List of Courses Addressing Local Needs:			
A	*Course Code*	*Course Title*	*Brief Justification*
	BR18001GE	**Industrial Entomology**	Learner would adopt modern rearing techniques of honey bees, silkworm and lac and would realize the economic scope of apiculture, sericulture and their products.
	BR18101CR	**Plant Resources**	Understand the concepts economic Botany and relate them with sustainable development goals.
	BR18102CR	**Animal Resources**	To familiarize the learners with entrepreneurial opportunities in entomology, Dairy farming, psciculture etc. provide information on productive animals and their products.
	BR18003OE	**Infectious Diseases and Livestock Health**	Students will possess the knowledge required to improve the health of livestock systems and apply economically effective interventions to control infectious disease.
	BR18103CR	**Biodiversity and Bioresources**	To understand the concept and components of biodiversity at organisational and spatial levels and know about the magnitude, distribution and values of biodiversity
	List of Courses Addressing **Regional Needs**:		
B	*Course Code*	*Course Title*	*Brief Justification*
	BR18103CR	**Biodiversity and Bioresources**	To understand the concept and components of biodiversity at organisational and spatial levels and know about the magnitude, distribution and values of biodiversity
	BR18101CR	Plant Resources	Understand the concepts economic Botany and relate them with sustainable development goals
	BR18102CR	Animal Resources	To familiarize the learners with entrepreneurial opportunities in entomology, Dairy farming, psciculture etc. provide information on productive animals and their products.
	List of Courses Addressing **Global Needs**:		
C	*Course Code*	*Course Title*	*Brief Justification*
	BR18203CR	Bioenerg and Biofuels	To understand the technology interventions and methods of improving energy efficiency of biomass as fuel and understand the relationship between

			feedstock characteristics and biofuel production process and its impact on biofuel cost.
	BR23306DCE	Biofertilizers and Biopesticides	Understand application and usefulness of biofertilizers for crop production and protection of environment and to understand the requirements, scope and potential of microorganisms for disease control and pest management.
	BR22004GE	Bioresource Mangement	To learn about the natural and forced species extinction and factors responsible for biodiversity and importance and limitations of conservation strategies in biodiversity conservation and management.

1.1.2	Does the Programme offer focus on Employability/ Entrepreneurship/ Skill development courses (Y/N) YES

If YES, provide the information below

A	List of **Employability Courses**

Course Code	*Course Title*	*Brief Justification*
BR18007GE	Industrial Entomology	Learner would adopt modern rearing techniques of honey bees, silkworm and lac and would realize the economic scope of apiculture, sericulture and their products.
BR22008GE	Organic Farming	To Produce Organic Crops systematically through scientific selection of crops, adoption of appropriate cropping pattern and Crop cultivation under organic farming, Maintain the quality of the produce and find a market for their Organic products.
BR22002GE	Algal Resources	To learn about the nutritive value of algae, their medicinal importance and their possible use in modern medicine to understand the advantages and limitation of using algae in sustainable energy production and as biofertilizers for sustainable agriculture.
BR18005GE	Biomedicine and Bioprospecting	To understand the importance of plants as a rich sources of medicine especially for those living in close proximity with nature like tribal and forest dwellers to have idea about different types of herbal extracts and preparations used in traditional systems of medicine.

List of **Entrepreneurship development Courses**:

Course Code	*Course Title*	*Brief Justification*
BR18004OE	Bioindustries	Given the status and scope of Bioindustries in modern society, the students should be endowed with strong theoretical knowledge of this technology. In conjunction with the practicals in processing, handling and packaging of various products, the students should be able to take up biological research as well as placement in the relevant bioindustries industry.
BR18306DCE	Biocosmetics	To abreast students with the basics structure of skin and hair and products for skin and hair care. Give them idea about use of biobased formulations for skin and hair care. Give them know how about the important plants and their products used in skin and hair care. To study about the biobased fragrances, allergenicity of fragrances and aromatherapy.

List of **Skill development Courses**:

Course Code	*Course Title*	*Brief Justification*
BR22001GE	Industrial Entomology	To familiarize the students with entrepreneurial opportunities in entomologyprovide information on productive animals and their products. To equip learners with the knowledge of methodology of lac culture, processing and uses of Lac.
BR23403CR	Microbial Biotechnology	To understand, learn and gain skills of isolation, culturing and maintenance of pure culture.To understand the importance of replication, transcription, translation, mutation and repair in the cell. To learn about fermentation techniques, fermentation processes, fermentors. Students will understand the use of microbes for the production of various items of commercial use.
BR23402CR	Animal Cell and Tissue Technology	To learn the fundamentals of tissue engineering, tissue repairing and their clinical applications. To understand the basic concept behind tissue engineering focusing on the stem cells, biomaterials and its applications.
BR22006GE	Biocontrol and Crop Management	To familiarize the students with beneficial use of microbial biofertilizers and biopesticides. To familiarize students with the microbes used as biocontrols for various crop plants and their advantages over chemical fertilizers.

	List of courses addressing S**ustainability Issues**:		
	Course Code	*Course Title*	*Brief Justification*
	BR18103CR		To understand the concept and components of biodiversity at organisational and spatial levels and know about the magnitude, distribution and values of biodiversity
	BR18004GE	Boresource Mangement	To know the components and levels of biodiversity and appreciate the importance of biodiversity rich regions in conservation of biodiversity. To learn about the natural and forced species extinction and factors responsible for biodiversity and importance and limitations of conservation strategies in biodiversity conservation and management.
	BR18008GE	Organic Farming	To Produce Organic Crops systematically through scientific selection of crops, adoption of appropriate cropping pattern and Crop cultivation under organic farming, Maintain the quality of the produce and find a market for their Organic products.
	BR18006GE	Biocontrol and Crop Management	To familiarize the students with beneficial use of microbial biofertilizers and biopesticides. To familiarize students with the microbes used as biocontrols for various crop plants and their advantages over chemical fertilizers.

SEMESTER I

Course No.: BR23101CR **Course Title: Plant Resources**
Total Credits: 4 (4 L + 0 T + 0 P) **Maximum Marks: 100 (20 + 80)**

Course Description

To familiarize the students with conventional and non-conventional plant resources being used by humans. Sustainable utilization of these resources on the principles of modern thoughts and advancements.

Learning objectives

1. Origin, evolution, cultivation and uses of food, fodder, fibers, oil yielding crops, Non-wood forest products (NWFPS) Gums, Dyes, Resins, Fruits, spices and condiments with particular emphasis on the plant resources from Jammu and Kashmir
2. Medicinal and Aromatic plants: Morphological peculiarities, chemical properties and uses
3. Bioprospecting: concept, methods and importance of Bioprospecting, role of TKDL for preserving and safeguarding economic interests.

Learning outcomes:

On completion of this course, the students will be able to:

1. Understand the concepts economic Botany and relate them with sustainable development goals.
2. Develop critical understanding on the pattern of origin, evolution and cultivation of crops, importance of diversification in nature and thus develop a basic knowledge of important families of useful plants.
3. Understand the importance of medicinal plants, their pharmacognostic procedures and authentication of specimens, preservation of plants and their products. Moreover, they will understand the importance of the traditional knowledge, its application and the intellectual property rights (IPRs).

Unit: I **(16 lectures)**

Plant as Agriculture resources: Origin of agriculture; Centers of origin and domestication of cultivated plants as proposed by de Candolle and Vavilov; Poverty and food insecurity, Nutrition availability, Environmental impact; Green revolution (GR), Impact of GR on indigenous crops, Modern super crops, Coalition for digital environmental sustainability (CODES).Cereals and pseudocereals: Cultivation and utility of rice (*Oryza sativa*), wheat (*Triticum aestivum*), maize (*Zea mays*), buckwheat (*Fagopyrum* spp.).

Unit: II **(16 lectures)**

Fodder, fruit and oil crops: Fodder crops (Introduction), methods of domestication and utility of alfalfa (*Medicago sativa*); Extraction and processing of mustard and sunflower oil.

Fiber crops: Plant fibers, types; Origin and processing of cotton and jute. Fruits: Cultivation and commercial importance of some fruits grown in Kashmir (apple, pear, walnut, almond, apricot).

Unit: III **(16 lectures)**

Suggested Readings.

- Aruga H. 1994. Principles of Sericulture. Oxford & IBH, New Delhi.
- Aruga H. 1994. Principles of Sericulture. Oxford & IBH, New Delhi. Atwal AS. 2006. The World of the Honey Bee. Kalyani Publ., New Delhi.
- Atwal AS. 2006. The World of the Honey Bee. Kalyani Publ., New Delhi.
- Ganga G. 2003. Comprehensive Sericulture. Vol. II. Silkworm Rearing and Silk Reeling. Oxford & IBH, New Delhi.
- Jhingran VG 1998. Fish and Fisheries of India. Hindusthan Publishing Corporation, New Delhi
- Kerry J, Kerry J & Ledward D. 2005. Meat Processing-Improving Quality. Woodhead Publ. Ltd., UK
- Singh S. 1975. Beekeeping in India. ICAR, New Delhi.

e-Resources

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www.mla.org.au
www.FAO.org
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Swayam Moocs

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https://www.classcentral.com/course/sustainablefood-1402
https://www.classcentral.com/course/swayam-dairy-and-food-process-and-products-technology-13980
https://www.classcentral.com/course/dairy-4055

SEMESTER I

Course No.: BR23102CR **Course Title: Animal Resources**
Total Credits: 4 (4 L + 0 T + 0 P) **Maximum Marks: 100 (20 + 80)**

Learning objectives

- To familiarize the students with entrepreneurial opportunities in entomology, Dairy farming, psciculture etc. provide information on productive animals and their products.
- To disseminate knowledge about production of high quality meat, milk, fish and other animal products.
- To empower students on recent advances in processing, preservation, quality control, packaging, regulations and standards of animal products.

Course Outcomes

- Describe the prospects and scope of animal based resources at various levels.
- Learner would adopt modern rearing techniques of honey bees, silkworm and other livestock.
- Learners would realize the economic scope of apiculture, sericulture, livestock and their products.

Unit: I **(16 lectures)**

Insect resources: Importance and scope of insect based industries; Silkworm breeds, synthesis of silk and cocooning, diseases of silkworms.

Bee keeping-Apiculture products and apitherapy (honey, beeswax, bee pollen, propolis, royal jelly, bee venom) and value added honey products; Pests and diseases of honey bees. IPM (integrated Pest Management).

Bionomics of lac insect. Lac production technology. Lac processing, Bio products of lac industry and their utilization. Edible insect industry (Entemophophagy). Use of insects in scientific research.

Unit: II **(16 lectures)**

Pisciculture: Fish monoculture, polyculture and composite culture; Major cultivable carps Labeo, Catla and Cirrhinus & other carps. Composite fish culture system of Indian and exotic carps. Natural and artificial breeding in fish; Fish as a food commodity; Fish by-products; Processing and preservation of fish and its products. Introduction to Trout culture.

Unit: III **(16 lectures)**

Livestock domestication: History of domestication; Important exotic and indigenous breeds of livestock (cow, sheep, goat, buffalo) and poultry with special reference to economic characters; Important methods of selection and systems of breeding in farm animals; Applications of inbreeding and out-breeding; Controlled breeding; Genetic basis of heterosis and inbreeding depression. Important infectious diseases of livestock and poultry and their control.

Unit: IV **(16 lectures)**

Animal products and processing:

Introduction to major animal by-products. Major Milk product Processing and their preservation. Judging & grading of milk & its products. Introduction, Manufacturing process, packaging, storage, defects and prevention of milk products – Butter-milk powder, Whey Powder, Infant milk food. Homogenized, toned and skimmed milk-Introduction to Milk Industry.

Introduction to Meat and poultry industry. Methods of preservation of meat, poultry (drying, chilling, curing, fermentation, irradiation, chemical treatment and thermal processing (canning). Slaughter house by products and their utilisation.

Vegetables, spices and condiments: Methods of cultivation of vegetables grown in Kashmir (*Brassica oleracea)*; Wild vegetables of Kashmir (*Taraxicum officinalis*); Spices and condiments: Origin, distribution, cultivation and importance of Zeera; (*Bunium persicum)*, saffron; (*Crocus sativus*). Extractives: Gums and resins, classification, important sources and their commercial value; Dyes and tannins, extraction, processing and use.

Unit: IV **(16 lectures)**

Medicinal plants: Morphology, ethno botanical and medicinal importance of *Arnebia benthamii*, *Aconitum heterophylum*, *Atropa acuminata*, *Podophyllum hexandrumn*, *Digitalis purpurea, Picrorhiza kurroa, Dioscorea deltoidea.*

Bioprospecting — Concept and methods of Bioprospecting; Role of traditional knowledge in Bioprospecting; Biopiracy, case studies of Biopiracy (Basmati, Neem, periwinkle); Traditional Knowledge Digital Library (TKDL)—concept and importance, Challenges (classification system, knowledge systems, appropriation); Intellectual property rights (IPR).

Suggested Readings:

- Wickens GE (2004) Economic Botany: Principles and Practices, Springer, ISBN 978-0-7923- 6781-9.
- Rashtra Vardhana.2009. Economic Botany. Sarup Book Publishers Pvt. Ltd, New Delhi -110002
- Ramesh Umrani (2009). Basics of Economic Botany. Anmol Publications Pvt.Ltd, New Delhi – 110002.
- Ashwini Dutt (2008). Economic Botany. Adhyayan Publishers & Distributors, New Delhi-110002.
- K.V.Krishnamurthy (2003).An Advanced Text book on Biodiversity: Principles and Practice. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
- Ganguli P (2001). Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill. 13
- Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publishing House, New Delhi.
- Shivanna KR (2003) Pollen Biology and Biotechnology. Enfield, New Hampshire, U.S.A., Science Publishers.

Swayam Moocs

https://onlinecourses.swayam2.ac.in/cec19_bt10/preview

SEMESTER I

Course No.: BR23103CR **Course Title: Biodiversity and Bioresources**

Total Credits: 4 (4 L + 0 T + 0 P) **Maximum Marks: 100 (20 + 80)**

Course Description: The course "Biodiversity and Bioresources" is designed to provide a wholesome idea about the components, organization and distribution of biodiversity. It provides an understanding of factors responsible for biodiversity loss and the methods available for measuring and monitoring biodiversity and its conservation. The main goal of the course is to abreast the students with organization, distribution and importance of biodiversity and need for conservation and sustainable use of biodiversity.

Learning Objectives

- To understand the concept and components of biodiversity at organisational and spatial levels and know about the magnitude, distribution and values of biodiversity.
- To learn about the methods of biodiversity measurement and to understand the role of science of taxonomy, remote sensing and computer technology in unravelling, understanding, enumerating and conserving biodiversity.
- To understand the causes of biodiversity loss and methods of In-situ and ex-situ conservation.
- To abreast students with important phenomenon like global warming, acid rain, ozone depletion and their impact on biodiversity.

Learning Outcomes

- To appreciate the importance of biodiversity and understand its variation across space and time in biosphere.
- To develop the concept of importance of biodiversity rich regions in conservation programmes and to understand the need and importance of various in-situ and ex-situ biodiversity conservation methods.
- To be able to understand the methods of biodiversity measurement in research and biodiversity exploration programmes and to understand the importance of technology in conservation and sustainable use of biodiversity.
- To understand the relation of climate change visa vis biodiversity loss and conservation

Course No.: BR22001GE **Course Title: Industrial Entomology**

Total Credits: 2 (2 L + 0 T + 0 P) **Maximum Marks: 50 (10 + 40)**

Learning objectives

- To familiarize the students with entrepreneurial opportunities in entomology.
- provide information on productive animals and their products.
- To equip learners with the knowledge of methodology of lac culture, processing and uses of Lac.

Course Outcomes

- Describe the prospects and scope of insect based resources at various levels.
- Learner would adopt modern rearing techniques of honey bees, silkworm and lac.
- Learners would realize the economic scope of apiculture, sericulture and their products.

Unit: I **(16 lectures)**

Apiculture: Introduction to apiculture; Bee species (Life cycle and Social organization); Properties and uses of honey; bee product (Apitoxin); Common diseases of bees. Sericulture: Silk worm species, systematic position and salient features (life cycle and types of silk); Common diseases of silk worms.

Unit: II **(16 lectures)**

Lac culture: Lac insect, biology and habitat; common diseases of Lac; processing techniques of lac; Physical and chemical characteristics of lac; Types of lac and their uses.

Beneficial Insects: Insects as pollinators and biocontrol agents. Use of insects and insect products in medicine; in scientific investigations, as food source (Entomophagy).

Suggested Books / Reading Material

1. A text book of Applied Entomology –vol. II by K.P. Srivastava Kalyani Publishers

2. A text book of Applied Zoology by Pradip V. Jabde.

3. Modern Entomology by D. B. Tembhare Himalaya Publishing House.

4. Singh S. 1975. Beekeeping in India. ICAR, New Delhi.

SEMESTER II

Course No.: BR23203CR **Course Title: Bioenergy and Biofuels**

Total Credits: 4 (4 L + 0 T + 0 P) **Maximum Marks: 100 (20 + 80)**

Course Description: The course "Bioenergy and Biofuels" provides insights into the history of bioenergy, sources of bioenergy and use of microbes and algae in energy production like ethanol, biodiesel and hydrogen. It providess provides know how about the current trending sources of bioenergy, their advantages and bottlenecks faced in commercialization of biofuels.

Learning Objectives

- To understand the concept of bioenergy and limitations of traditional ways of using biomass as energy sources.
- To understand the technology interventions and methods of improving energy efficiency of biomass as fuel and understand the relationship between feedstock characteristics and biofuel production process and its impact on biofuel cost.
- To understand the concept of liquid biofuels such as bioethanol and biodiesel and the methods of their production from biological feedstock.
- To understand the process of biological methods of hydrogen production and how artificial biomimetic systems can be used for hydrogen production.

Learning Outcomes

- To appreciate the importance of bioenergy as environmental friendly alternative sustainable energy source in backdrop of energy crisis and climate change.
- To learn the methods of production of various biofuels and to appreciate the importance of biological models in development of artificial systems for the production of energy.
- To develop understanding of how waste biomass can be utilised as an energy source on the line of waste to energy programmes.
- Understand the limitations in production, storage and use of various forms of bioenergy in order to be able to innovate to overcome these difficulties.

Unit: I **(16 lectures)**

Biomass and Bioenergy: Biomass as energy source; History and classification of biofuels (first, second, third and fourth generation biofuels); Biomass and residual feedstocks, biomass feedstock characterization; Biomass fuel analysis; Wood pellet technology; Pyrolysis and gasification of biomass; Syn-gas fermentation.

Unit: II **(16 lectures)**

Bioethanol: Production of bioethanol from sugar and starch biomass; Ethanol production from Lignocellulosic biomass (Advantages and limitations); Biorefinery (Bottom up and Top down type);

Course No.: BR22003OE **Course Title: Infectious Diseases and Livestock Health**

Total Credits: 2 (2 L + 0 T + 0 P) **Maximum Marks: 50 (10 + 40)**

Learning objectives

- To equip learners with the knowledge of possible risk factors and preventive measures of infectious diseases.
- Students will possess the knowledge required to improve the health of livestock systems and apply economically effective interventions to control infectious disease.

Course Outcomes

Upon successful completion of this course, students will be able to:

- Recognize factors that influence infectious disease transmission within and between livestock production systems.
- Identify strategies to minimize the risk of pathogen transmission.
- Create a comprehensive health improvement program for a given livestock production system

Unit: I **(16 lectures)**

Introduction to Infectious Diseases and there immune response: Common diseases of livestock diseases: Anthrax Aetiology, Pathogenesis, Diagnosis and Control; Salmonellosis (Gastroenteritis) Pathogenesis, Diagnosis and Control. Foot & Mouth Disease -Distribution, Pathogenesis and Control. Aspergillosis, Aetiology, Epidemiology, Pathogenesis, Diagnosis and Control.

Unit: II **(16 lectures)**

Nature and Consequences of Parasitism: Parasitology, types of parasites, life cycle of different parasites, Host Parasitic associations; Parasitic adaptations; Host parasite interaction, Zoonosis-Classification. Morphology life cycle, Pathogenicity, prophylaxis and control of *Fasciola hepatica.*

Suggested Books / Reading Material

1. Livestock Diseases and Management by Minakshi Prasad, Rajesh Kumar, Mayukh Ghosh, Shafiq M. Syed

2. Parasitology (Protozoology & Helminthology) by K. D. Chatterjee

3. General parasitology by Thomas C. Cheng

BR22103CR: Biodiversity and Bioresources

Unit: I

Biodiversity and Bioresources: Components of Biodiversity— species richness and species evenness; Levels of biodiversity— organizational (genetic, species and ecosystem), spatial (alpha, beta, gamma, point and epsilon diversity); Magnitude of biodiversity (Global and national level); Valuing biodiversity— direct- and indirect use values; Food security and agrobiodiversity.

Unit: II

Measuring and Monitoring biodiversity: Geological Time Scale and species evolution (overview), Species extinction; Methods of survey and sampling procedures; Biodiversity surrogates; Global biodiversity targets and indicators; Role of Taxonomy in Biodiversity studies; Remote Sensing and Geographical Information System in biodiversity studies; Biodiversity informatics— concept and applications.

Unit: III

Biodiversity conservation: Factors of biodiversity loss, IUCN scheme of threat categories (species and ecosystems); RED Data Book; *In situ* and *Ex situ* conservation strategies; Overview of major Protected Areas (National parks, Wildlife sanctuaries and Biosphere reserves) in India; Global biodiversity hotspots; Role of Traditional Knowledge in Biodiversity Conservation; Conservation Projects in India (Tiger project, Cheetah, Crocodile)

Unit: IV

Biodiversity and Environment: Ozone depletion; UV-B and its impact on life; Kyoto Protocol; Greenhouse effect and Global warming; Eutrophication; Acid rain; Ramsar Convention, Convention on Biological Diversity (CBD); Sustainable Development Goals 2030; Millennium Developmental goals and biodiversity; National Biodiversity Action Plan.

Biofungicides (role and application); Biopesticides from plants (neem, pyrethrins).
Bioherbicides: Concept, current status and prospects; Mass production and commercial formulations; Role of biocontrol in Integrated Pest Management.

Unit: IV **(16 lectures)**

Bio-insecticides: Classification and mode of action; Bacterial insecticides (*Bacillus thuringiensis)*; Mechanism of action.

Fungal and viral insecticides: Biology and their use in insect control; Commercial formulations; Entomopathogenic nematodes and protozoans. Mode of action and field efficacy; Preventive and safety measures required in using biopesticides. Merits and demerits of bioinsecticides.

Suggested Readings

- Sharma, R.2006. Text book of Microbiology. Mittal Publications. New Delhi. 305pp.
- S.C.Santra, T.P.Chatterjee & A.P.Das (2012). College Botany-Practical (Vol.1).New Central Book Agency (P) Ltd. 8/1 Chintamoni Das Lane, Kolkata-700009.
- S.C.Santra, T.P.Chatterjee & A.P.Das (2010). College Botany-Practical (Vol.2).New Central Book Agency (P) Ltd. 8/1 Chintamoni Das Lane, Kolkata-700009.
- Sambamurthy A.V. S.S. 2006. A Textbook of Plant Pathology. I.K. International Pvt.Ltd., New Delhi.
- Ananthanarayanan, R. and CKJ. Paniker, 2004. Textbook of Microbiology. Orient Longman.
- Dubey, R.C. and D.K. Maheswari, 2007. A Textbook of Microbiology, S. Chand & Company.
- R.P. Singh, (2005) Plant Pathology. Kalyani Publishers Ludhiana.
- Singh DP & Singh A. 2007. Disease and Insect Resistance in Plants. Oxford & IBH, New Delhi Biotechnology. Oxford & IBH, New Delhi.
- Vashista, B.R. and Sinha, A.K. (2008) Botany for degree students-Fungi. S. Chand and Company Ltd, New Delhi-pp 1-752.

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- https://onlinecourses.swayam2.ac.in/cec21_ag03/preview
- https://nptel.ac.in/courses/126105014
- https://www.mitconbiopharma.com/training/bio-tech-training/certificate-course-in-biofertilizers-biopesticides-production/

Practical Work Based on BR233006DCE

- Preparation of Potato Dextrose Agar (PDA), medium for fungal growth.
- Preparation of Yeast Extract Mannitol Agar (YEMA), medium for bacterial growth.
- Isolation and study of the root nodule bacteria.
- Preparation of a water squash mount of a living mosquito fern (Azolla) and to study its symbiotic association with cyanobacteria (Anabaena).
- Preparation of vermicompost.

SEMESTER II

Course No.: BR23306DCE **Course Title: Biofertilizers and Biopesticides**

Total Credits: 4 (4 L + 0 T + 0 P) **Maximum Marks: 100 (20 + 80)**

Learning Objectives:

- Learning the basic concept of biofertilizers and their uses in improving the soil characteristics, soil fertility and nutrient availability to plants.
- Developing the integrated management practices using biofertilizers comprising of various representative microorganisms able for fix nitrogen, phosphorus and potassium.
- Utility and importance of using formulations and biocontrols for controlling diseases and managing pests.

Learning Outcomes: On completion of this course, the students will be able to:

- Understand application and usefulness of biofertilizers for crop production and protection of environment.
- Understand the requirements, scope and potential of microorganisms for disease control and pest management.

Unit: I **(16 lectures)**

Biofertilizers: Concept, types and applications; Basics of soil health, enhancing soil health, Bacterial biofertilizers (symbiotic and non-symbiotic nitrogen fixing) *Rhizobium, Azotobacter* and *Frankia*; Molecular Nitrogen fixation and nitrogenase, nifgenes and their regulation.

Phosphorous Solubilising Microorganisms (PSMs); benefits, mechanisms of organic solubilization and inorganic mineralization.

Unit: II **(16 lectures)**

Cyanobacteria and Azolla as Biofertilizers: Morphology, life cycle, association, cultivation and inoculation; Factors affecting biofertilizer efficiency; Mass production and quality control of biofertilizers.

Arbuscular Mycorrhizas (AMF): Background and characteristics of AMF, Characteristics of AMF, AMF as biofertilizer, role and application of AMF (nutrient uptake, resistance to stress).

Unit: III **(16 lectures)**

Biopesticides: Definition, types, merits and demerits; Biocontrol against fungal diseases in plants;

Fischer Tropsch synthesis for liquid fuels; Hydrothermal technology for biofuels; Biobutanol and Biopropanol production process.

Unit: III **(16 lectures)**

Biodiesel and Energy plantation: Vegetable oils as fuel; Biodiesel, Methods of biodiesel production (acid, base , lipase catalyzed transesterification); Non catalytic process for biodiesel production (Super critical method, Ultrasonic method); Purification of biodiesel; Oleaginous microbes in biodiesel production; Jatropa, Sugarcane, Sweet sorghum, Pongamia and Maize

Unit: IV **(16 lectures)**

Gaseous biofuels and Biofuel economy and environment: Biogas production process; Biohydrogen, Hydrogen production by Green algae and Cyanobacteria (Light dependent and light independent processes); Two stage photosynthesis; Artificial photosynthesis; Environmental sustainability of biofuels; Carbon footprints, Economic sustainability of biofuels.

Suggested Readings:

1. Ayhan Demirbas, Bioenergy and Biofuels. Springer. 2007.
2. Robert C. Brown and Christian Stevens. Thermochemical Processing of Biomass: Conversion into Fuels, Chemicals and Power. Wiley. 2011
3. John C.F. Walker, Primary Wood Processing - Principles and Practice, Springer, 2006.
4. PrabirBasu, Biomass Gasification and Pyrolysis - Practical Design and TheoryAcademic Press, 2010.
5. Vijayalakshmi, Meena Devi, Nagendra Prasad, Fuels and Biofuels Agrogbios, India. 2007
6. Sunggyu Lee, Y.T. Shah, Biofuels and Bioenergy: Processes and Technologies,CRC Press. 2012.
7. N. El Bassam, Handbook of Bioenergy Crops,Earthscan, 2010.
8. Gopalakrishnan, Kasthurirangan; van Leeuwen, J. (Hans), Brown, Robert C Sustainable Bioenergy and Bioproducts. Springer. 2012.

Course No.: BR23403CR **Course Title: Microbial Technology**

Total Credits: 4 (4 L + 0 T + 0 P) **Maximum Marks: 100 (20 + 80)**

Learning Objectives:

1. To understand the structure and functions of a typical prokaryotic cell
2. To know the various physical and chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.
3. To understand, learn and gain skills of isolation, culturing and maintenance of pure culture.
4. To understand the importance of replication, transcription, translation, mutation and repair in the cell
5. To learn about fermentation techniques, fermentation processes, fermentors.
6. Students will understand the use of microbes for the production of various items of commercial use.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Understand the structural similarities and differences among microorganisms and the unique structure/function relationships of prokaryotic cells.
2. The student will learn the techniques of studying bacterial growth curve and factors effecting growth curve.
3. At the end of the course, the students will be able to understand how DNA replication and recombination occurs in bacteria. The students will be able to understand the concept of gene expression, gene regulation, mutations and DNA repair in prokaryotes.
4. Will be able to understand various upstream processes like media formulation, sterilization, process control and selection of the appropriate fermentation process.
5. Will have knowledge about microbial production of various industrial products such as alcohols, Vitamins, enzymes, organic acids, Antibiotics, biofertilizers, biopesticides, vaccines and biofuel etc.

Semester III

Course No.: BR23306DCE **Course Title: Wood Resource Utilization**

Total Credits: 4 (4 L + 0 T + 0 P) **Maximum Marks: 100 (20 + 80)**

Course Description: The course "Wood Resource Utilization" deals with the structure of wood and its formation. It provides an account of physic-chemical properties of wood and their impact on quality of wood. It gives introduction about wood deterioration, pests and pathogens responsible for wood degradation and common wood preservation techniques. It also deals with different types of wood based products and important commercially used wood species.

Learning Objectives

1. To study the basic structure and formation of wood in gymnosperms and dicots
2. To study the physical and chemical properties of wood.
3. To learn about the some basic wood degrading agents, wood seasoning and wood preservation.
4. To have an overview of the important woody species and wood

Learning Outcomes

1. To acquaint students with the importance of wood as a bioresources.
2. To be able to classify woods into various group on the basis of their origin, source and physico-chemical properties for their appropriate use.
3. To learn about the basics of wood deterioration and preservation techniques for proper use and long storage of wood.
4. To appreciate the importance of some important woody species as a resource and the related art and goods as a sources of income.

Unit: I **(16 Lectures)**

Structure and formation of wood: Organization of shoot and root apical meristem; Formation of wood— cambium and its derivatives, Secondary growth (Pine and Willow); Growth rings, Early and late wood, Sap wood and heartwood; Soft wood and hard wood species — morphology and wood anatomy of Pine, Deodar, Silver fir, Willow and Walnut; Defects in wood - knots, shakes, cross grain.

Course No.: BR22002GE **Course Title: Algal Resources**

Total Credits: 2 (2 L + 0 T + 0 P) **Maximum Marks: 50 (10 + 40)**

Course Description: The course "Algal Resources" gives introduction to habit and habitat of algae. It provides about the importance of algae in primary productivity and their importance as a sources of food, fodder and medicine. It gives idea about the use of algae in bioenergy production, agriculture and bioremediation.

Learning Objectives

- To abreast students with the various types of algae, their habit, habitat distribution and their role in primary productivity.
- To study about the algae and algal products as food, fodder and as a source of antimicrobials, antioxidants and other therapeutic agents.
- To study algae as a resource for the production of biodiesel and the mechanism of hydrogen production and nitrogen fixation by cyanobacteria and algae.
- To let students understand how algae are used in waste water treatment and pollution control.

Learning Outcomes

- To appreciate the importance of algae in primary productivity and advantages of using algae as an important resources to meet future demand of food and fodder.
- To learn about the nutritive value of algae, their medicinal importance and their possible use in modern medicine.
- To understand the advantages and limitation of using algae in sustainable energy production and as biofertilizers for sustainable agriculture.
- To acquaint students with the importance of algae as an agent for bioremediation.

Course No.: BR22003GE **Course Title: Microbial Resources**

Total Credits: 2 (2 L + 0 T + 0 P) **Maximum Marks: 50 (10 + 40)**

To familiarize the students with basics in microbiology particularly the microbial diversity and its economic potential

COURSE OBJECTIVES:

- To impart the students with the knowledge about microbial growth and microscopy
- introduce various microorganisms present in the ecosystem and cellular architecture
- To complement the students with cultivation and control of microbe with physical and chemical approach
- To highlight the number and range of pathogens that may be found in air, water and soil. To describe some of the key preventative and monitoring actions which maintain and improve microbiological quality of water, air and soil. To introduce the concept and use of indicator bacteria specially in water quality monitoring.
- To instill practical skills about methods of isolation, characterization, control of Microbes and familiarize with fundamental aspect of cellular chemistry

COURSE OUTCOMES: After successful completion of this course, the students are expected to:

- Competently explain various aspects of environmental microbiology Aware about the pollution, Water and air-borne diseases and their transmission, methods of determination of sanitary quality of water and sewage treatment methods employed in waste water treatment
- Appreciate the diversity of microorganisms and learn the abundance, distribution and significance of microorganism in the environment such as bioremediation and Plant microbe interactions understand various biogeochemical cycles - microbes involved and biochemical mechanisms of Carbon, Nitrogen, Phosphorus cycles etc.
- After successful completion of this course, the students are expected to: Understand the basics of fermentation technology, screening techniques, microbial culture preservation techniques etc. Know the concepts of inoculum development and media sterilization for fermentation process. Learn about

Unit: I **(16 lectures)**

Algae as food and medicine: Introduction, habit and habitat; Contribution in primary productivity; Algae as food (nutrient profile- vitamins, proteins, lipids, carbohydrates and minerals); Algae as fodderfor cattle and poultry**;** Algae as source of medicine (antimicrobials, antioxidants, antivirals and therapeutic agents); Use of algae in forensic medicine research and HIV vaccine model.

Unit: II **(16 lectures)**

Energy production and Pollution control: Algae as sources of oil for Biodiesel production; Algae in hydrogen production; Mechanism of biological nitrogen fixation by cyanobacteria; Cyanobacteria as biofertilizers; Immobilized and inactivated algal biomass for waste water treatment and metal removal; Algal bi-products—Agar agar, alginates and carrageenin.

Suggested Readings:

1. K. S. Bilgrami and L. C. Saha. 2018. A Textbook of Algae.. CBS Publishers. ISBN: 9788123900490
2. M.K.Shukla, A. K. Kushwaha, M.K.Shukla. 2020. A Text Book of Algae: For Degree Students. KDP Print US. ISBN: 9798672633657.
3. Rathinam Raja, Shanmugam Hemaiswarya, Kulanthaiyesu Arunkumar, Isabel S. Carvalho. 2022. Algae for Food: Cultivation, Processing and Nutritional Benefits. CRC Press. ISBN: 9780367762087
4. Richa Kothari, Vinayak V Pathak and and V V Tyagi. Algal Biofuel: Sustainable Solution. TERI Press. ISBN: 9789386530943.
5. Jeyabalan Sangeetha, Devarajan Thangadurai. 2022. Algal Genetic Resources Cosmeceuticals, Nutraceuticals and Pharmaceuticals from Algae. ISBN: 9781774637487.
6. Ashfaq Ahmad, Fawzi Banat, Hanifa AlBlooshi. 2022. Algal Biotechnology: Integrated Algal Engineering for Bioenergy, Bioremediation, and Biomedical Applications. Elsevier. ISBN: 9780323904766.
7. Jeyabalan Sangeetha, Devarajan Thangadurai, Saniyasi Elumalai, Shivasharana Chandrabanda Thimmappa. 2022. Phycobiotechnology: Biodiversity and Biotechnology of Algae and Algal Products for Food, Feed, and Fuel. Apple Academic. Press. ISBN: 9781774637609.

Unit: I **(16 Lectures)**

Microbial genome: Bacterial genome: structure and mechanism of replication; Genetic exchange (transformation, transduction and conjugation); Plasmids, types, structure and functions; Bacteriophages: Viral Life cycles (lytic and lysogenic and its regulation); Antimicrobial drug resistance.

Unit: II **(16 Lectures)**

Culturing of microbes:

Cultivation of microbes-factors affecting microbial growth (pH, temperature, water, oxygen, CO_2), Culture types— static cultures, suspension cultures; synchronous cultures, growth kinetics; (growth curve, generation time); Isolation and screening of microorganisms. Metagenomics (introduction and applications).

Unit: III **(16 Lectures)**

Fermentation technology: Introduction; Types of fermentation (aerobic, anaerobic), fermenters and their types, substrates for fermentation; Role of enzymes in various fermentation processes; Microbial chemostat cultures; Scale-up of cultivation of microorganisms; Microbes in beverages and food production (wine, beer, bread, cheese); Advantages of fermented foods.

Unit: IV **(16 Lectures)**

Economic importance of microbes: Major commercial microbial products (amino acids, enzymes, steroids, therapeutic agents and biopolymers); Single Cell Proteins; Role of microbes in bioremediation; Role of microbes in waste water treatment; Microbes as bioindicators; Biodefense and bioterrorism.

Suggested Readings:

1. **Pelczar, M.J., Chan, E.C.S. and Krieg, N.R Microbiology.**
2. **Schlegel, H.G. General Microbiology. Cambridge University Press.**
3. **Slonczewski, J.L. and Foster, J.W. 2009. Microbiology: An evolving Science.**
4. **Microbiology by Lansing M. Prescott**
5. **Essential Microbiology byStuart Hogg**

the typical structure of fermenter and its parts, types of fermentation processes and synchronous growth. Aware about the detail downstream process of fermentation of important microbial products.

Unit: I **(16 lectures)**

Role of microorganisms in food production and beverages (wine, beer, bread, cheese); Single Cell Proteins— production and utility; Microbes as sources of antibiotics and therapeutic agents; Major commercial microbial products (amino acids, enzymes, steroids and biopolymers).

Unit: II **(16 lectures)**

Bioremediation; Role of microbes in bioremediation of soil and water; Role of microbes in waste water treatment. Role of microbes in biogeochemical cycles (carbon, nitrogen, sulphur &phosphorus cycle); Microbes as bioindicators; Phycoviruses and algal blooms; Biodefence and bioterrorism.

Suggested Readings:

- Tauro P, Kapoor KK, Yadav KS, and Sequeira MG (2019) An Introduction to Microbiology 3 rded., New Age International Publishers. ISBN: 0852268785.
- Sherwood LM, Woolverton C.J (2017) Prescott's Microbiology, 10th ed., McGraw-Hill Education. ISBN 9781259281594.
- Dubey, R.C. and Maheswari, D.K (2013) A text book of Microbiology 3rd ed.. Revised S. Chand and Company Ltd, New Delhi. ISBN: 9788121926201.
- Pelczar Jr. M (2001) Microbiology 5th ed., McGraw Hill Education ISBN: 9780074623206.
- *MP, Beuchat LR, Montville TJ, editors*. 2001. Food microbiology: fundamentals and frontiers. 2nd ed. Washington (DC): American Society for Microbiology
- *Doyle, M. P. and Beuchat, L. R.* 2007. Food Microbiology: Fundamentals and Frontiers, Third Edition, ASM Press

Web Sources

- https://onlinecourses.swayam2.ac.in/cec19_bt11/preview
- https://onlinecourses.swayam2.ac.in/cec20_ag09/preview

Unit: I **(16 lectures)**

Biodiversity conservation: Biodiversity and levels of biodiversity; Magnitude of biodiversity (Global and National level);Global biodiversity hotspots; Species extinction; Threats to biodiversity; IUCN threat categories, Red data book**;** Strategies of biodiversity conservation— *In situ* and ex *situ* conservation strategies; Scared grooves and Bio-villages.

Unit: II **(16 lectures)**

Acts and policies: Sustainable development; Environment Impact Assessment (EIA); Wildlife management Act; Environment (protection) Act 1986; Hazardous waste (Management and Handling) Rules 1989;National Biodiversity Action Plan National Biodiversity Act 2002; Sustainable Development Goals 2030 with special reference to Environment.

Suggested Readings:

1. Singh, J. S. Gupta, S. R. and Singh, S. P. Ecology Environmental Science and Conservation. S. Chand Publishers. 2014.
2. Primack, R. B. Essentials of Conservational Biology. Sinauer Associates, Inc. Sunderland, M A. 2002.
3. Jaswal. P.S., JASWAL. N. Environmental Law. Pioneer Publications. 2007.
4. Gaston, K. J and Spicer, J. I. Biodiversity: An introduction.Blackwell Science, London, UK. 1998.
5. Wilson, E. O. Diversity of Life. Harvard University Press, Cambridge, MA. 1993.
6. Barthlott, W. and Winiger, W. Biodiversity. Springer-Verlag, New York. 2001.
7. Katwal and Banerjee. Biodiversity Conservation in Managed and Protected areas. Agrobios. 2002.
8. Negi, S.S. Biodiversity and its conservation in India. Indus Publishing Co. New Delhi. 1993.
9. Barnes, R.S.K.. Diversity of living organisms. Blackwell Sciences Ltd., U.K. 1998
10. Michael, P. Ecological methods for field and laboratory investigation. Tata McGrawHill, New Delhi. 1984

Course No.: BR22004GE **Course Title: Bioresource Management**

Total Credits: 2 (2 L + 0 T + 0 P) **Maximum Marks: 50 (10 + 40)**

Course Description: The course "Bioresource Management" introduces the concept of biodiversity and magnitude of biodiversity at global and national level. It gives idea about the components and levels of biodiversity, biodiversity rich regions and importance of in-situ and ex-situ methods of conservation. It provides about the important national acts and global and national policies relating to the conservation, management and sustainable use of biodiversity.

Learning Objectives

- To abreast the students about the concept of biodiversity, its levels, components and its magnitude at global and national level.
- Give them idea about species extinction and biodiversity loss and the factors responsible for biodiversity loss.
- Give them idea about the biodiversity rich regions like and various in-situ and ex-situ strategies of biodiversity conservation.
- To introduce students to various policies and acts at global and national level related to management and conservation of biodiversity.

Learning Outcomes

- To know the components and levels of biodiversity and appreciate the importance of biodiversity rich regions in conservation of biodiversity.
- To learn about the natural and forced species extinction and factors responsible for biodiversity and importance and limitations of conservation strategies in biodiversity conservation and management.
- To acquaint students with the basic idea and importance of global and national policies enforced to prevent biodiversity loss and help its management and sustainable use.

Course No.: BR22005GE **Course Title: Biomedicine and Bioprospecting**

Total Credits: 2 (2 L + 0 T + 0 P) **Maximum Marks: 50 (10 + 40)**

Course Description: The course "Biomedicine and Bioprospecting" introduces various traditional systems of medicine that are being practiced parallel to the modern system of medicine in India. It provides introduction about the concept bioprospecting and biopiracy especially in relation to discovery of medicine. It introduces the concept of traditional knowledge as a tool for drug discovery from biological resources. It gives know-how about the important medicinal plants of the region and methods of crude drug extractions and preparations used in traditional systems of medicine.

Learning Objectives

- To abreast students with the principles and concept of health and disease in traditional systems of medicine such as Ayurveda, Siddha and Unani system practised in India.
- Give them idea about methods of bioprospecting and role of traditional knowledge in drug discovery. Understand the concept of biopiracy and Traditional Knowledge Digital Library and its importance.
- Give them know how about the medicinal plants of Kashmir Himalaya and their ethno-medicinal use.
- To introduce students to various methods of crude drug extraction and types of ethno-medicinal preparations made from biological resources.

Learning Outcomes

- To acquaint students with the concept and importance of Traditional Systems of medicine in healthcare in India and its advantages.
- To understand the methods of bioprospecting and appreciate the importance oftraditional knowledge and TKDL as tool for drug discovery and prevention of biopiracy.
- To understand the importance of plants as a rich sources of medicine especially for those living in close proximity with nature like tribal and forest dwellers.
- To have idea about different types of herbal extracts and preparations used in traditional systems of medicine.

Course No.: BR22007GE **Course Title: Biocosmetics**

Total Credits: 2 (2 L + 0 T + 0 P) **Maximum Marks: 50 (10 + 40)**

Course Description: The course "Biocosmetics" is designed to provide basic information about skin and hair care. It provides information about the structure of skin and hair and types of creams, lotions, shampoos, conditioners and colourants. It types of biological agents and biobased cosmetics used in skin and hair care and their advantages. It gives introduction to types of biobased fragrances, extraction and processing of fragrant plant oils and aromatherapy.

Learning Objectives

- To abreast students with the basics structure of skin and hair and products for skin and hair care.
- Give them idea about use of biobased formulations for skin and hair care.
- Give them know how about the important plants and their products used in skin and hair care.
- To study about the biobased fragrances, allergenicity of fragrances and aromatherapy.

Learning Outcomes

- To acquaint students with skin health and skin care products in general.
- To acquaint students with hair health and hair care products.
- To learn about the concept and advantages of biobased skin and hair cosmetics in general.
- To have know-how about common biological sources and health benefits of the fragrances.

Unit: I **(16 lectures)**

Skin care: Structure of skin; Types of Formulations— Emulsions, lotions, gels, creams, balm, muds, scrub; Sun screen products and anti-acne creams; Facial skin care; bath time herbs; Botanicals in skin care (Neem, Tulsi, Aloe vera, Soy, Turmeric, Tea, Coffee); Cosmaceuticals— Vitamin C, Vitamin E, Retinol, Caffeine, Lycopene.

Unit: III **(16 lectures)**

Hair care, Perfumes and Fragrances: Structure of hair; Hair care - Shampoos, surfactants and conditioners; Biobased hair colourants and hair gels; Biobased products in hair fall control; Biobased

fragrances; Extraction and processing of essential oils (Rose, Lavender and Rosemary); Fragrance and allergenicity, Aromatherapy.

Unit: I **(16 lectures)**

Traditional systems of medicine andBioprospecting: Introduction to Ayurvedic, Unani, Sidha Chinese/ Amchi, and Homeopathic systems of medicine; Concept and methods of bioprospecting; Role of traditional knowledge in discovery of medicine; Biopiracy, case studies of biopiracy (Neem, Turmeric, Periwinkle, Enola bean); Traditional Knowledge Digital Library (TKDL)- concept and importance.

Unit: II **(16 lectures)**

Medicinal plants and Herbal crude medicines: Ethnobotanical and medicinal importance of *Arnebiabenthamii*, *Aconitum heterophylum*, *Atropaacuminata*, *Podophyllumhexandrum*, *Saussureacostus*, *Rheum emodi*, *Digitalis purpurea, Picrorhizakurroa, Dioscoreadeltoidea* and *Hippophaerhamnoides*; Herbal crude medicines- Collection and processing; Techniques for extraction of crude medicine, advantages and limitations; Plant drug standardization.

Suggested Readings:

1. Irfan Ali Khan (Author), Atiya Khanum. Ethnomedicine and Human Welfare. Ukaaz Publications. 2006. ISBN: 978-8188279296.
2. Swapan Kumar Kolay. Ethno-Medicine for Traditional Health Care. B.R. Publishing Corporation. 2016. ISBN: 9789350502631.
3. Akash Akash, Navneet Navneet and B.S. Bhandari. Ethnomedicinal Plant Use and Practice in Traditional Medicine. IGI Global. 2020.ISBN13: 9781799813200
4. Maharaj Krishnen Kaul. Medicinal plants of Kashmir and Ladakh: Temperate and cold arid Himalaya. Indus Pub. Co. ISBN: : 978-8173870613
5. Ghulam Hassan Dar, Anzar A. Khuroo. Biodiversity of the Himalaya: Jammu and Kashmir State. Springer Nature. 2020. ISBN: 9813291745.
6. Rob Kidd. Medicinal Plants of India: An Engclopaedia. Daya Publishing House, New Delhi. ISBN: 9788170353041
7. JOSHI S.G. MEDICINAL PLANTS. OXFORD & IBH PUBLISHING. 2018. ISBN: 978-8120414143
8. Sudhanshu Kumar Jain , Robert A. Defilipps. Medicinal Plants of India. Reference Pubns. 2021. ISBN:

Course No.: BR22008GE **Course Title: Organic Farming**

Total Credits: 2 (2 L + 0 T + 0 P) **Maximum Marks: 50 (10 + 40)**

To familiarize students with principles of organic farming, objectives and requirements for the long term sustainability to achieve food security.

COURSE OBJECTIVES:

- To familiarize the students with standards of organic agriculture and the meaning of organic certification and with the management of organic crop production by utilizing different methods
- To familiarize students with the maintenance of soil fertility and management of animals for organic production

COURSE OUTCOMES: After completing the course students will have knowledge:

- To Produce Organic Crops systematically through scientific selection of crops, adoption of appropriate cropping pattern, Crop cultivation under organic farming, Maintain the quality of the produce and find a market for their Organic products.

Unit: I **(16 lectures)**

Organic agriculture: Principles of organic agriculture and requirements of organic standards; Criteria for substances used in organic production and processing; Organic certification.

Organic crop production: Split production and parallel production; Crop production and conversion period; Diversity in crop production; Soil fertility and fertilization; Pest, disease and weed management.

Unit: II **(16 lectures)**

Organic animal husbandry: Animal management; Animal origin and domestication; Mutilations; Animal nutrition; Veterinary medicine; Beekeeping.

Vermi compositing—methods, materials and advantages; Role in soil fertility, plant growth promotion and disease management.

Suggested Reading:

- Arun K Sharma. A handbook of Organic Farming , Agrobios Publication

Web Links

- https://onlinecourses.swayam2.ac.in/cec21_ag03/preview
- https://nptel.ac.in/courses/126/105/126105014/

Course No.: BR22006GE **Course Title: Biocontrol and Crop Management**

Total Credits: 2 (2 L + 0 T + 0 P) **Maximum Marks: 50 (10 + 40)**

To familiarize the students with adverse consequences of plant production and protection by chemical usages, specifically on the biotic and abiotic components of environment.

COURSE OBJECTIVES:

- To familiarize the students with beneficial use of microbial biofertilizers and biopesticides.
- To familiarize students with the microbes used as biocontrols for various crop plants and their advantages over chemical fertilizers.

COURSE OUTCOMES: After successful completion of this course students are expected to:

- The students will become familiar with the vast reserves of available microbial biodiversity that provide abundant opportunities to harness the ability of micro – organisms.
- The students will become aware about the chemical constituents of microbes that would sustainably minimize damage from pests or increase agricultural productivity and production.

Unit-I **(16 lectures)**

Biocontrol: Importance and scope; Biological control agents— predators, parasitoids and pathogens; Classical biological control—principles and procedures; Conservation biological control—conservation, habitat management and augmentation; Mass multiplication method and effective evaluation techniques of biocontrol agents. Disease resistance and molecular approach for disease management; Fungicides, bactericides and antibiotics in disease management.

Unit: II **(16 lectures)**

Post harvest diseases: Concept of post harvest diseases; Postharvest management; Cultural practices in perpetuation of pathogens; Phytoextracts in controlling post-harvest diseases and improving the shelf life of produce. Integrated Pest Management (IPM): History, concept and principles; Components of IPM— host plant resistance, agronomic manipulations, mechanical, physical, chemical, biological, genetic and behavioural control methods;

Course No.: BR22004OE **Course Title: Bioindustries**

Total Credits: 2 (2 L + 0 T + 0 P) **Maximum Marks: 50 (10 + 40)**

Course Objectives: The objectives of this course are to teach students with various approaches to know various Bio-industries and their applications in biological research as well as in biotechnology industries. Apply professional skill, knowledge & employability skills while performing jobs.

Learning Outcomes: Given the status and scope of Bioindustries in modern society, the students should be endowed with strong theoretical knowledge of this technology. In conjunction with the practicals in processing, handling and packaging of various products, the students should be able to take up biological research as well as placement in the relevant bioindustries industry.

Unit-I **(16 lectures)**

Bio-industries Introduction: Concept and scope, role of natural resources in economic development, Indicators of sustainable development, status and scope of agriculture, sericulture, horticulture, forest, dairy industry, herbal drug industry. Fruit Industries: Harvest, Processing, storage and marketing

Unit-II **(16 lectures)**

Bio-industrial Revolution: Industrial economic sectors: Primary, Secondary, Tertiary and Quaternary sectors, , Quality control and quality assurance, Intellectual Property Rights (Patent, Copy right, Trade mark, Trade secret, Industrial design, Geographical Indications), Small scale industries, Self-Employment, concept and scope of Entrepreneurship.

References:-

1. BioIndustry Ethic by David L. Finegold, Elsevier..
2. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in by Nambisan, P.
3. Bioentrepreneurship Development: A Resource Book by s. Shreya Sanghvi Malik
4. BioProducts publisher De Gruyter Bhima R. Vijayendran
5. Materials Processing Handbook by Joanna R. Groza et al. publisher Rose Library