growth and metabolism.	16 hours
9.	Microbes in extreme environment – special features of the thermophilic, methanogenic and halophilic archaea; Photosynthetic bacteria, Cyanobacteria; Microbes in other extreme conditions – deep ocean, and space. Microbial Techniques in isolation, culturing , detection and staining.	20 hours
10.	Microbial analysis of water, waste water and soil. Microbiological equipment's. Basic requirements of microorganisms. Bacterial growth, characteristics of microorganism and its safety measures. Microbial communities in natural water determining sanitary quality of water: bacteriological evidence of faecal pollution. Water pollution: causes hazards and control of human water borne diseases. Water purification methods. Disinfection of potable water supplies	16 hours
	Total project hours	**160**

Text Book

1. Environmental science and biotechnology Theory and techniques. By A.G Murugesan and C Rajakumari. MJP Publisher 2005.
2. Microbial Bioremediation By P Rajendran and P Gunasekaran. MJP Publisher 2006.

Reference Books			
1.	Pelczar M.J., Chan E.C.S. & Kreig N.R., Microbiology: Concepts and Application.,Tata McGraw Hill.		
Mode of Evaluation: Assessments and Report			
Recommended by Board of Studies	29/10/21		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Metabolite Production Technology from Medicinal Plants	L	T	P	C
BAG4003		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Providing insight into extraction and production technology of metabolites from medicinal plants
2. Developing skills for scale up and commercial production of extracts
3. Motivating students to become entrepreneurs

Expected Course Outcome: At the end of the course the student should be able to

1. Identify commercially important extracted metabolites from medicinal plants
2. Isolate and scale up the metabolites
3. Commercially produce the metabolites suitable for varied environments
4. Culture medicinal plants and produce therapeutically significant metabolites
5. Follow the steps involved in quality control of therapeutic agents and the scaling up of metabolites

Project

1.	Types and importance of different kinds of medicinal plants for production of therapeutically significant metabolites.	4 hours
2.	Classification of different kind of medicinal plants. Culturing of medicinal plants.	12 hours
3.	Extraction techniques of plant metabolites using solvents like ethanol and phenol	20 hours
4.	Selection of efficient strains, mixing of culture and carriers - Production - carrier based	20 hours
5.	Analytical techniques for Identification and characterization of the metabolites – HPLC, GCMS, SEM, TEM, chromatography	20 hours
6.	Scaling up techniques for the isolated metabolites	16 hours
7.	ISI standards. Storage techniques	16 hours
8.	Preparation of plan for the production unit and proposal of loan.	16 hours
9.	Mass production and testing of quality parameters and standardization	20 hours
10.	Visit to certified production units	16 hours
	Total project hours	**160**

Text Book

1. Bird. C. 2014. The Fundamentals of Horticulture: Theory and Practice, Royal Horticultural Society, Cambridge University Press, London.
2. Tiwari, A.K. 2012. Fundamentals of Ornamental Horticulture and Landscape Gardening, New India Pub. Agency, New Delhi, India.2
3. Kumar, N. 2010. Introduction to Horticulture. Oxford &Ibh Publishing Co Pvt Ltd. India.

Reference Books

1. Jitendra Singh, 2014. Basic Horticulture. Kalyani Publishers. New Delhi.
2. Adams, C., Early M., J. Brook and K Bamford. 2014. Principles Of Horticulture: Level 2, 7th Revised Edition., Taylor and Francis, London, UK.
3. Misra, K.K and R. Kumar. 2014. Fundamentals of Horticulture. Biotech Books, India

Mode of Evaluation: Assessments and Report

Recommended by Board of Studies	29/10/21		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Phytoremediation	L	T	P	C
BAG4004		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial	Syllabus version			
BAG4099	Attachment (RAWE & AIA)	1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on the significance of phytoremediation of polluted area.
2. Describing the physiology of the crops and their metabolism
3. Explaining the morphology, vegetative, reproductive structures and taxonomy of different plants in different families which is used in phytoremediation.

Expected Course Outcome: At the end of the course the student should be able to

1. Recognize the importance and scope of phytoremediation and analyze the causes and factors leading to remediation pathway.
2. Classify plants taxonomically for designing effective remediation strategies.
3. Differentiate plants based on morphology, vegetative and reproductive characteristics.
4. Relate the metabolic pathway based on cycles and crop physiology.
5. Describe the crop physiology and the strategies for phytoremediation.

Project

1.	Plants for phytoremediation- essential characteristics of plants for phytoremediation, plants adaptation for adverse conditions, plants involved in phytoremediation and metabolic process involved in phytoremediation.	4 hours
2.	*Gramineae and Leguminosae* plants for phytoremediation. Crops and microbial interaction for rhizo-remediation optimizations. Factors affecting phytoremediation, phytoremediation mechanisms and limitations.	12 hours
3.	Phytoremediation techniques-*In situ and Ex situ* techniques and characterization of essential factors for phytoremediation.	20 hours
4.	Strategies for the improvement of phytoremediation techniques, physical, chemical and biological parameters.	20 hours
5.	Molecular techniques in the analysis of contaminated sites and successful phytoremediation projects.	20 hours
6.	Phytoremediation of contaminants-organic wastes, nature of organic compounds, decomposition of organic matter, mineralization and immobilization. Microbes involved in decomposition, anaerobic decomposition of organic matter, humus and lignin in interaction with plants.	16 hours
7.	Environmental impact of fertilizers and treatment of domestic sewage with phytoremediation.	16 hours
8.	Phytoremediation of inorganic compounds and mixed contaminants. Phytoremediation of contaminants.	16 hours
9.	Studies on phytoremediation techniques with different crops - cereals - ragi, jowar, cumbu; pulses - black gram and green gram – tree crops - Casuarina, teak involved in phytoremediation.	20 hours
10.	Microbial Techniques in isolation, culturing, detection and staining of microbes involved in rhizoremediation associated with phytoremediation.	16 hours
	Total project hours	**160**

Text Book

1. Phytoremediation: Management of Environmental Contaminants, Volume 1- Guy R. Lanza, Lee Newman, Sarvajeet Singh Gill, Ritu Gill, Abid A. Ansari- Springer Publications 2014.
2. Microbial Bioremediation By P Rajendran and P Gunasekaran. MJP Publisher 2006.

Reference Books

1. Environmental science and biotechnology Theory and techniques. By A.G Murugesan and C Rajakumari. MJP Publisher 2005.

Mode of Evaluation: Assessments and Report

Recommended by Board of Studies	29/10/21		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Sustainable Smart Agriculture	L	T	P	C
BAG4004		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives:

1. Explain the process and practice of precision agriculture.
2. Impart the knowledge on different tools and techniques used in precision agriculture.
3. Develop the skills needed for agricultural students to pursue their career in precision agriculture.

Expected Course Outcome:

1. Understand the concepts of precision agriculture.
2. Define the role of remote sensing and GIS in precision agriculture.
3. Describe various crop and soil related sensors used in precision agriculture.
4. Comprehend the importance of farm machineries in precision agriculture.
5. Elaborate on water conservation methods, renewable energy applications and water quality assessment.
6. Apply the concept of precision agriculture in real world situations.

Project

1.	Precision agriculture – overview of technologies- challenges faced by farmers and strategies to implement precision agriculture – advantages of precision agriculture over traditional agriculture- precision agriculture data handling and management processes.	10 hours
2.	Remote sensing, geographical information system (GIS) and global positioning system (GPS) - components – type of GPS- functions and usage of GPS. RS platforms-hardware and software - data conversion -map coordinate systems- data types and inputs -raster based – multispectral, hyper spectral and thermal-vector based data – point line and polyogn. Tasks completed in RS and GIS platform- image processing for various applications – spectral signatures- vegetative indices - uses and applications.	20 hours
3.	Overview of different sensors used in precision agriculture- soil – crop and weather sensors – usage of IoT enabled sensors at field scale for various applications.	15 hours
4.	Implementation of drones techniques in precision agriculture – fixed and rotary wing drones – planning of flight path ways – creating ground control points – image capturing – processing of data- real world applications.	20 hours
5.	Usage of farm machineries in precision agriculture – tractor operated primary and secondary tillage implements – sowing methods- nursery preparation for machine transplanting – walk type or ride type paddy transplanter-seed drill- harvest methods – economic benefits of various methods used – cost of cultivation – cost benefit analysis.	20 hours
6.	Irrigation methods- drip-sprinkler- water quality assessment – surface and ground water – tools and techniques – renewable energy application in agriculture- soil and water conservation methods – watershed management.	15 hours
7.	Industry and field visits to experience precision agricultural practices.	10 hours
8.	Discussions with industry experts of precision agriculture – application of drones – farm machineries – IoTs – irrigation methods.	10 hours
9.	Hands on training with various soils and crop related sensors – usage of drones – software – hardware.	20 hours
10.	Implementation of precision agriculture technology in VIT farm – Pilot plot studies.	20 hours
	Total project hours	**160**

Text Books

1.	**D. Kent Shannon David E. Clay Newell R. Kitchen. 2020. Precision Agriculture Basics. Publisher: ACSESS.**
2.	**John Stafford. 2018. Precision agriculture for sustainability. Publisher: Burleigh Dodds Science Publishing Limited. ISBN-10:1786762048**

Reference Book and Materials

1.	Ruth Kerry and Alexandre Escola. 2021. Sensing Approaches for Precision Agriculture. Publisher: Springer Nature Switzerland AG.
2.	Scientific research articles, reports, conference proceedings videos pertaining to precision agriculture.

Mode of Evaluation: Assessments and Report

Recommended by Board of Studies	29/10/21		
Approved by Academic Council	No. 64	**Date**	16/12/2021

Course code	Microbial Metabolites – Production and Application	L	T	P	C
BAG4004		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Providing insight into extraction and production technology of metabolites from seaweeds, fungi, bacteria, Actinomycetes and PGPRs
2. Developing skills for scale up and commercial production of extracted metabolites like antibiotics, amino acids, auxins and gibberellins.
3. Motivating students to become entrepreneurs

Expected Course Outcome: At the end of the course the student should be able to

1. Identify commercially important extracted metabolites for mass production
2. Isolate and scale up the metabolites
3. Commercially produce the metabolites suitable for varied environments
4. Culture the bioagents which are responsible for the production of therapeutically significant metabolites like antibiotics and auxins.
5. Follow the steps involved in quality control of bioagents and the scaling up of metabolites.

Project

1.	Types and importance of different kind of bioagents (seaweeds, fungi, bacteria, Actinomycetes, PGPRs) in agriculture and organic farming systems for production of the production of therapeutically significant metabolites like antibiotics, amino acids, auxins and gibberellins.	4 hours
2.	Classification of different kind of bioagents production. Preparation of media used for isolation and culturing of bioagents: Jensen's agar, NFb medium, Yeast extract mannitol agar, BGA-medium and Pikovaskaya's medium, PDA medium and nutrient agar medium.	12 hours
3.	Isolation techniques of bacteria, fungi, actinomycetes from root nodules, rhizosphere and phyllosphere. Isolation techniques from rhizosphere of cereal crops, from soil, from roots of gramineous plants, BGA from soil, Mycorrhizae from the roots, phosphate solubilizing and sulphur oxidizing microorganisms, ion chelators, potash mobilizers, organic matter decomposers and their isolation in pure culture form.	20 hours
4.	Extraction techniques of metabolites - ethanol, phenol extraction from mother culture, selection of efficient strains, carriers and their sterilization, mother culture preparation, mass multiplication using shake culture method, mixing of culture and carriers. Production of carrier based formulations.	20 hours
5.	Analytical techniques for Identification and characterization of the metabolites – HPLC, GCMS, SEM, TEM, chromatography	20 hours
6.	Scaling up techniques for the isolated metabolites	16 hours
7.	ISI standards. Storage techniques.	16 hours
8.	Preparation of plan for the production unit and proposal of loan.	16 hours
9.	Mass production and testing of quality parameters and standardization	20 hours
10.	Visit to certified production units	16 hours
	Total project hours	**160**

Text Book

1. Sahayaraj, K. 2014. Basic and applied aspects of biopesticides. Springer, India.
2. Giri, B., Prasad, R., Wu, Q.S. and A. Varma. 2019. Biofertilizers for Sustainable Agriculture and Environment. Springer International Publishing, Germany.

Reference Books

1. Ignacimuthu, S., and A. Sen. 2001. Microbials in insect pest management. Science Publishers, India.
2. Panda, H. and D. Hota. 2007. Biofertilizers and organic farming. Gene-Tech Books. India.
3. Md. Arshad Anwer. 2017. Biopesticides and Bioagents: Novel Tools for Pest Management. Apple Academic Press, USA.

Mode of Evaluation: Assessments and Report

Recommended by Board of Studies	29/10/21		
Approved by Academic Council	No.	**Date**	16/12/2021

Course code	Value Addition of Traditional Knowledge in Agriculture	L	T	P	C
BAG4004		0	0	0	10
Pre-requisite	Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)	Syllabus version			
BAG4099		1.0			

Course Objectives: The course is aimed at

1. Imparting knowledge on importance of documenting traditional knowledge and practices in agriculture and animal husbandry.
2. Document the traditional practices and knowledge in agriculture and animal husbandry.
3. Validate the documented traditional knowledge and practices and develop prototype model through entwining traditional knowledge with scientific knowledge.

Expected Course Outcome: At the end of the course the student should be able to

1. Understand and comprehend the importance of documenting traditional knowledge and practices in agriculture
2. Understand and comprehend the importance of documenting traditional knowledge and practices in
   animal Husbandry
3. Identify different traditional practices in agriculture
4. Identify different traditional practices in animal husbandry
5. Develop prototype model in agriculture and animal husbandry by entwining the traditional knowledge with scientific knowledge

Project

1.	Documentation of traditional knowledge and practices in agriculture and animal husbandry. Basic concepts in documentation: why and how in documentation. Primary, Secondary and Tertiary documentation. Definition, Scope and Meaning of traditional knowledge and practices. Scouting of traditional knowledge. Tool Kit- WIPO. Constraints in scouting. Strategies to facilitate scouting. Reasons for refusal to share ITK.	60 hours
2.	Analysing the scientific rationality of different traditional knowledge and practices in agriculture and animal husbandry. Validation of traditional knowledge and practices in agriculture and animal husbandry. Strategies to integrate ITK's for scientific research process.	60 hours
3.	Entwining the scientific knowledge with traditional knowledge to develop cost effective viable prototype model in agriculture and animal husbandry ITK and IPR. Key Issues- IPR. Protection of ITK in Indian Acts. Traditional Knowledge Digital Library TKDL	40 hours
	Total project hours	**160**

Text Book

1.	Mishra, Anupam, Singh, S.R.K., Raut, A.A. (2020). Traditional Knowledge in Agriculture. Division of Agricultural Extension, ICAR, New Delhi.

Reference Books

1.	WIPO, Switzerland (2017). Documenting Traditional Knowledge- Toolkit WIPO Publication Number 1049E
2.	Nisha, D.D., Amulya.G. (2019). Intellectual Property Rights and the protection of the traditional knowledge.

Mode of Evaluation: Assessments and Report

Recommended by Board of Studies	29/10/21		
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