



# **DEPARTMENT OF BIORESOURCES**

**SCHOOL OF BIOLOGICAL SCIENCES**

**UNIVERSITY OF KASHMIR, SRINAGAR**

**NAAC Accredited "A<sup>+</sup>"**

**Coordinator/Head**

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No.F(UG Syllabus- NEP) BIORES/KU/2024

Dated:- 10-07-2024

## **UG syllabi as per NEP 2020**

Department of Bioresources prescribed /designed the following under graduate courses as per NEP 2020 which includes skill based and innovative along with the minutes of Board of studies are attached below.

Sd/-

**Coordinator/Head**

Department of Bioresources



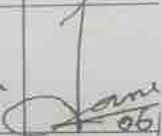


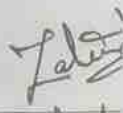

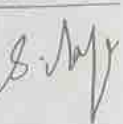
**UNIVERSITY OF KASHMIR**  
**NAAC Accredited Grade A\***  
**DEPARTMENT OF BIORESOURCES**  
**SCHOOL OF BIOLOGICAL SCIENCES**

**NOTES:**

No.F. (BOS-UG meeting)Biores/KU/23  
Dated: 06-06-2023




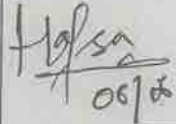
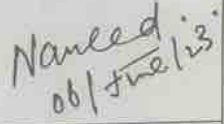
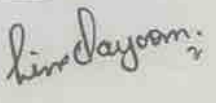
**Minutes of Meeting of the Board of Undergraduate Studies (BOS-UG) in Bioresources |  
on 06-06-2023**

A meeting of Board of Undergraduate Studies in Bioresources duly authorized by Competent Authority was convened in Compliance with NEP -2020 on 06-06-2023 in Department of Bioresources, University of Kashmir under the chairmanship Prof. Abdul Hamid Wani, chairman undergraduate Board of Studies (BOS-UG), University of Kashmir, Srinagar. The Following members attend the meeting.


Sl. No.	Name & Designation	Role	Signature
1.	<b>Prof. Abdul Hamid Wani</b> Department of Botany University of Kashmir, Srinagar.	Chairman <i>in person</i> on Duty to GDC <i>Dulhama</i>	
2.	<b>Dr Manzoor Ahmad Mir</b> Coordinator Department of Bioresources University of Kashmir	Convener	
3.	<b>Prof. Inayatullah Tahir</b> Department of Botany University of Kashmir, Srinagar.	Member	
4.	<b>Prof. Syed Tanveer</b> Department of Zoology University of Kashmir, Srinagar.	Member Acting Chairman	
5.	<b>Prof. Ehtishamul Haq</b> Department of Biotechnology University of Kashmir, Srinagar.	Member	
6.	<b>Dr. Hidayatullah Tak</b> Department of Bioresources University of Kashmir, Srinagar.	Member	
7.	<b>Dr. Mohd. Yaqoob</b> Department of Botany University of Kashmir, Srinagar.	Member	N.A
8.	<b>Dr. Mudasir Andrabi</b> Department of Animal Biotechnology SKUAST-K, Srinagar	Member	N.A.
9.	<b>Dr. Zahoor Ahmad Parray</b> Scientist E2, IIM University of Kashmir, Srinagar.	Member	
10.	<b>Dr. Reiaz Ul Rehman</b> Department of Bioresources University of Kashmir, Srinagar.	Member	
11.	<b>Mr. Sheikh Tajamul Islam</b> Department of Bioresources University of Kashmir, Srinagar.	Member	
12.	<b>Dr. Zahoor Ahmad Parray</b> Scientist E2, IIM Sanat Nagar, Srinagar.	Member	X

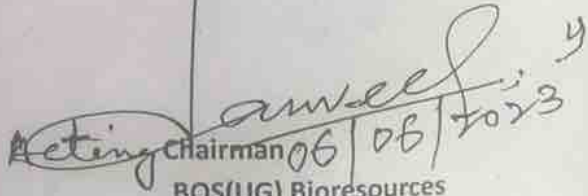
# DEPARTMENT OF BIORESOURCES

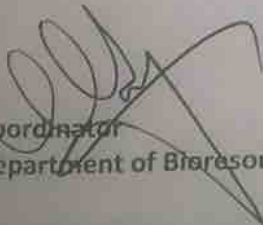
NOTES:

SCHOOL OF BIOLOGICAL SCIENCES			
14.	Dr. Bilal Ahmad Bhat Department of Zoology University of Kashmir, Srinagar	Member	 06/06/23
15.	Dr Peerzada Tanveer Bilal Govt. Degree College for Women Pulwama, Kashmir	Member	 08/06/23
16.	Dr Basharat Ahmad Bhat Amar Singh College, Cluster University, Srinagar	Member	 08/06/23
17.	Miss Hafsa Qadri Ph.D Research Scholar Department of Bioresources	Opted Member	 06/06/23
18.	Miss Naveed Mushtaq Ph.D Research Scholar Department of Bioresources	Opted Member	 06/06/23
19.	Miss Hina Qayoom Ph.D Research Scholar Department of Bioresources	Opted Member	 06/06/23

The Convener Dr. Manzoor Ahmad Mir, Coordinator Bioresources presented the syllabus before the Undergraduate Studies. The members discussed and reviewed the contents of the syllabi at length. The suggestions from the experts from the undergraduate level were considered for incorporation in the syllabi. After a long discussion and deliberations, finally members granted approval to the undergraduate syllabi based on NEP-2020 to be implemented in the colleges of J&K, affiliated to University of Kashmir Srinagar for the academic session 2023-24.

  
Convener  
BOS(UG) Bioresources

  
Acting Chairman  
BOS(UG) Bioresources  
06/06/2023

  
Coordinator  
Department of Bioresources



**DEPARTMENT OF BIORESOURCES**  
**UNIVERSITY OF KASHMIR, SRINAGAR**

**Syllabi: Undergraduate level**  
**Details of Courses**

**Core Courses**

- 1. Fundamentals Of Bioresources**
- 2. Plant Resources**
- 3. Animal Resources**
- 4. Microbial Resources**

**Discipline Specific Electives (DSE) Bioresources (Any Two)**

- 1. Bioindustries**
- 2. Biomedicine and Biocosmetics**
- 3. Biostatistics and Biotechniques**
- 4. Bioresources Technology**

**Skill Enhancement Courses (SEC)**

**Bioresources**

- 1. Applied Entomology**
- 2. Fish Farming**
- 3. Dairy Farming**
- 4. Poultry Farming**
- 5. Life Style Horticulture**
- 6. Wood Resource Utilization**

**Fundamentals of Bioresources****Theory  
Lectures: 60****Unit: I (15 Lectures)**

**Bioresources:** Bioresources— Plant, animal and microbial diversity (brief concept); Concept and levels of Biodiversity; Mega-biodiversity countries; Biodiversity hotspots (concept and distribution); Biodiversity and climate change— concerns and challenges; Valuing biodiversity— direct- and indirect use values; Role of remote sensing in Biodiversity studies.

**Unit: II (16 Lectures)**

**Biodiversity conservation:** Species extinction, causes of Biodiversity loss— ultimate and proximate causes; IUCN threat categories; Red data Book; Biodiversity surrogates; *In situ* conservation strategies— National parks, Wildlife sanctuaries and Biosphere reserves; *Ex situ* conservation strategies— Botanical gardens, Zoos, Aquaria, Cryo-banks).

**Unit: III (14 Lectures)**

**Bioresources and Livelihood:** Livelihood and its relation with bioresources management; Threats to traditional livelihood, food insecurity; Impact of globalization and urbanization on livelihood; Sustainable development; Energy crisis and need for green energy; Concept of green Building, vertical gardens; Green washing, eco-labelling (concept and examples).

**Unit: IV (15 Lectures)**

**Bioresources Management policies:** Indian Bioresources Information Network— organisation and role; Convention on Biological Diversity (CBD)- Aims and objectives; Ramsar Convention; Environment Protection act 1986- Scope and objectives; Environment Impact Assessment (EIA)- Concept and stages of EIA; Biodiversity conservation and public participation.

**Practical Work:**

- Collection, description and herbarium preparation of various types of leaves, inflorescences and fruits.
- Determination of minimum size and number of quadrats for phytosociological studies.
- Computation of frequency, density and abundance of constituent species of different communities.
- Field demonstration of Global Positioning System (GPS) and its utility in biodiversity studies.
- Constituent of aquarium and construction of aquarium.
- Role of Herbarium and its significance in biodiversity studies.
- Prepare well labelled herbarium sheets of economically important plants.
- Prepare an inventory of important threatened wild animal species of Kashmir Himalayas with special reference to the causes of their population decline.
- Field study of various threatened endemic plants of Kashmir Himalaya.
- Prepare a list of in-situ conservation sites of Kashmir Himalayas.

**Suggested Readings:**

- An Advanced Textbook On Biodiversity: Principles And Practice, 2004, Krishnamurthy, Oxford and IBH Publishing ISBN, 8120416066, 9788120416062
- Principles of conservation biology, Gary K. Meffe
- Conservation Biology for All, 2010, Navjot S. Sodhi and Paul R. Ehrlich, ISBN: 9780199554249
- Essentials of Conservation Biology 6th Edition, Richard B. Primack, SBN-13: 978-1605352893, ISBN-10: 1605352896
- Biodiversity: An Introduction, Kevin J. Gaston, John I. Spicer,
- Biodiversity, E.O. Wilson, National Academies Press, ISBN, 030956736X, 9780309567367

**Plant Resources  
Theory  
Lectures: 60**

**Unit: I****(15 Lectures)**

**Plant resources:** Plant kingdom— Cryptogams and Phanerogams; Origin of agriculture; Centres of origin and domestication of cultivated plants (proposed by Vavilov); Green revolution.

**Bioprospecting:** Bioprospecting— Concept; Role of traditional knowledge in bioprospecting; Biopiracy, case studies of biopiracy (Basmati, Neem, Turmeric); Traditional Knowledge Digital Library (TKDL).

**Unit: II****(16 Lectures)**

**Food and fodder crops:** Underutilised crops— importance as future food; Cultivation practice and limitations of buckwheat (*Fagopyrum* spp.) and foxtail millet (*Sterea italica*); Cultivation and utility of rice (*Oryza sativa*) and maize (*Zea mays*); Cultivation, extraction and processing of mustard oil; Fodder crops, cultivation and utility of alfalfa (*Medicago sativa*).

**Unit: III****(15 Lectures)**

**Fruits, vegetables and spices:** Cultivation of apple, walnut and apricot; Storage and packaging of fruits; Important wild vegetables of Kashmir (*Taraxacum officinale*, *Cichorium intybus*, *Rumex*, *Malva sylvestris*); Spices and condiments, Saffron (Cumin, coriander, Fennel).

**Non woody forest products (NWFP's):** Important sources of gums, resins and dyes their economic importance.

**Unit: IV****(14 Lectures)**

**Medicinal plants of Kashmir:** Morphology, ethnobotanical and medicinal importance of *Artemisia absinthum*; *Arnebia benthamii*, *Atropa acuminata*, *Saussurea costus*, and *Rheum emodi*.

**Essential oils:** Cultivation and extraction of lavender and rose oil, their economic importance.

### **Practical Work:**

- Study the diagnostic features of some economically important angiosperm families (Asteraceae, Apiaceae, Brassicaceae, Fabaceae, Rosaceae, Lamiaceae and Poaceae).
- Study various types of plant fibres.
- Study the presence and structure of starch granules and oil bodies in various food crops.
- Estimation of starch content and its comparison in various food crops.
- Identification and cultivation practices of oil yielding crops- Sunflower and Mustard.
- Pseudocereals- Buckwheat: Morphological features and seed structure; Test for presence of starch and proteins.
- Collection of wild vegetables from the field and preparation of herbarium.
- Study some commonly used spices and condiments.
- Study the diagnostic features and medicinal importance of native medicinal plants of Kashmir Himalaya.

### **Suggested Readings:**

- Textbook Of Economic Botany, 2009, Verma V, Ane Books Pvt Ltd, ISBN 8180521672, 9788180521676.
- Textbook of Economic Botany, 2016, ISBN-13: 978-8193241554
- Economic Botany, [B P Pandey](#), S. Chand Publishing, ISBN 9788121903417
- Economic Botany Paperback, 2009 , S. Sen, New Central Book Agency (1 January 2009) ISBN-10: 8173812063, ISBN-13: 978-8173812064
- Economic Botany, Principles and Practices, **Wickens**, G.E. © 2017 Springer International Publishing ISBN 978-0-7923-6781-9



**Core Course: Bioresources Paper III**

**Semester 3<sup>rd</sup>  
Animal Resources  
Theory  
Lectures: 60**

**Credits 6(theory 4 +practical 2)**

**Unit: I**

**(14 Lecture)**

**Introduction to Animal Resources:** Important animal resources; Aquaculture, cattle, goats, poultry, and sheep in human service; Principles and practices for production of high quality milk, meat and eggs; Scope of meat, fish and poultry processing industry in J&K.

**Unit: II**

**(14 Lecture)**

**Livestock:** History of domestication; Important methods of selection and systems of breeding in farm animals and poultry birds; phenotypic and genetic consequences: applications of inbreeding and out-breeding; Genetic basis of heterosis and its use.

**Unit: III**

**(16 Lectures)**

**Fish Resources:** Status and prospects; Role of aquaculture in food supply; Agencies involved in promoting academic, research and entrepreneurship in aquaculture; Types of farming systems- extensive, semi intensive and intensive culture; Cage culture; Integrated fish farming with details of paddy-cum-fish culture.

**Unit: IV**

**(16 Lectures)**

**Insect resources:** Importance and scope of insect based industries; Honey industry, Silk Industry and Lac industry; Advances in insect based industries of J&K and their economic potential; Edible insect industry (Nutritional Entomology); Insects as biosensors; Use of insects in Forensic Science and Biomedicine; Role of insects in pollination.

**Practical Work:**

- Study the procedure to ascertain the quality of silk, wool, honey, milk and meat.
- Study of life history of silk worm by rearing.
- Dissection of silk glands of the silk worm larva.
- Identification of culturable fishes in Kashmir valley.
- Demonstration of induced-breeding technology in cultured fishes.
- Identification of various breeds of cattle, buffalo, sheep and goat.
- Study the methods of preparation of different kinds of feed for Fish, Poultry and livestock
- Field trips to an organised fishery, Sericulture research stations and Dairy farms.

**Suggested Readings:**

- Prost, P.J. (1962) Apiculture. Oxford and IBH, New Delhi.
- Srivastava, C.B.L. (1999) Fishery Science and Indian Fisheries. Kitab Mahal publications, India.
- Dunham R.A. (2004) Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.
- Atwal, A. S. (1993) Agricultural Pests of India and South East Asia. Kalyani Publishers, New Delhi.
- Atwal, A. S. (1993) Agricultural Pests of India and South East Asia. Kalyani Publishers, New Delhi.
- Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher.

**Microbial & Fungal Resources****Theory****Lectures: 60****Unit: I (14 Lecture)**

**Microbial Resources:** Historical perspective; Different types of microbial resources (bacteria, fungi, algae and viruses).

**Microorganisms and environment decontamination:** Microorganisms in wastewater decontamination; Bioremediation through the use of microbial resources

**Unit: II (16 Lecture)**

**Microbial resources and crop productivity:** Mycorrhiza- Biology and their applications; Role of Trichoderma and biofilmed fertilizers; Production and application of Rhizobium, Azospirillum, Azotobacter; Plant growth promoting Rhizobacteria (PGPR's) and their uses; Mushroom industry— Edible and non-edible mushrooms, Mushroom production and cultivation techniques.

**Unit: III (16 Lecture)**

**Microbiota and human health:** Bifidobacteria, probiotics in promoting human health; Potential anticancerous compounds from microbial resources; Microbial cells as food (single cell proteins); Bioconversions— production of alcohol, cheese and beer; Role of fungi in beverage (Beer, lager, sake) and bread making industry.

**Unit: IV (14 Lecture)**

**Bioactive microbial agents:** Biopolymer and biosurfactant production from microbial resources; Industry-brewing, Medicine— vaccines, hormones and environment bioleaching; Antibiotics from fungi— penicillin, Ergot alkaloids; Fungi as biocontrol agents; Microbial production of PUFAs.

**Practical Work:**

- Basic bacterial staining, fungal staining, capsule staining, flagella staining and algal staining.
- Preparation of solid and liquid culture media.
- Streak plate and spread plate, Isolation of single colonies of bacteria and fungi on solid media.
- Preparation of slides of rhizobium isolated from leguminous plants.
- Alcohol production by fermentation of sugars.
- Identification of permanent slides of penicillium, yeasts, chlorella, plasmodium and trypanosomas.
- Isolation of lactobacillus from milk products and observation of bacilli under microscope.

**Suggested Readings:**

- The handbook of microbial bioresources. Eds: Gupta, V. K., Sharma, G. D., Tuohy, M. G., Gaur, R. (2016) ISBN 9781780645216. DOI: 10.1079/9781780645216.0000.
- Mushroom Production and Processing Technology. Eds: Pathak VN / Yadav N / Gaur M (2013) Published by Agrobios (India), Jodhpur ISBN 13: 9788177540062.
- Introduction to Fungi 3rd edition by Webster, John, Weber, Roland (2007) Cambridge University Press. ISBN-13:9780521014830.
- Biotechnology of Biofertilizers Editors: Kannaiyan, Sadasivam (Ed.) (2002) Springer Netherlands ISBN: 978-1-4020-0219-9.
- Microbes as Bio-fertilizers and their Production Technology S. G. Borkar (2015) Woodhead Publishing India in Agriculture. ISBN 9789380308579.
- Bioremediation of Wastewater: Factors and Treatment. Ed: Olga Sanchez (2017) Apple Academic Press; 1<sup>st</sup> ed. (2015). ISBN-13: 978-177188162.
- Medically Important Fungi: A Guide to Identification – 5th Edition by Larone Davise H. (2011) ASM Press. ISBN: 978-1555816605.

DSE

Semester 5<sup>th</sup>  
**Bioindustries**  
Theory  
Lecture 60

Credits 6 (Theory 4 + Practical 2)

**Unit: I**

**(15 Lecture)**

**Introduction to Bioindustry:** Bioindustry- Concept and recent trends in the development of Bioindustry; Scope and status of Bioindustries in India (Dairy, Sheep, Floriculture); Scope and status of Bioindustries in J &K (Dairy, Sheep, Aquaculture, Horticulture and Textile); Agriculture crop production trends and demand for staple food.

**Unit: II**

**(15 Lecture)**

**Bio-based waste utilization:** Composting, vermicompositing- methods, materials and advantages; Pulping (mechanical and chemical pulping); Municipal wastes- segregation and uses; Bio-based plastics and fibres; Biomass as energy source, Biogas production, Bio-fuels- Concept and classification.

**Unit: III**

**(15 Lecture)**

**Bioindustries and Green economy:** Marketing strategies for Bioresources products- Product launching, evaluation and advertisements, value addition; Intellectual property rights (Patents, Copy Rights, & Trademarks); Concept of Bio-villages and biotechnological parks.

**Unit: IV**

**(15 Lecture)**

**Bioindustry and Entrepreneurship:** Entrepreneurship, Small Scale Industries, Self employment schemes in relation to bioindustries; Status and scope and of establishing bio-based small scale industries (Cosmetics, Fertilizers, Leather, aquaculture, Ornamental horticulture and Herbal Medicine); Concept of Green entrepreneurship.

## **Tutorials: 2credits**

### **Suggested Readings:**

- Entrepreneurship: New Venture Creation, David H. Holt
- Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
- Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
- Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad
- N.S. Gopalakrishnan & T.G. Agitha, (2009) Principles of Intellectual Property. Eastern Book Company, Lucknow.
- Entrepreneurial Development by S.S. Khanka (S.Chand)
- Watal J. 2001. Intellectual property rights in the WTO and developing countries. Oxford University Press. Oxford.

DSE

Semester 5<sup>th</sup> Credits 6 (Theory 4 + Practical 2)

**Biomedicine and Biocosmetics**

**Theory**

**Lecture: 60**

**Unit: I**

**(15 Lecture)**

**Biomedicine:** Introduction, Sources of biomedicine (plants, animals, microorganism); Concept of AYUSH; Development of important traditional systems of medicine (Ayurvedic and Unani); Concept of health and disease, principles of prevention and treatment of disease and health care in traditional systems of medicine (Amchi, Ayurvedic and Unani); leach therapy, maggot therapy, apitherapy.

**Unit: II**

**(15 Lecture)**

**Herbal medicines:** Classification, collection and processing of herbal crude drug; Plant drug standardization; Quality control and quality assurance of herbal drugs; Causes for the decline and the current revival of interest in indigenous systems of medicine; Advantages and disadvantages of traditional systems of medicine over modern system of medicine.

**Unit: III**

**(14 Lecture)**

**Bio-cosmetics:** Fundamentals of biocosmetics, classification of biocosmetics, A brief study of raw materials used for biocosmetic preparations (animals, plant and marine substances); Stability of biocosmetics- Shelf-life, effects of environmental factors (light, temperatures etc) on product stability; Quality control, Packaging and labelling

**Unit: III**

**(16 Lecture)**

**Types of cosmetics:** Advantages of bio-cosmetic over synthetics; Personal hygiene products (shaving creams, tooth pastes); Hair Care Products (Conditioners, Setting lotion, Hair creams and dyes); Skin Care Products (skin cleaners, moisturizers, sunscreen products, acne products, anti ageing creams); Perfumes (types of essential oils); Aromatherapy (essential oils for stress relief, weight loss and beauty aid).

### **Practical Work:**

- Qualitative test for secondary metabolites (Alkaloids, Saponins, terpenes, tannins, glycosides, phenols)
- Ethno-medicinal Survey & documentations.
- Identification of crude drugs containing Alkaloids by morphological characters.
- Determination of ash value of different powdered crude drugs.
- Determination of Antifungal activities of different powdered crude drugs.
- Quantitative estimation of resin & sugars.
- Study of Morphological & Microscopic characters of Herbs used in Skincare.
- Application of various methods for extraction, solvent systems & isolation of active constituents.
- Study of various oils used in Aromatherapy with special reference to its applications.

### **Suggested Readings**

- Hand Book on Ayurvedic Medicines, H.Panda National Institute of Industrial Research, Delhi-7
- Indian Herbal Pharmacopoeia vol. I & II Indian Drug Manufacturer's association, Mumbai
- Alternative medicine, by Dr. K.B. Nangia.
- Perfumes, Cosmetics and Soaps by Poucher.
- Cosmetic Science and Technology Vol I, II, III by Sagarin.
- Hand Book of herbal products Vol I & II by NIIR Board of Technologist
- Cosmetics Analysis selective methods with techniques by P. Bare.
- Bannerman, R.H., Burton, J. and Wen Chen, C. (eds). 1983. *Traditional medicine and health care coverage*. WHO, Geneva.
- Chancellor, P.M. 1971. *Handbook of the Bach flower remedies*. Saffron Waldon, Essex.
- Cotton, C.M. 1996. *Ethnobotany: principles and applications*. John Wiley & Sons, New York.
- Foster, G.M. and Anderson, B.G. 1983. *Medical anthropology*. John Wiley, New York.
- Gopalan, C., Ramasastri, B.V. and Balasubramanian, S.C. 1985. *Nutritive Value of Indian Foods*. National Institute of Nutrition, Hyderabad.



- Hughes, C.C. 1968. Ethnomedicine. In: *International Encyclopedia of Social sciences*. Vol. 10 MacMillan, New York.
- Jamil, T. 1997. *Complementary Medicine*. Butterworth Heinemann, Oxford.
- Jayasurya, A. 1997. *The Future of Complementary Medicines*. Medicina Alternativa, Colombo
- Kameswara Rao, C. 2000. *Database of Medicinal Plants*. KSCST, Bangalore.
- Keys, J.D. 1976. *Chinese herbs*. CE Tuttle Co., Tokyo.
- Lawless, L 1997. *The Complete Illustrated Guide to Aromatherapy*. Element Books Ltd., Dorset.
- Leavitt, D. 1974. *Chine herbal medicine*. DHEW Publishers, New York
- Lele, R.D. 1986. *Ayurveda and Modern Medicine*. Baratiya Vidya Bhavan, Mumbai.
- Martin, G.S. 1995. *Ethnobotany*. Chapman and Hall, London.
- Mukherjee, B. (ed). 1993. *Traditional Medicine*. Oxford & IBH Pub. Co. Pvt. Ltd. New Delhi.
- Oliver-Bever, B.E.P. 1986. *Medicinal Plants of Tropical West Africa*. Cambridge University Press, Cambridge.
- Pushpangadan, P. 1995. *Ethnobiology in India: a Status Report. All India Coordinated Research Project on Ethnobiology*. Ministry of Environment and Forests, Govt. of India, New Delhi.
- Pushpangadan, P., Nyman, U. and George, V. 1995. *Glimpses of Indian Ethnopharmacology*. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, Kerala.
- Schultes, R.E. and Reis, S. von (eds). 1995. *Ethnobotany: evolution of a discipline*. Chapman and Hall, London
- Savanur, H.V. 1993. *A Handbook of Ayurvedic Materia Medica*. Vol. I. Dr. Jarthar and Sons, Mathuri Street, Belgaum, Karnataka, India.
- Savanur, H.V. 1993. *A Handbook of Ayurvedic Materia Medica*. Vol. VI (4). Dr. Jarthar and Sons, Mathuri Street, Belgaum, Karnataka, India. Pp: 258-261.
- Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.

DSE

Semester 6<sup>th</sup>

Credits 6 (Theory 4 + Practical 2)

**Biostatistics and Biotechniques**

**Theory**

**Lecture: 60**

**Unit: I**

**(14 Lecture)**

**Data types and collection:** Types of data— Continuous and discrete data; Methods of primary and secondary data collection and their limitations.

**Processing and analysis of data:** Measures of Central Tendency— arithmetic mean, mode, median; Measures of dispersion— mean deviation, standard deviation, coefficient of variation.

**Unit: II**

**(14 Lecture)**

**Correlation and regression:** Simple correlation— calculation of correlation coefficient; Simple linear regression— calculation of regression coefficients.

**Graphical and diagrammatic representation of data:** Histogram, frequency polygon, frequency curve; Line diagram, bar diagram, pie diagram; Significance and limitations of graphical and diagrammatic representation of data.

**Unit: III**

**(16 Lecture)**

**Biotechniques:** Resolution and magnification power of a microscope; Principle & working of compound light microscope; Principle and applications of scanning electron microscopy and transmission electron microscopy; Principle and working of spectrophotometer; Basic principles of chromatography, Paper and thin layer chromatography.

**Unit: IV**

**(16 Lecture)**

**Bioinformatics:** Bioinformatics— concept and application; Bioinformatics databases— Concept of Genome, Nucleic acid and Protein databases (NCBI, Gene Bank, SwissProt); Sequencing— Concept of Conventional and next generation sequencing; Basic Concept of sequence similarity, identity and homology; Sequence based database searches— Concept and examples (blast, fasta).

### **Practical Work:**

- Collection of data from a target population and presentation of data in frequency distribution tables.
- Calculation of measures of central tendency (arithmetic mean, median and mode).
- Comparison of mean height, weight etc of target populations using graphs.
- Collection of Secondary data on crop production and presentation of data using pie charts.
- Demonstration of some common statistical software.
- Demonstration of working of a colorimeter/spectrophotometer.
- Separation of plant pigments using paper chromatography.
- Preparation and development of TLC plates.
- Demonstration for accessing a bioinformatics database.
- Demonstrate Blast analysis by using tentative sequences.

### **Suggested Readings:**

- Biostatistics, Khan and Khanum.
- Statistics, Gupta
- Wayne W. Daniel, Biostatistics : A foundation for Analysis in the Health Sciences, 8th Edition, Wiley, 2004.
- Prem S. Mann, Introductory Statistics, 6th Edition, Wiley, 2006.
- Fundamentals of Biostatistics (6th Ed.), Bernard Rosner. Thomson Brooks/Cole. 2006
- Instrumental Analysis by Skoog, Holler, Crouch, 2007, Brooks/Cole,
- Campbell and Heyer, Discovering Genomics, Proteomics, & Bioinformatics, 2nd Edition, Benjamin Cummings, 2002.
- Cynthia Gibas and Per Jambeck, Developing Bioinformatics Computer Skill, 1st Edition, O'Reilly Publication, 2001.
- Current Protocols in Bioinformatics, Edited by A.D. Baxevanis et al, Wiley Publishers. 2005
- Bioinformatics by David W. Mount, Cold Spring Harbor Laboratory Press. 2001
- Fundamental concepts of Bioinformatics by D.E. Krane and M.L Raymer, Pearson Education. 2003
- Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson and John Walker (eds.), Cambridge University Press, Cambridge.

DSE

**Semester 6<sup>th</sup>**      **Credits 6 (Theory 4 + Practical 2)**  
**Bioresources Technology**  
**Theory**  
**Lecture: 60**

**Unit: I** **(15 Lecture)**

**Biotechnology:** Introduction, scope and applications; Cloning, Recombinant DNA technology– Restriction enzymes, gel electrophoresis, blotting techniques; DNA libraries– Genomic and cDNA library; Plant tissue culture and its application; Methods of gene transfer; GMO's – ecological and ethical concerns.

**Unit: II** **(16 Lecture)**

**Green concept in biotechnology:** Bioremediation, bioleaching and biodegradation (heavy metals, hydrocarbons, xenobiotics); Biorefinery, White Biotechnology; Microbes as biosensors; Bioflavours and Biocolourants obtained through bioresource biotechnology; Sources of Enzymes and their commercial use.

**Unit: III** **(14 Lecture)**

**Animal cell and tissue culture:** History, scope and applications; Transfection methods, culture of cell lines for production of biomolecules and valuable products; Transgenesis (cloning) and its application; Somatic cell fusion – concept and utility.

**Unit: IV** **(15 Lecture)**

**Cell culture products:** Viral vaccines, interferons, recombinant proteins and hybrid antibodies; Hybridoma technology and production of monoclonal antibodies; Stem cell lines– origin and types, stem cell therapy and its applications; Tissue Engineering-brief concept.

### **Practical Work:**

- Estimation of DNA
- Estimation of protein by Bradford method
- Effect of pollution on plant bioresources and water quality:
  - a) To calculate the Leaf Area Index of leaf samples collected from different sites to study the effect of pollution on leaf morphology
  - b) To analyze water samples (tap water, stream water and stagnant water) for dissolved CO<sub>2</sub> and dissolved oxygen.
- Estimation of heavy metals in various samples by AAS.
- Demonstration of Biosensors.
- Visit to sewage treatment plants.

### **Suggested Readings:**

- *Applied Bioremediation and Phytoremediation*. A. Singh O. P. Ward (Eds), Springer, New York, NY, 2004
- Desmond S. T. Nicholl (2008). *An Introduction to Genetic Engineering*, 3rd Edition, Cambridge University press.
- Ruane J, Sonnino A. 2006. *The role of biotechnology in exploring and protecting agricultural genetic resources*. Food and Agriculture Organization of the United Nations, Rome.
- Singh, B. D. (2007). *Biotechnology: Expanding Horizons*. Kalyani Publishers.
- Desmond S. T. Nicholl (2008). *An Introduction to Genetic Engineering*, 3rd Edition, Cambridge University press.

**Applied Entomology  
Theory  
Lecture: 30**

**Unit: I****(7 Lecture)**

**Insect resources:** Importance and scope of insect based industries; Beneficial role of insects (Pollination and waste degradation); Insect products (honey, silk and lac); Cultural entomology— ornamental insects, edible insects, weed killers, soil builders and scavengers insects in biological control of pests.

**Unit: II****(7 Lecture)**

**Apiculture:** History and scope; Social organization, communication, and life history of honey bee, Products of apiculture (honey, Bee wax, bee venom); Bee keeping management and prospectus, bee keeping equipment; Modern methods in Apiculture, Bee keeping as Industry in J&K; Diseases of honey bee and their management.

**Unit: III****(8 Lecture)**

**Sericulture:** History and scope, development and organization of silk industry, food plants of silkworm, the cultivation and management, Mulberry and non-mulberry silkworms, Bio-ecology of mulberry silkworm, silkworm rearing technology, Diseases, predators and parasitoid of silkworms and their management. Silkworm breeds, synthesis of silk and cocooning, harvesting and grainage.

**Unit: IV****(8 Lecture)**

**Lac culture:** History and scope of lac culture, Bionomics of lac insect, Lac production technology, Lac processing, Life history of Lac insect. Lac cropping techniques and harvesting; Bio products of lac industry and their utilization; Processing techniques of lac; Physical and chemical characteristics of lac; Natural enemies of lac insect and their management.

**Suggested Readings:**

1. An introduction to Sericulture by G. Ganga & J. Sulochana Chetty Oxford & IBH Publ. Co. pvt. Ltd.
2. Apiculture by P.J. Prost, Oxford & IBH, New Delhi
3. Economic and applied entomology by A. Kumar & P.M. Nigam Emkay Publications
4. Elements of Economic Entomology 8th Edition by B.V. David
5. Entomology: Novel Approaches by Jain,P.C. & M.C.Bhargava New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
6. General and Applied entomology by K. K. Nayar
7. Hand book of Economic Entomology by Shukla Daya Publishing House, New Delhi
8. Principles of sericulture by H. Aruga Oxford & IBH, New Delhi
9. The fascinating world of bees by V.V. Rodionov & I.A. Shabarshov Mir Publ., Moscow

**Fish Farming  
Theory  
Lecture: 30**

**Unit: 1****(6 Lecture)**

**Fish Industry:** Global scenario; Fish Industry in J&K, Role of Fish industry in food supply and human service; Major food fishes of J&K, production and export potential; Agencies involved in promoting academic, research and entrepreneurship in Pisciculture.

**Unit: II****(8 Lecture)**

**Types of fish farming systems:** Extensive, semi intensive and intensive culture; cage culture; integrated fish farming with details of paddy— cum-fish culture; Fish ponds: types and management; construction, preparation and maintenance of ponds; Manuring, feeding and harvesting; Types of feeds and feeders used in aquaculture.

**Unit: III****(8 Lecture)**

**Sustainable aquaculture:** Intensive aquaculture and environmental degradation; Ornamental fisheries— Aquarium management and maintenance; Composite fish culture; Induced breeding, significance of induced breeding; Egg collection, induced spawning; Cryo preservation of fish germplasm and semen bank.

**Unit: IV****(8 Lecture)**

Types of fishing nets and gears— methods of operation; Fishing crafts; Characteristics of fish populations; Methods of fish stock identification— use of classical and modern tools; Significance of marking and tagging in fish industry; Processing and preservation of fish and its by-products.



### **Suggested Readings:**

1. Advances in Harvest and Postharvest Technology of Fish by Nambudari,D.D. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
2. Aqua Culture by B. R. Selvamani and R. K. Mahadevan
3. Breeding and seed production of finfish and shellfish by Thomas, Rath Daya pub.
4. Fish and Fisheries of India by Kadam, Sandhya New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
5. Fish Harvesting and Processing by B. R. Selvamani & R. K. Mahadevan Publisher Campus books international
6. Fish processing technology by Gopakumar ICAR
7. Freshwater aquaculture by R.k. Rathy Scientific publication
8. Handbook of fisheries and aquaculture by Yadav ICAR
9. Handbook on Freshwater Aquaculture by N.P. Singh & B.Santhosh New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
10. Ornamental fish farming by Saroj. K, swain ICAR
11. Postharvest technology of fish and fish products by Balachandran Astral

**Dairy Farming  
Theory  
Lecture: 30**

**Unit-I****(8 Lecture)**

**Introduction to Dairy Farming:** History, origin and domestication of dairy animals. Important breeds of cattle (indigenous and exotic); Important methods of selection and systems of breeding in dairy animals. Genetic applications of inbreeding and outbreeding; Genetic basis of heterosis and its use; Common diseases of dairy animals (Anthrax, Foot & Mouth disease, Parasites)

**Unit-II****(8 Lecture)**

**Principles of Milk and Milk Processing:** Principles and practices for production of high quality milk; nutritive value of milk and milk products; Filtration, Clarification, pasteurization, ultra-high temperature treatment, homogenization, sterilization, cooling and chilling of milk; Milk secretion and composition of colostrums; Common adulterants and preservatives used in milk and their detection.

**Unit-III****(7 Lecture)**

**Dairy products and processing:** Meat hygiene: Slaughter house management and clean meat production and preservation; Utilization and processing of various dairy by-products: blood, fat, hides, bones, wool, hair, and feather; Scope of meat processing industry in J&K; Basic principles of refrigeration and cold storage of milk products.

**Unit-IV****(7 Lecture)**

**Dairy products technology:** Composition and method of manufacture of cream, butter, dahi, khoya, Ice cream, condensed milk, milk powder, cheddar and cottage cheese; Common adulterants of Ghee and khoya and their detection; Cleaning and sanitization of dairy equipment; Factors affecting the quantity and quality of dairy products; Use of biotechnological tools in improving dairy products.

### **Suggested Readings:**

1. Abattoir Practices By-Products and Wool Techn.. by V P Singh New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
2. Animal Breeding and Genetics by C.V.Singh New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
3. Animal Welfare and Management by BHM Patel, Prasanna, S.B. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
4. Biotechnology in Animal Health and Production by Jindal, S.K. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
5. Dairy Animal Production by Biswajit Roy New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
6. Dairy Plant Management by Puranik,D.B. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
7. Dairy Technology: Vol.01 & Vol 2 : Milk and Milk Proc.. by Singh, Shivashraya New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
8. Extension Techniques for Livestock Developmen.. by Singh S.K. & S.D.Singh New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
9. Farm Animal Management: Principles and Practi.. by Singh, Rana Ranjit New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
10. Fat Rich Dairy Products by Thompkinson, D.K. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
11. Fish and Fisheries of India by Sandhya S. Kadam New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
12. Genetic Improvement of Livestock and Poultry by Singh, C.V.& R.S.Barwhal: Ed. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
13. Goat Production and Health Management by Jindal, S.K. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India

14. Infectious Diseases of Animals Their Identifi.. by Nandi, S. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
15. Livestock Economics: Marketing,Business Manag.. by Gangadhar, K.S. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
16. Livestock Nutrition: Analytical Techniques by Gopal Krishna New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
17. Livestock Production and Management: Recent T.. by Sunil Kumar: Ed. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
18. Nutraceuticals in Livestock and Poultry by Amitav Bhattacharya New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
19. Practical Animal Nutrition by Mudgal, Vishal New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
20. Quality Assessment of Milk & Milk Products by Thompkinson, D.K. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
21. Textbook of Ruminant Nutrition by Mondal, G. Publisher New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India

**Poultry Farming  
Theory  
Lecture: 30**

**Unit-I****(7 Lecture)**

**Poultry Farming:** Introduction and History; Scope and strategies of Poultry farming. Important breeds of fowl and turkey (indigenous and exotic); Common poultry feeds (preparation, processing and management); Genetic applications of inbreeding and outbreeding in poultry; Present status and future prospects of poultry farming in J&K.

**Unit-II****(8 Lecture)**

**Principles of Poultry farming:** Poultry farms: Housing system (Free range, semi-intensive and intensive); Floor space requirements in different age groups; Site selection, topography, availability of feed, medicine and vaccination, market accessibility, water and electricity supply; Droppings management; Bio-safety and Bio-security with relation to poultry farming.

**Unit-III****(7 Lecture)**

**Management of Poultry Diseases:** Common diseases and parasites of Poultry (Bird flu, Ranikhet, Fowl cholera and Fowl pox); Vaccination in poultry; Vaccination schedule and vaccination methods; Anthelmintic used in poultry, dose and method of deworming. Debeaking (Purpose, age, method and precautions).

**Unit-IV****(8 Lecture)**

**Poultry products technology:** Egg production, table bird production. selection of eggs, hatching, incubation, brooding, sexing and vaccination. Nutritive value and utilization of various poultry by-products; Use of biotechnological tools in improving poultry productivity; Scope of poultry processing industry in J&K.

### **Suggested Readings:**

1. Animal Breeding and Genetics by C.V.Singh New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
2. Animal Welfare and Management by BHM Patel, Prasanna, S.B. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
3. Avian Poultry Production: 2nd Revised and Enl.. by Sapkota, D., D Narahari and J D Mahanta New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
4. Biotechnology in Animal Health and Production by Jindal, S.K. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
5. Genetic Improvement of Livestock and Poultry by Singh, C.V.& R.S.Barwhal: Ed. New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India

**Life style Horticulture  
Theory  
Lecture: 30**

**Unit: I****(7 Lecture)**

**Introduction:** Floriculture industry— Concept & history, Global scenario, Floriculture industry in India and j &K; Concept of Life style horticulture; Landscaping— concept, Functional uses of plants in the landscape; Principles of gardening, Types of gardens; Aesthetic values.

**Unit: II****(7 Lecture)**

**Production practices:** Nursery development and management; Fertilizers and manures for floriculture; Asexual and vegetative methods of propagation; Seed production and collection, Controlled atmosphere for plant propagation— Green house and phytotrons.

**Unit: III****(8 Lecture)**

**Ornamentals:** Concept and examples of foliage ornamental plants; trees, shrubs, climbers, edges and hedges and ground covers and potted plants; Bulbous ornamentals; Dry flowers from wild and cultivated plants; Cut flower crops and loose flower crops; Cut flower quality parameters, post harvest handling; Ethylene sensitivity.

**Unit: IV****(8 Lecture)**

**Horticulture as a therapy:** Ornamental horticulture for physical and psychological health; Horticulture to decrease mental fatigue and levels of fear; Natural play settings and Attention Deficit Disorder (ADD) in children; Garden as a learning tool; Community gardens, their importance; Gardens as a learning tool.

**Wood Resource Utilization****Theory****Lecture: 30****Unit: I**

**Introduction:** Wood as a resource; Forest cover in J & K; General morphology and diversity of commercially important wood species in Kashmir Himalayas— pine, deodar, willow, poplar and walnut.

**Wood Structure and formation:** Wood elements in gymnosperms, monocots and dicots; Formation of wood, Early wood and late wood, growth rings.

**Unit: II**

**Wood properties:** Physical properties of wood- colour, luster, odour, weight, and density; Soft wood and hard wood, sap wood and heartwood; Effect of growth rings on density; Chemical constituents of wood- cellulose, hemicellulose and lignin— structure and functions.

**Unit: III**

**Wood resource management:** Wood preservation processes— non pressure and pressure processes; Wood preservatives; Wood seasoning— Concept & importance; Air seasoning— air drying, accelerated air drying; Special seasoning methods— drying by boiling in oily liquids and vacuum drying.

**Unit: IV**

**Wood products:** Wicker works and their importance as sources of income in Kashmir; Wood resources and sports items (cricket bats, hockey sticks, base ball bats); Water resistant woods; Wood as timber; wood as fuel; Saw dust and its uses; Plywood.



## Course Title: Herbal Technology

Semester V (Type 1) Credits 4 (theory 3 +practical 1) Maximum Marks: 100 (75L+25P)

### Learning Objectives

- To learn about various herbs, methods of crude herbal extraction and processing and types of formulations used in traditional system of medicine.
- To study about the ethno-botanical and medicinal importance of selected medicinal plants of Kashmir Himalaya.
- To learn about various botanical used for skin and hair care in traditional system and modern cosmetics.
- To study about the herbs used in oral health and hygiene and fragrances.

### Learning Outcomes

- To have idea about different types of herbal extracts and preparations used in traditional systems of medicine.
- To understand the importance of plants as a rich sources of medicine and their use in traditional healthcare especially for those living in close proximity with nature like tribal and forest dwellers.
- To understand the concept of biocosmetics and herbs used in formulations for skin and hair care in general.
- To have know-how about common herbal sources fragrances and use of herbs in oral care.

### Unit: I

(15 Lecture)

**Herbs-Processing and Extraction:** Concepts of herbs; Collection, processing and storage of herbs; Types of extracts- Decoction, Infusion, Digestion, Tinctures, Liquid extracts, Soft extracts, Dry extracts; Methods of extraction- Maceration and Digestion Percolation, Soxhlet Extraction, Extraction of essential oils (Water and Steam Distillation).

### Unit: II

(15 Lecture)

**Herbs in medicine:** Historical perspective of herbs in traditional health management; Ethno-botanical and medicinal importance of *Atropa acuminata*, *Aconitum heterophyllum*, *Saussurea costus*, *Arnebia benthami*, *Catharanthus roseus*, *Digitalis purpurea*; Herbal

nutraceuticals and their role in managing Diabetes, CVS diseases, Cancer, and various Gastro intestinal diseases.

### **Unit: III**

**(15 Lecture)**

**Herbs in cosmetics:** Herbal sources of fixed oils, waxes, gums, bleaching agents, antioxidants for skin and hair care; Herbs in Shampoos, surfactants and conditioners; Biobased hair colourants; Biobased products in hair fall control; Herbs in oral health and hygiene; Herbs as sources of fragrances (lavender, rose, rosemary).

### **Practical Work:**

- Morphological identification of important medicinal plants of Kashmir Himalayas.
- Qualitative test for presence of secondary metabolites (Alkaloids, terpenes, tannins, glycosides, phenols)
- Quantitative estimation of sugars and Phenols.
- Methods of extraction (Demonstration of Maceration, Digestion and Soxhlet extraction)
- Morphology and importance of Lavender and Rose.
- Ethno-medicinal Survey & documentations.

### **Suggested Readings**

- Agarwal, S.S. and Paridhavi, M., "Herbal Drug Technology" Universities Press (India) Private Limited, 2007.
- Vipin Kumar Singh, VP, Das S, Kumar M.(2018) Bioprospection of Traditionally used Medicinal Plants: An Overview.
- Panda H (2004) Handbook of Herbal Drugs and its plant sources.
- Khare, C.P (2004) Indian Herbal remedies-Rational Western therapy, Ayurvedic and other usage, Botany, Springer.
- Daniel, M., "Herbal Technology: Concepts and Advances" Satish Serial Publishing House, 2008.
- Cosmetic Science and Technology Vol I, II, III by Sagarin.
- Cosmetics Analysis selective methods with techniques by P. Bare.
- Bannerman, R.H., Burton, J. and Wen Chen, C. (eds). 1983. Traditional medicine and health care coverage. WHO, Geneva.
- Pushpangadan, P. 1995. Ethnobiology in India: a Status Report. All India Coordinated Research Project on Ethnobiology. Ministry of Environment and Forests, Govt. of India, New Delhi.

## Course Title: Fungal Resources & Diseases

Semester V (Type II) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

**Course objective:** To provide detail knowledge about the fungal pathogens their ecology and host-pathogen interactions, development of diseases and their epidemics and management through various approaches. To classify fungi and phylogeny, thallus structure, nutrition and reproduction and their economic importance for the welfare of mankind. To provide detail knowledge about the macro-fungi (mushrooms), edible fungi and important cultivated mushrooms, their cultivation technology, and production. Imparting knowledge about fungi-host interactions.

**Course outcome:** Students are expected to develop a tangible idea about the fungi and their different dimensions concerning ecology, disease and management which help to initiate research in fungal pathology. Students will gain knowledge about the mushrooms, their biology and cultivation techniques for conducting individual research on mushroom and entrepreneur development.

### Unit: I

(14 Lecture)

Introduction to fungi: General characteristics; Classification based on Nutrition (saprophyte, biotrophic, symbiotic, predaceous); Affinities with plants and animals; Thallus organization; Cell Structure; General characteristics of Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota, (Overview); Economic importance of fungi (Decomposition of organic matter, lignin and pesticides).

### Unit: II

(16 Lecture)

Applied Mycology: Role of fungi in beverage (Beer, lager, sake) and bread making industry. Antibiotics from fungi— penicillin, cephalosporins, Clavacin, Griseofulvin, Ergot alkaloids; Edible mushrooms, Life cycle of *Agaricus bisporous*. Mushroom production and cultivation techniques. Non-edible and poisonous mushrooms (*Amanita phalloieds*)

### Unit: III

(16 Lecture)

Human pathogenic fungi: *Candida spp.*, *Aspergillus spp*, *Cryptococcus spp.*; Opportunistic Fungal Pathogens of Humans; Human Fungal Diseases: *Candidiasis*, *Aspergillosis*, *Cryptococcosis*. *Mucormycosis*, *Histoplasmosis*; Fungal infections: Superficial Infections, Subcutaneous Infections, Systemic Infections: Antifungal drugs, their mode of action and drug resistance

### Unit: IV

(14 Lecture)

Fungi and plant health: Plant disease — Apple scab, Early blight of potato, Loose and covered smut, soft rot and damping off disease (Causative organisms, symptoms and control measures). Fungi as biocontrol agents (mycofungicides, mycoherbicides, mycoinsecticides,

myconematicides); Mycorrhizas (Endo- and ecto-mycorrhiza) role in plant health; Lichen: Classification & Economic Importance.

### **Practical Work:**

- Alcohol production by fermentation of sugars.
- Identification of permanent slides of penicillium, yeasts,
- Study of fungal diseases in the field: Blast of rice, Tikka disease of ground nut, powdery mildew of locally available plants and white rust of crucifers.
- Agaricus: Specimens of button stage and full grown mushroom; sectioning of gills of Agaricus, and fairy rings are to be shown.
- Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
- Preparation of solid and liquid culture fungal growth media.
- Streak plate and spread plate, Isolation of single colonies of fungi on solid media.

### **Suggested Readings:**

- Mushroom Production and Processing Technology. Eds: Pathak VN / Yadav N / Gaur M (2013) Published by Agrobios (India), Jodhpur ISBN 13: 9788177540062.
- Introduction to Fungi 3rd edition by Webster, John, Weber, Roland (2007) Cambridge University Press. ISBN-13:9780521014830.
- Medically Important Fungi: A Guide to Identification – 5th Edition by Larone/Davise H. (2011) ASM Press. ISBN: 978-1555816605.
- Introduction to Fungi. 3rd Edition (2007) Webster & Webster. Cambridge University Press.
- Larone's Medically Important Fungi: A Guide to Identification, 7th Edition Lars F. Westblade, Eileen M. Burd, Shawn R. Lockhart, Gary W. Procop ISBN: 978-1-683-67442-9 (2023) ASM Press
- Cryptococcus neoformans (2014) Arturo Casadevall, John R. Perfect ISBN: 978-1-683-67264-7 ASM Press
- An Introduction to Fungi. Dube H.C. 2012. Scientific Publishers
- Molecular Principles of Fungal Pathogenesis (2014) Joseph Heitman (Editor), Scott G. Filler (Editor), John E. Edwards Jr. (Editor), Aaron P. Mitchell (Editor) ISBN: 978-1-683-67180-0, ASM Press
- Introductory Mycology. Dorian Snyder. 2019. Larsen & Keller Educ.
- Aspergillus fumigatus and Aspergillosis (2014) Jean-Paul Latge (Editor), William J. Steinbach (Editor) ISBN: 978-1-683-67138-1, ASM Press
- Cellular and Molecular Biology of Filamentous Fungi (2014) Katherine A. Borkovich (Editor), Daniel J. Ebbole (Editor) ISBN: 978-1-683-67129-9, ASM Press

- Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
- Deacon, J.W. (2013). Fungal Biology, 4th edition, John Wiley & Sons Ltd
- Candida and Candidiasis, 2nd Edition (2014) Richard A. Calderone (Editor), Cornelius J. Clancy (Editor) ISBN: 978-1-683-67095-7, ASM Press
- The Fungal Kingdom (2017) Joseph Heitman, Barbara J. Howlett, Pedro W. Crous, Eva H. Stukenbrock, Timothy Yong James, Neil A. R. Gow ISBN: 978-1-683-67082-7 ASM Press

**Course Title: Cell Biology**

*Semester V (Type 3) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)*

**Learning Objectives:**

- To study the structural organization of prokaryotic and eukaryotic cells and general structure and similar and differences in cell wall in prokaryotes and eukaryotes.
- To study the structural of cell membrane, cell organelles and their role in important processes.
- To learn about the various phases of cell cycle and structural organization of cytoskeleton, cell adhesion and cell junctions

**Learning Outcomes:**

- To understand complexity of structural organization of cell and organization of cell membranes, cell wall and extracellular matrix.
- To understand the organisation of eukaryotic cell and the structure and role of cellular organelles.
- To understand the process of cell cycle and cell division and importance of checkpoints in cell cycle.

To understand the basis and structural organization of cell— cell interaction and cell matrix organisation.

**Unit: I**

**(15 Lecture)**

**Cells and cell membrane:** Types of cells (Bacteria, Archaea (prokaryotic) and eukaryotic cells)- similarities and differences; Cell membrane structure and composition, Fluid Mosaic Model of cell membrane; Components of extracellular matrix; Cell wall structure (comparison of bacterial, plant and fungal cell wall).

**Unit: II**

**(15 Lecture)**

**Cytoskeleton and Cell junctions:** Cytoskeleton— microtubules, actin filaments, intermediate filaments; Centriole and basal bodies. Cell-Cell Interactions (tight junctions, desmosomes, hemi-desmosomes, gap junctions and plasmodesmata).

**Unit: III**

**(15 Lecture)**

**Intracellular organelles:** Structural organization of endoplasmic reticulum, golgi bodies, ribosome, lysosomes, peroxisomes, vacuoles; Structural organization and genome

organization in mitochondria and chloroplast; Structural organization of nucleus—nuclear membrane and nuclear pore complex, Nucleolus, Nuclear matrix;

**Unit: IV**

**(15 Lecture)**

**Chromosomes and Cell cycle:** Chromosome structure; Types of Chromosomes (Lampbrush and Polytene chromosomes). Chromosomal aberrations (Deletion, Duplication, Inversion and Translocation) Characteristics features of phases of cell cycle; Cell Cycle Check points and their importance; Phases and importance of mitosis and meiosis;

**Practical Work:**

- Comparative study of prokaryotic & eukaryotic cells
- Comparative study of plant & animal cell.
- Study Membrane stability Index.
- Study of stages of Meiosis and Mitosis from permanent slides.
- Study pollen mother cell meiosis.
- Study meiotic stages during gamete formation in grasshopper
- Study stages of mitosis from root tips.
- Extraction of Nuclear DNA.

**Suggested Readings:**

- Cell and Molecular Biology Biology, P.K. Gupta. ISBN: 8171338178.
- Cell and Molecular Biology: Concepts and Experiments, Gerald Karp, John Wiley publishers New York. ISBN: 111830179X.
- Cell Biology.C.B.Powar. ISBN: 9350246694
- Geoffrey M. Cooper . The Cell: A Molecular Approach. ISBN: 1605351555.
- Bruce Alberts, Dennis Bray, Karen Hopkin and Alexander Johnson: Essential Cell Biology. ISBN: 081534130X.

**Course Title: Industrial Entomology**

*Semester VI (Type I) Credits 4 (theory 3 +practical 1) Maximum Marks: 100 (75L+25P)*

**Course objectives:**

- To introduce the domestic species of honey bees, silk worms.
- To study the modern methods of apiculture, rearing of silkworms and processing of Lac.
- To understand the commercial uses of silk and lac.
- To familiarize the learners to the economic aspects of apiculture, sericulture and lac culture.

**Course outcome:**

- Learner would adopt modern rearing techniques of honey bees and silkworms.
- Learners would realize the economic scope of apiculture, sericulture and lac culture.
- Learner would understand the processing techniques of stick Lac to powder Lac.
- Learner would understand products of sericulture, apiculture and Lac.

**Unit: I**

**(15 Lecture)**

**Apiculture:** History and scope; Social organization, communication, and life history of honey bee, Products of apiculture (honey, Bee wax, bee venom); Bee keeping management and prospectus, bee keeping equipment; Modern methods in Apiculture; Diseases of honey bee and their management; Bee keeping as Industry in J&K.

**Unit: II**

**(15 Lecture)**

History and scope, development and organization of silk industries, Food plants of silkworm their cultivation and management. Mulberry and non-mulberry silkworms; Bio-ecology of mulberry silkworm, Silkworm rearing technology, diseases, predators and parasitoids of silkworms and their management; Silkworm breeds, synthesis of silk and cocooning, harvesting and grainage. Status of sericulture industry in J&K?

**Unit: III**

**(15 Lecture)**

Lac insect, biology, life cycle. Preparation of Feeding Ground for Lac Insects (Host, plants their management). Lac products, properties and their uses (lac dye, lac wax, shellac, bleached shellac, dewaxed bleached shellac, aleuritic acid); Enemies of Lac Insects and their Control; Parasites, Predators and microbial diseases. Edible and medicinal insect based industry.

**Practical Work: 1 Credits**

- Collection, preservation and identification of economically important insects.
- Study of life history of silk worm by rearing.



- Dissection of silk glands of the silk worm larva.
- Mounting: sting apparatus of Honey bees.
- Study of different castes of honey bee.
- Honey extraction and processing methods of hive products extraction.
- Quality analysis of honey.

**Suggested Readings:**

1. An introduction to Sericulture by G. Ganga & J. SulochanaChetty Oxford & IBH Publ. Co. pvt. Ltd.
2. Apiculture by P.J. Prost, Oxford & IBH, New Delhi
3. Economic and applied entomology by A. Kumar & P.M. Nigam Emkay Publications
4. Elements of Economic Entomology 8th Edition by B.V. David
5. Entomology: Novel Approaches by Jain,P.C. &M.C.Bhargava New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
6. General and Applied entomology by K. K. Nayar
7. Hand book of Economic Entomology by Shukla Daya Publishing House, New Delhi
8. Principles of sericulture by H. Aruga Oxford & IBH, New Delhi  
The fascinating world of bees by V.V. Rodionov& I.A. Shabarshov Mir Publ., Moscow

**Course Title: Livestock Product Technology**

*Semester VI (Type II) Credits 6 (theory 4 +practical 2)      Maximum Marks: 150 (100L+50P)*

**Learning objectives:**

1. To educate about common food adulterants and their detection.
2. To educate about standards and composition of foods and role of consumer.

**Learning outcome:** The learners will understand about basics of engineering as used in food processing and waste management and bio-utilization.

**Unit I: Basic and General Aspects of Livestock Products (15 Lectures)**

Milk and milk products- preservation of milk and production of fermented milk products (yoghurt, cheese and cultured butter milk). Meat and meat products- preservation and curing of meat. Egg and egg products- nutritive value, composition and preservation of egg. Sea foods- preservation and use of brine.

Composition and Physio-chemical properties of milk. Milk proteins, lipids, carbohydrates, minerals, vitamins and other minor constituents of milk. Nutritive value of milk. Processing and related techniques pasteurization and homogenization. Nutritive aspects and functional properties of different kinds of meat, fish, poultry and eggs. Food processing and food born infections.

**Unit II: Packaging of animal products (15 Lectures)**

Principles of packaging. Types of packaging material, methods and system of packaging. Standardization and quality control of packaging material. Active and smart packaging, antimicrobial packaging, edible films and coatings, nanocomposite materials for food packaging. Use of biosensors in livestock products packaging.

**Unit III: Quality control and Marketing (15 Lectures)**

Grades and grading of livestock products. Stress factors effecting meat quality-PSE, DFD, hot boning, cold shortening, thaw rigor, freezer burn and electrical stimulation. Regulatory and inspection methods – Municipal and state laws of Indian Standard and International Standards of fresh meat and poultry. Detection of antibiotics, chemical residues, heavy metals and toxins in meat. Techniques for detection of adulterations of meat. Present status, constrains and future aspects of livestock production and marketing in Jammu and Kashmir.

**Unit IV: Post Harvest Technology (15 Lectures)**

Consumer protection; role of voluntary agencies such as, Agmark, I.S.I. Quality control laboratories of companies ,private testing laboratories, Quality control laboratories of consumer co-operatives,. Standardization of Foods; Definition, Standards of Quality, Milk and milk products, Meat and meat products, poultry and canned fish.

Waste management; solid and liquid wastes; industrial effluents and their management, dairy industry and other food processing industries. Bio-utilization of wastes and by products.

## **Practicals**

Testing adulteration of Milk and products:

### **A) Adulteration of Milk**

Physical Tests; Detergent Test; Filter Test; Flow Test

**B] Chemical Tests:** Clot on boiling test; Test for starch in Milk; Test for cane sugar in Milk; Test for skim milk powder in milk

- Detect the presence of added carbonates and bicarbonates in milk
- Adulteration of Ghee:
- Test for vegetable fat:
- Nitric acid test; Soda ash test
- Analysis of butter: Test for Dalda in butter.
- Adulteration of Paneer: Presence of starch in paneer.
- Food adulteration awareness campaign – know your food quality
- Visit to a State food testing Laboratory / NGRA Food Quality Testing Laboratory.

## **Reference Books;**

1. Food Science & Quality Control by SMT. B. Poornima - Centrum Press First edition 2014.
2. A first course in Food Analysis – A.Y. Sathe, New Age International (P) Ltd., 1999. Food Microbiology – Frazier, W.C., Ed-4, Mc. Graw Hill – 2013.
3. Microbiology by John Garbult Essentials of Food Microbiology - Arnold International Student edition 1997.
4. Betty - c Hobbs & Diane Roberts – Food poisoning and food hygiene sixth edition by Arnold International Students edition – 1993.
5. Practical Food Microbiology & Technology – Mountney Gould, Ed-3, Krieger Publishing Company, 1992.
6. Modern Food Microbiology – Jay J.H. CBS Publishers, 1990.
7. The Microbiological safety of processed foods – Growther, Marthi, Oxford and IBH Publishers Pvt. Ltd., 1988.

## Course Title: Molecular Biology

Semester VI (Type III) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

### Course objectives:

- Course chiefly concerns understanding different nucleic acids and proteins including the interactions between the different types of DNA, RNA, and protein biosynthesis and learning how these interactions are regulated.

### Course outcomes:

- Upon successful completion of this course, students will be able to:
- Describe DNA replication, including the principle steps and enzymes involved.
- Illustrate DNA and RNA structure, replication, transcription, protein synthesis.
- Discuss DNA repair mechanisms.
- Describe transcription, including the principle steps and enzymes involved.
- In detail, describe the process of translation, identifying the principles steps.

### Unit-I

(15 Lecture)

#### Structure and Functions of Nucleic Acids:

The beginning of Molecular Biology; DNA: A carrier of genetic information, Chemical structure of DNA and Base composition, Watson-Crick model; Structure of different types of nucleic acids, Conformation of nucleic acids: A-, B-, Z-, DNA. Structure and function of different types of RNA (m-RNA & t-RNA).

### Unit-II

(16 Lecture)

#### DNA Synthesis and repair:

Unit of replication, enzymology of DNA replication, replication origin and replication fork, fidelity of replication, Mechanism of DNA replication in prokaryotes and eukaryotes. DNA damage and repair mechanisms.

### Unit III

(16Lecture)

#### RNA synthesis and processing:

Transcription in prokaryotes:Structure and function of RNA polymerases. Promoters. Transcription in Eukaryotes:Promoters, Transcription factors and enzymes, formation of initiation complex, elongation and termination. Transcription activators and repressors. RNA processing; capping, splicing and polyadenylation.

### Unit-IV

(15 Lecture)

#### Protein synthesis and processing:

Ribosome, genetic code, aminoacylation of tRNA, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination.Posttranslational modification of proteins (Overview).

**Practical Work:**

1. Demonstration of Gel Electrophoresis
2. Isolate DNA from biological samples
3. Characterize isolated DNA using agarose gel electrophoresis
4. Demonstration of Polymerase Chain Reaction, Gel electrophoresis and analysis of bands
5. Isolate a specific protein from a biological sample
6. Construction of calibration curve for protein estimation
7. Demonstration of SDS-PAGE electrophoresis

**Books Recommended:**

1. Freifelder D (2012). Molecular Biology, 5th edition. Narosa Publishing House, India
2. Berg JM, Tymoczko JL, Gatto GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co., New York.
3. Allison A. Lizabeth (2012) Fundamental Molecular Biology, 2nd Edition. J Willey and Sons, Hoboken, New Jersey.
4. Freifelder D and Malacinski GM (2005) Essentials of Molecular Biology, 4th Edition, John and Bartlett Publishing, UK
5. Krebs JE., Kilpatrick ST and Goldstein ES. (2013). Lewin' GENES XI, Jones & Bartlett Learning. Burlington, MA.

## Course Title: Bioresource Technology

Semester VII (Type I) Credits 4 (theory 3 +practical 1) Maximum Marks: 100 (75L+25P)

**Course objectives:** This course provides the students with an understanding of principles, techniques, concepts and methods associated with development and analysis of transgenics. This course is framed for providing a broader context about the advances in the field of recombinant DNA technology.

- Different molecular methods for genetic engineering and their application in plant transgenic for improved traits.
- Application of biotechnology in environmental clean-up, sustainability, nutrition and health
- The goal of this course is to provide the necessary theoretical knowledge on animals cells for in vitro studies for valuable products
- To understand the basic concept of stem cell therapy and tissue engineering focusing on biomaterials and its applications

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

- Learn Basic principles and applications of recombinant DNA technology.
- Learn molecular biology skills along with usage and applications of the instrumentation.
- Learn about the usage of transgenic for the production of biochemicals.
- Learn Ethical and legal issues of Recombinant DNA Technology.

### Unit: I

(15 Lecture)

**Plant Biotechnology:** Introduction, scope and applications; Cloning, Recombinant DNA technology– Restriction enzymes, gel electrophoresis, blotting techniques; Plant tissue culture and crop improvement; Methods of gene transfer ; Transgenic plants with improved traits, GMO's – ecological and ethical concerns.

### Unit: II

(15 Lecture)

**Green concept in biotechnology:** Bioremediation, bioleaching and biodegradation (heavy metals, hydrocarbons, xenobiotics); Microbes as biosensors; Microbes as source of medicinally important secondary metabolites; Bioflavours and Biocolourants obtained through bioresource biotechnology; Sources of Enzymes and their commercial use.

### Unit: III

(15 Lecture)

**Animal cell and tissue culture:** History, scope and applications; Transfection methods, Culture of cell lines; Transgenesis (cloning) and its application; Somatic cell fusion – concept and utility. Cell culture products: Viral vaccines, interferons, recombinant proteins and hybrid antibodies; Hybridoma technology and production of monoclonal antibodies

## Practical Work: 2 Credits

- Extraction of DNA from plant, microbe and animal tissue
- Demonstration of Agarose gel electrophoresis
- Preparation of plant tissue culture medium
- Demonstration of gene transfer methods
- Estimation of protein by Bradford method
- Effect of pollution on water quality: analyze BOD and COD
- Estimation of heavy metals in various samples by AAS.
- Demonstration of Biosensors.

## Suggested Readings:

- *Applied Bioremediation and Phytoremediation*. A. Singh O. P. Ward (Eds), Springer, New York, NY, 2004
- Desmond S. T. Nicholl (2008). *An Introduction to Genetic Engineering*, 3rd Edition, Cambridge University press.
- Ruane J, Sonnino A. 2006. *The role of biotechnology in exploring and protecting agricultural genetic resources*. Food and Agriculture Organization of the United Nations, Rome.
- Singh, B. D. (2007). *Biotechnology: Expanding Horizons*. Kalyani Publishers.
- Desmond S. T. Nicholl (2008). *An Introduction to Genetic Engineering*, 3rd Edition, Cambridge University press.
- Cooper Jeffrey M-2013: *Cell-A Molecular Approach*, 6th Edition. Sinauer Assoc. Inc. USA
- Jocelyn E Krebs et al. 2010. *Lewin's Gene X*. Jones And Bartlett Publishers, Inc USA.
- Watson and others – 2004 : *Molecular Biology of the gene ( V)*; PearsesEducatias, Inc India
- P.C. Turner and others – 2002 : *Molecular Biology (II)*; Viva Books, Pvt. Ltd., New Delhi.
- W. Ream and KG. Field – 1999 : *Molecular Biology Techniques* ; Academic Press, London.
- Bruce Alberts et al – 1983 : *Molecular Biology of the cell* ; Garland Publ. Inc., New York.
- Buchanan B, Gruissem G and Jones R. (2000) *Biochemistry and Molecular Biology of Plants*, American Society of Plant Physiologists, Rockville, USA.
- C. K. Matthews, K. E. Van Holde and K. G. Ahern. (2007). *Biochemistry*, 3rd Edition, Pearson Education, New Delhi
- Freshney, R. I. (2010). *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications*. Wiley-Blackwell, 2010. 6th Edition.
- Davis, J. M. (2008). *Basic Cell Culture*. Oxford University Press. New Delhi.
- Davis, J. M. (2011). *Animal Cell Culture*. John Willy and Sons Ltd. USA.

- Freshney R. I. (2005). Culture of Animal Cells. John Willy and Sons Ltd. USA.
- Butler, M. (2004). Animal Cell Culture and Technology. Taylor and Francis. New York, USA
- Bernhard O.Palsson,SangeetaN.Bhatia,"Tissue Engineering" Pearson Publishers 2009.
- Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of Tissue Engineering and Regenerative Medicine.2009.



## Course Title: Bioresources in Health Management

Semester VII (Type II) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

### Course objectives

- To familiarize the students about the relationship between food, nutrition, health and diseases which would make them aware about the role of macro and micro nutrients in diet
- To familiarize the students about the food servings (meal planning) and understand the nutrient metabolism as well as nutrient-microbe interaction.
- To familiarize the students about the benefits of consuming phytochemicals on regular bases and also develop the concept of food spoilage and safety.

### Course outcomes

- On completion of the course the students are expected to have rational and critical knowledge associated with plant based diets and their uses by society.
- The students will be able to apply the scientific Knowledge of plant based diets for promotion of health by getting rid of the so called diseases of civilization.

### Unit: I

(15 Lecture)

**Introduction:** Plants in the diet of hunter gatherers; Plants in modern western diet; Plants as sources of proteins (amino acids, protein quality:PER, BV, NPU), carbohydrates(monosaccharides, disaccharides, polysaccharides), fats and lipids (types, importance and composition), vitamins (Fat soluble and water soluble) and minerals (biological role and occurrence of inorganic elements).

### Unit: II

(15 Lecture)

**Good things from plants in the diet:** Dietary fibre and health, Antioxidants (phytochemicals, phytosterols); Gut microbiotome; Role of phytonutrients in influencing gut microbiotome.

### Unit: III

(15 Lecture)

**Plants as source of healthy diet:** Nutrition (energy value of food), Basal metabolic rate, Recommended dietary allowances (RDA), Natural health products (functional foods and nutraceuticals); Algae (Chlorella, Spirulina) and fungi (Mushrooms, Pleurotus) as source of human food; Plant diet in pregnancy, lactation, infancy, childhood and adolescence (Principles of meal planning of plant diet).

### Unit: IV

(15 Lecture)

**Plant diet and diseases:** Impact of food matrix and phytonutrients against chronic diseases; Plant diet and disease management— diabetes, heart disease, cancer, obesity; Plants in health improvement, fitness and sports (stamina, energy and food selection); Food safety and poisoning (spoilage, toxicity and allergy).

### Practicals

- Demonstrate the grouping of plant foods according to ICMR classification.
- Demonstrate and compare the protein quantity in staple foods (Rice, Maize, Wheat).
- Demonstrate and compare the Total sugar in staple foods (Rice, Maize, Wheat).
- Observe the seeds of the staple foods.
- Observe the microscopic structure of different starches (rice, wheat and corn).

- Perform the qualitative tests of plant based foods for phenol and flavinoid
- Extraction of oil from nuts
- Demonstrate and compare the cellulose, lignin and hemicelluloses from important dietary plants

**Suggested Reading:**

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2009). Textbook of Human Nutrition, 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.
2. Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.
3. Srilakshmi (2005), Dietetics, Revised 5th edition. New Age International Ltd.
4. Wardlaw MG, Paul M Insel Mosby (1996). Perspectives in Nutrition, Third Edition.
5. Codex Guidelines on Nutrition Labelling (CAC/GL 2\_1985) (Rev.1\_1993). Rome, Food and Agriculture Organisation of the United Nations / World Health Organisation, 1993.
6. Food Safety and Standards Authority of India portal, Government of India
7. Gopalan, C (1990). NIN, ICMR. Nutritive Value of Indian Foods.
8. Seth V, Singh K (2005). Diet planning through the Life Cycle: Part 1. Normal Nutrition. A Practical Manual, Fourth edition, Elite Publishing House Pvt Ltd.

## Course Title: Human Genetics

Semester VII (Type III) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

### Course objectives:

To give the students an understanding of:

- Structure, Function and Inheritance of the human genome,
- Genomic Variation, Genotype-phenotype correlations,
- Pedigree analysis and Expressivity,
- Chromosomal Basis of Genetic Disorders and Genetic mapping.

### Course outcomes:

- Course is specially designed to supplement and enhance the understanding of students about different dimensions of human genetics starting from genes to proteins and mutations in genes to the genes in the evolution of humans.
- This course is expected introduce the rapid advancements in our understanding the role of human genome in health and disease.

### Unit: I

(15

#### Lectures)

**Basic Human Genetics:**History of Human Genetics; Introduction to Hereditary and Inheritance; Pedigrees- gathering family history, pedigree symbols, construction of pedigrees; Monogenic traits - Autosomal inheritance-dominant and recessive; Pleiotropy; Polygenic inheritance; Multifactorial inheritance, Sex-linked inheritance- dominant and recessive; Sex-limited and sex-influenced traits; Y-linked ; Mitochondrial inheritance. Linkage and crossing over-Types.

### Unit: II

(15

#### Lectures)

**Human Genome:**The genome project- history, organization and goals of human genome project; mapping strategies, current status of various maps; human genome diversity; Organization of human genome, Mitochondrial genome, gross base composition of nuclear genome, gene density. Genetic mapping, Sequencing strategies (PCR based Sanger sequencing to Exome sequencing). Introduction to Epigenetics. Common mechanisms of Epigenetics, Epigenetics and diseases.

### Unit: III

(15

#### Lectures)

**Clinical Genetics:**Scope of clinical genetics; Monogenic diseases- Cystic fibrosis, Tay-Sachs syndrome, Marfan syndrome; Polygenic diseases- Hyperlipidemia, Diabetes mellitus, Atherosclerosis; Inborn errors of metabolism and their genetic bases- Phenylketonuria, Maple syrup urine syndrome, Mucopolysaccharidosis, Galactosemia. Infertility - genetic basis of male infertility, genetic basis of female infertility; recurrent pregnancy loss.

**Lectures)**

**Genetic Counseling:** Patterns of inheritance: classical and non classical, Overview of genetic counseling, components of genetic counseling, information gathering and construction of pedigrees and their interpretation. Risk assessment and counseling in common Mendelian and multifactorial syndromes, Management of genetic disorders.

**Practicals:**

- Genetics of Blood Groups a) ABO –typing b) Rh (D) typing
- Isolation of DNA from peripheral Blood
- Isolation of DNA from Tissue
- Isolation of RNA from Lymphocytes

**References**

1. Human Molecular Genetics by Tom Strachan, Andrew P. Read Garland Science/Taylor & Francis Group, 2011
2. Essentials Of Human Genetics Fifth Edition (University Press), By Manu L. Kothari, Lopa A. Mehta · 2009
3. Human Genetics: Concepts and Applications by Ricki Lewis, McGraw Hill Publishers 2020.
4. Human Genetics, 6<sup>th</sup> Edition, SD Gangane, Elsevier Publishers 2021
5. Principles of Genetics by EJ Gardner, MA, Simmons and DP Snustad, 8<sup>th</sup> Edition, Willey Press 2006.

**Course Title: Biotechniques and Biostatistics**

*Semester VIII (Type I) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)*

**Learning Objectives**

- To study about types of data and analysis of measures of central tendency and graphical representation of data.
- To study measures of dispersion, correlation, regression and basic idea about hypothesis testing.
- To study principle and application of microscopy, spectroscopy and chromatography.

**Learning Outcomes**

- To learn the basic use of the statistical tools for problem solving in the field of biological science.
- To learn about methods of data collection, their limitation and basic measures central tendency and dispersion, correlation and regression and their application in biological studies.
- To learn about the application of basic biotechniques and tools in biological analysis and experimentation.

**Unit: I**

**(16 Lectures)**

**Types of data and Measures of central tendency:** Types of Data and their advantages and limitations (Primary data and secondary data); Measures of central tendency (Mean, mode, median); Graphical representation of data (Bar diagram, line graph, Histogram, and Pie chart)

**Unit: II**

**(16 Lectures)**

**Measure of dispersion and Tests of Significance: Measures of dispersion** (Mean deviation, variance, standard deviation) Simple linear correlation; Simple linear regression; Hypothesis testing (t-Test, and Chi Square test), F- test (One Way ANOVA).

**Unit: III**

**(16 Lectures)**

**Microscopy and spectroscopy:** Principle, working & application of Compound Microscope, Fluorescence microscope, Scanning electron and Transmission electron

microscopy; Principle and working of a spectrophotometer; Radioisotopes— applications in biology.

**Unit: IV**

**(16 Lectures)**

**Chromatography and Centrifugation:** Principle and applications of Paper, Thin layer, Ion exchange, adsorption and molecular exclusion chromatography, High-performance liquid chromatography (HPLC); Centrifugation (Principle and its types).

**Practical Work**

- Collection of data from field and construction of frequency tables.
- Diagrammatic and graphical representation of data.
- Comparison of populations parameters based on mean, mode and median.
- Calculation of standard deviation
- Introduction to use of excel for data storage and analysis.
- Isolation of pigments using Paper and TL Chromatography
- Demonstration of microscopy (structure and use of compound microscope)
- Principle and working of a spectrophotometer (demonstration)

**Suggested Readings**

- Fundamentals of Biostatistics by Khan and Khanum, sixth edition, ISBN: 9788190944103.
- Fundamentals of Statistics. S.C. Gupta, 2018, ISBN: 9350517698.
- Biotechniques (Theory & Practice ). Rastogi Publications by Prof. S.V.S. Rana. ISBN: 817133993X.
- Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson, John Walker ISBN: 9780521731676.
- Modern Biotechniques and Biotechnology by Gupta Neelima.

**Course Title: Drug Discovery and Development**

*Semester VIII (Type II) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)*

**Learning objectives**

- Identify the various classifications of drug products.
- Understand the basic concepts of new drug development with emphasis on design and conduct of clinical trials and interpretation of their results.

**Learning Outcome**

- Use antimicrobials judiciously for therapy and prophylaxis.
- Evaluate scientific, ethical and market-related considerations of importance in the drug development.

**Unit: I (16 lectures)**

**Drugs and mode of action:**-Introduction to various classes of drugs, Drug discovery, Relation of Drug structure and its chemical and biological properties, Drug targets: Classification, structure, drug receptor interaction (G-protein, Ion channels and Ion channel linked receptors, nuclear receptors).

**Unit: II (16 lectures)**

**Drug Simulation:**- Computer aided drug designing, selection of targets, Docking and Molecular Docking Simulations. Various tools used for drug targeting. Antimicrobial drugs: Antibacterials: Discovery and development of Penicillin's and Tetracyclins.

**Unit: III (16 lectures)**

**Drug development and toxicity:**Stages of drug development;admet screening angLipink's rule, Drug laws, FDA. Different methods in toxicity testing: Dose determination, response characterization. Mechanism of toxicity: Evaluation across different models: Target organs, cell death, necrosis, apoptosis, oxidative stress, chromosome and DNA damage. Acute and chronic toxicity.

**Unit: IV (16 lectures)**

**Approaches for Targeted Drug Delivery:**- Principles of drug targeting and molecular basis of targeted drug delivery: Receptor mediated endocytosis; Different types of targeting-active and passive targeting. Disease based targeting approaches, Organ based targeting, Cell/Organelles based targeting, Carrier based approach for targeted drug delivery.

**Practicals**

1. Handling of laboratory animals.
  - Various routes of drug administration.
  - Techniques of blood sampling, anesthesia and euthanasia of experimental animals
  - Oral glucose tolerance test.
2. Estimation of proteins by Brafrod/Lowry's in biological samples.

3. Protocol design for clinical trial.
4. In-silico docking studies.
5. In-silico pharmacophore based screening.

### **Suggested Readings**

1. Pharmacology for Technicians: 6th edition, Ballington, Laughlin, and McKennon-Paradigm, 2017 – EVC Book Store
2. Goodman & Gilman's: The Pharmacological Basis of Therapeutics, 13e
3. An Introduction to Mechanisms in Pharmacology and Therapeutics, Howard Rogers and Roy Spector publisher Elsevier.
4. Drug Discovery and Development; Technology in Transition. HP Rang. Elsevier Ltd 1st edition 2006.
5. Pharmacology in Drug Discovery. T. P. Kenakin. Elsevier, 1st Edition 2012.
6. An introduction to medicinal chemistry. G. L. Patrick. 5th Edition Oxford UK, Oxford University Press, 2013.
7. Textbook of Drug Design. Krogsgaard-Larsen, Liljefors and Madsen (Editors), Taylor and Francis, London UK, 2002.
8. Drug Discovery Handbook S.C. Gad (Editor) Wiley-Interscience Hoboken USA, 2005.



## Course Title: Medicinal Plants and Phytotherapeutics

Semester VIII (Type III) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

### Learning objectives

After completing this course, the student will be able to:

- To study the history and scope of plant derived drugs
- To study the characteristic and importance of major phytochemicals
- To know the extraction, purification and characterization of phytochemicals
- To know the process for development of plant drugs
- Discuss the advantages and disadvantages of Phytotherapy.
- Illustrate the natural products proven effective for the treatment of various diseases.

### Course outcome:

- Knowledge on the history and scope of plant derived drugs
- Knowledge on the characteristic and importance of major phytochemical
- Knowledge on extraction , purification and characterization of phytochemical
- Understand the process for development of plant derived drugs
- Knowledge of phytotherapy, natural products of verified pharmacological effect with their mechanisms, active ingredients obtained from natural products.

### Unit I: Medicinal plants

Medicinal Plants– past, present and future prospects in world and India. Biologically active substances of medicinal plants and their importance in determining phytotherapeutic effects. Ethno medicinal importance of some medicinal plants of J&K:- *Poddophyllum hexandrum*, *Viola orata*, *Aconitum heterophyllum*, *Picorhiza kurroa*. *Curcuma longa*, *Piper nigrum* and *Taraxicum officinale*.

### Unit-II Phytomedicine

Definition, scope, importance and classification of plant based drugs. Preparation of Crude drugs in different systems of medicine. Value addition grading and processing of plant drugs. Bioprospecting tools for drug discovery. Plants based drugs and their therapeutic use - Dioscorea, Ginseng, Vinblastin, Vincristin Glycyrrhiza, Atropine, Digitoxin, Amygdalin, Cyanidin, Malvidin, Taxol, and Curcumin.

### Unit – III Traditional System of Medicine

Introduction, Concept and Principles of Traditional System of Medicine (TSM)- Ayurveda, Unani, Siddha, Homeopathy and Amchi system. Bioprospecting, Biopiracy. Concept and importance of Traditional Knowledge of Digital Library (TKDL). Intellectual property Rights (IPR)-concept. (copyright, trademarks, patents, geographical indications, plant varieties, industrial designs and Trade secrets).

### Unit – IV Phytotherapy

Definition of phytotherapy, its role and place in modern medicine. Advantages and disadvantages of Phytotherapy. Phototherapeutic drugs and methods of their application. Phytomedicines used in parasitic, helminthiasis, protozoal and microbial infections, anti-diabetic, anti-cancer, skin diseases, nervous system, immune system.

### **Practicals:**

1. Sample collection of the selected species as per the course content.
2. Extraction of phytochemicals by different methods.
3. Qualitative estimation of Phytochemical.
4. Preparation of Crude drugs in different systems of medicine
5. Identification and medicinal value of locally available medicinal plants.
6. Methods of propagation of important medicinal plants.
7. Demonstration of solvent/s extract/s preparation using Soxhlet apparatus.
8. To prepare crude drug from plant parts.
9. Isolation, purification of crude drug from plant parts.
10. Determination of phytochemicals in crude plant extracts.

### **Suggested Readings:**

1. Medicinal Plants of the Himalays: advances and Insights by Amjad M Husaini (2010), Global Science Books, ISSN 1752-3389.
2. Medicinal Plants of Health and Wealth, by S.N.Das Agrotech Pblications, ISBN 9788183210232.
3. Fundamentals of Pharmacognosy and Phytotherapy; by Michael Heinrich, Joanne Barnes, Simon Gibbons and Elizabeth M Williamson (2012), Elsevier Ltd ISBN: 978-0-7020-3388-9.
4. Pharmacognosy; Trease and Evans. 16th Edition, 2009, Published by ELBS, London ISBN 978-0702029332
5. Medicinal Plants of Uttarakhand by C.P. Kala (2010).
6. Indian Medicinal Plants by P.C. Trivedi (2009).
7. Hand Book of Aromatic Plants by S.K. Bhattacharjee (2004).
8. Herbal therapy for human diseases: Irfan Ali Khan and Atiya Khanum (2007), Ukaaz publications ISBN: 81-88279-43-9.
9. Comprehensive pharmacy review; Leon S.Alan H. Mutnick et al; 4th edition ISBN:0-7817-2147-4.
10. Natural Medicines Comprehensive Database ([www.naturaldatabase.com](http://www.naturaldatabase.com)).



# **DEPARTMENT OF BIORESOURCES**

**SCHOOL OF BIOLOGICAL SCIENCES**

**UNIVERSITY OF KASHMIR, SRINAGAR**

**NAAC Accredited "A<sup>+</sup>"**

**Coordinator/Head**

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No.F(PG Syllabus- NEP) BIORES/KU/2024

Dated:- 10-07-2024

## **PG syllabi as per NEP 2020**

Department of Bioresources prescribed /designed the following courses as per NEP 2020 which includes skill based and innovative along with the minutes of Board of studies are attached below.

Sd/-

**Coordinator/Head**

Department of Bioresources



UNIVERSITY OF KASHMIR  
NAAC Accredited Grade A\*

DEPARTMENT OF BIORESOURCES

SCHOOL OF BIOLOGICAL SCIENCES

NOTES:

Minutes of the meeting of the Board of Postgraduate Studies in  
Bioresources held on 23-08-2022.

In order to finalize the already approved syllabus of PG Bioresources by Board of Studies members meeting. To do the required changes in order to make it synchronization with NEP-2020, a meeting of Board of Postgraduate Studies in Bioresources authorized by the academic section, University of Kashmir was convened on 23-08-2022 in the Department of Bioresources. The following members attended the meeting.

1.	Prof A. H. Wani Department of Botany	
2.	Dr. Manzoor Ahmad Mir Coordinator Sr. Assistant Professor Bioresources	
3.	Prof. Syed Tanveera Department of Zoology	
4.	Dr. Hidayatullah Tak Department of Zoology	
5.	Dr Mohd Yaqoob Associate Professor Botany	
6.	Prof. Ehtisham Ul Haq Department of Biotechnology	
7.	Dr Abid Hamid Dar Associate Professor, Biotechnology Central University of Kashmir	
8.	Dr. Reiaz Ul Rehman Assistant Professor Bioresources	
9.	Dr Mudasir Andrabi Animal Biotechnology, SKUAST-K Shuhama	
10.	Dr Riffat John Sr. Assistant Professor Botany	
11.	Dr Zahoor Ahmad Parry Scientist-E2, IIM Sanat agar Srinagar	
12.	Dr. Showkat Ahmad Ganaie Department of Clinical Biochemistry	
13.	Mr. Sheikh Tajamul Islam Assistant Professor Bioresources	
14.	Dr. Bilal Ahmad Bhat Department of Zoology	
15.	Dr Sheikh Tanveer Salam Assistant Professor Zoology, Govt Degree College, Gbl.	
16.	Dr. Basharat Amar Singh College Srinagar	
17.	Miss Hina Qayoom Research Scholar, Bioresources, University of Kashmir.	
18.	Mr Adil Rasool Research Scholar, Bioresources, University of Kashmir.	

The members discussed and reviewed the contents of the syllabi at length and after threadbare discussion finally granted approval for the revised P.G Syllabus as per NEP-2020 policy operative at Undergraduate level for Bioresources and Allied subjects. The members realized that since Bioresources Programme is multidisciplinary in nature and as such can provide opportunity to the students from various Allied subjects interested to pursue M.Sc in Bioresources

The meeting ended with the vote of thanks to the chair.

Coordinator Bioresources



**DEPARTMENT OF BIORESOURCES**  
**School of Biological Sciences**  
**UNIVERSITY OF KASHMIR**

NAACAaccredited Grade — `A+'  
Hazratbal, Srinagar - 190006

**MODIFIED CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME**  
**TO BE IMPLEMENTED FROM ACADEMIC SESSION 2023 AND ONWARDS**

Revised syllabi for M.Sc Bioresources as per the Modified Choice Based Credit System (CBCS) Scheme adopted by the University for Implementation at Post-Graduate level from the academic session 2023 and onwards is as under:

**Core Courses (CR):** There are 4 Core Courses per semester i.e 16 courses for 4 semesters. There are three 4 credit courses and one 2 credit course per semester. A student has to obtain 14 credits from CR Courses per semester.

**Discipline Centric Elective Courses (DCE):** There are 08 Discipline Centric Elective Courses, each having 4 credits and Project Work of 4 credits. **Project Work** is to be taken by the students in 4<sup>th</sup> semester. A student has to obtain 8 credits per semester from DCE Courses.

**The CR Courses and DCE Courses are exclusively meant for the Department's own students.**

**Generic Elective Courses (GE):** There are 8 GE Courses, each course having 2 credits.

A student has to obtain minimum of 4 credits from GE courses and can obtain maximum of 8 credits from GE courses.

**Open Elective Courses (OE):** There are 4 OE Courses, each course having 2 credits.

A student can obtain maximum of 4 credits from OE Courses

**To obtain M.Sc degree in Bioresources a student has to obtain 96 credits i.e 56 credits from Core and 32 credits from DCE and 8 credits from GE/OE Courses in 4 semesters.**

The Course Structure and credit break up has been given in tabulated form.

One credit means one hour of teaching/ tutorial or two hours of practical work/field work per week, for 16 weeks in a semester equivalent to 90 actual teaching days.

**Abbreviations**

<b>L</b>	<b>Lecture</b>
<b>T</b>	<b>Tutorial</b>
<b>P</b>	<b>Practical</b>
<b>CR</b>	<b>Core Course</b>
<b>DCE</b>	<b>Discipline Centric Elective</b>
<b>GE</b>	<b>Generic Elective</b>
<b>OE</b>	<b>Open Elective</b>





**DEPARTMENT OF BIORESOURCES**

**School of Biological Sciences**

**UNIVERSITY OF KASHMIR**

NAAC Accredited Grade — 'A+'

Hazratbal, Srinagar - 190006

**MODIFIED CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME AND COURSE STRUCTURE**

**TO BE IMPLEMENTED FROM ACADEMIC SESSION 2022 AND ONWARDS**

<b>SEMESTER I</b>						
<b>Course Code</b>	<b>Course Name</b>	<b>Paper Category</b>	<b>Hours per week</b>			<b>Credits</b>
			<b>L</b>	<b>T</b>	<b>P</b>	
<b>BR23101CR</b>	Plant Resources	Core	4	0	0	4
<b>BR23102CR</b>	Animal Resources	Core	4	0	0	4
<b>BR23103CR</b>	Biodiversity and Bioresources	Core	4	0	0	4
<b>BR23104CR</b>	Lab Course I (Based on BR23101CR, BR23102CR, BR23103CR)	Core	0	0	4	2
<b>BR23105DCE</b>	Cellular & Molecular Biology	Discipline Centric Elective	3	0	2	4
<b>BR23106DCE</b>	Immunology and Drug targeting	Discipline Centric Elective	3	0	2	4

## SEMESTER I

Course No.: BR23101CR

Total Credits: 4 (4 L + 0 T + 0 P)

Course Title: Plant Resources

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)

**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 heterophyllum*, *Atropa acuminata*, *Podophyllum hexandrum*, *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](https://onlinecourses.swayam2.ac.in/cec19_bt10/preview)



## SEMESTER I

**Course No.: BR23102CR**

**Total Credits: 4 (4 L + 0 T + 0 P)**

**Course Title: Animal Resources**

**Maximum Marks: 100 (20 + 80)**

### Learning objectives

- To familiarize the students with entrepreneurial opportunities in entomology, Dairy farming, pisciculture 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 (Entomophagy). 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.

## **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**

[www.meatscience.org](http://www.meatscience.org)

[www.amis.org](http://www.amis.org)

[www.meatami.com](http://www.meatami.com)

[www.mla.org.au](http://www.mla.org.au)

[www.FAO.org](http://www.FAO.org)

[www.agresearch.co.nz/mirinz](http://www.agresearch.co.nz/mirinz)

[www.fsis.usda.gov](http://www.fsis.usda.gov)

[www.poultryhelp.com](http://www.poultryhelp.com)

[www.nddb.org](http://www.nddb.org)

[www.ndri.res.in](http://www.ndri.res.in)

[www.amul.com](http://www.amul.com)

## **Swayam Moocs**

<https://www.classcentral.com/course/swayam-applied-entomology-17515>

<https://www.classcentral.com/course/swayam-general-sericulture-14089>

<https://www.classcentral.com/course/swayam-applied-and-economic-zoology-20222>

<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.: 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

## **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.

## 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. Gaston, K. J and Spicer, J. I. Biodiversity: An introduction. Blackwell Science, London, UK. 1998.
4. Wilson, E. O. Diversity of Life. Harvard University Press, Cambridge, MA. 1993.
5. Barthlott, W. and Winiger, W. Biodiversity. Springer-Verlag, New York. 2001.
6. Katwal and Banerjee. Biodiversity Conservation in Managed and Protected areas. Agrobios. 2002.
7. Thomas E. Lovejoy, Lee Jay Hannah. Climate Change and Biodiversity. Yale University Press. 2006.
8. Negi, S.S. Biodiversity and its conservation in India. Indus Publishing Co. New Delhi. 1993.
9. Cracknell AP, Hayes L (2009) Introduction to Remote Sensing. CRC Press, Boca Raton, USA (Special Indian Edition)
10. Gliessmann, S.R. Field and Laboratory Investigations in Agroecology. Technology & Engineering. 2006.
11. Eldredge, N. Systematics, Ecology and Biodiversity Crisis. Cambridge University Press, New York. 1992
12. Barnes, R.S.K.. Diversity of living organisms. Blackwell Sciences Ltd., U.K. 1998
13. Peter stiling, Ecology:Theories and application, PHI Learning Pvt Ltd. ISBN 978-81-203-2131-1.
14. Brewer, R. and McCann, M.T. Laboratory and field manual of ecology, Saunders College Publishing. 1982.
15. Michael, P. Ecological methods for field and laboratory investigation. Tata McGrawHill, New Delhi. 1984.

## e.resources

- <https://www.mooc-list.com/tags/biodiversity/>
- <https://www.my-mooc.com/en/mooc/biodiversity-and-global-change-science-action/>
- <https://www.my-mooc.com/en/>
- [https://onlinecourses.nptel.ac.in/noc23\\_1w06/preview](https://onlinecourses.nptel.ac.in/noc23_1w06/preview)
- [https://ugcmoocs.inflibnet.ac.in/index.php/courses/view\\_ug/205](https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/205)

## **SEMESTER I**

**Course No.: BR23104CR**

**Course Title: Lab Course I**

**Total Credits: 2 (0L + 0T + 2P)**

**Maximum Marks: 100 (20 + 80)**

### **Practical Based on BR23101CR**

1. Study various types of plant fibres.
2. Study the presence and structure of starch granules and oil bodies in various food crops.
3. Study some commonly used spices and condiments.
4. Pseudocereal- Buckwheat: Morphological features and seed structure; Test for presence of starch and proteins.
5. Study of powdered drugs – physical, chemical and microscopic examinations.
6. Quantitative microscopy of leaf drug – stomatal frequency and stomatal index,
7. Determination of palisade ratio and vein islet number.
8. Determination of water soluble and water insoluble ash from crude drugs.
9. Determination of foaming index from crude drugs

### **Practical Work Based on BR23102CR**

1. Identification of honey bee species, bee castes and special adaptations, identification and handling of bee-keeping equipments.
2. Study of life history of silk worm by rearing.
3. Preparation of permanent slides of mouth parts, spiracles and appendages of larva.
4. Identification of culturable fishes in Kashmir valley.
5. Demonstration of induced-breeding technology in cultured fishes.
6. Study of growth and age in fishes.
7. Field trips to an organised fishery, Apiary and animal breeding centre.
8. Identification of various breeds of cattle, buffalo, sheep and goat.
9. Quality analysis of honey.
10. Bacteriological examination of milk for microbial contamination.
11. Methylene Blue Reductase Test (MBRT) for determination of milk quality

### **Practical Work Based on BR23103CR**

1. Collection, description and herbarium preparation of various types of leaves, inflorescences and fruits.
2. Types of quadrats and their utility.
3. Determination of minimum size and number of quadrats for phytosociological studies.
4. Computation of frequency, density, abundance and cover of constituent species of different communities.
5. Field demonstration of Global Positioning System (GPS) and its utility in biodiversity studies.
6. Role of Herbarium and its significance in biodiversity studies.
7. Field study of various threatened endemic plants of Kashmir Himalaya
8. To prepare an inventory of economically important woody plants in KUBG.

## SEMESTER I

Course No.: BR23105DCE

Course Title: Cellular and Molecular Biology

Total Credits: 4 (4 L + 0 T + 0 P)

Maximum Marks: 100 (20 + 80)

### Learning Objectives:

1. This course aims to give the student an overview of basic cell, this module will focus on identifying key components that constitute living cells. The function and structure of each component will also be discussed.
2. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially membranes and organelles
3. Students will understand how these cellular components are used to generate and utilize energy in cells
4. Students will learn the mechanisms and regulation of genome maintenance and gene expression, emphasizing how molecular structure influences function.

### Course Outcomes:

1. The course should provide knowledge of the basic structures and cell biology-related mechanisms in a eukaryote cell. Upon successful completion of this course, students will be able to:
2. Account for the structure and function of the eukaryotic cell and its organelles.
3. Describe the structures and functions of cell organelles
4. Discuss energy transfer, enzyme function and the pathways of cellular respiration and photosynthesis.
5. Describe the eukaryotic cell cycle, mitosis and meiosis.
6. Identify DNA structure and replication, transcription, translation and gene expression.

### Unit: I

(16 lectures)

**Cell membrane and Associated elements:** Cell membrane (structure and composition), membrane rafts, membrane fluidity; Components of extracellular matrix; Cell wall structure (comparison of bacterial, plant and fungal cell wall); Cell-cell junctions; Solute transport (Passive and Active transport, Channels and Pumps); Structure and functions of cytoskeletal elements.

### Unit: II

(16 lectures)

**Cell organelles:** Structural organization of nucleus (nuclear membrane and nuclear pore complex); Mitochondria and chloroplast (structure and genome organization); Endoplasmic reticulum and golgi bodies (structure and role in protein sorting); Structure and function of Ribosomes, Lysosomes, peroxisomes, vacuoles; Vesicular transport—vesicle budding and vesicle fusion.

### Unit: III

(16 lectures)

**Nucleic acid synthesis and Regulation of Cell Cycle:** DNA replication (enzymes, mechanism of replication in prokaryotes and eukaryotes); RNA synthesis— structure of mRNA, promoters, Mechanism of transcription (prokaryotes and eukaryotes); Regulation of cell cycle— Cell cycle check points; Cyclins, CDKs, Cell Cycle inhibitors.

### Unit: IV

(16 lectures)

**Translation and Regulation of gene expression:** Genetic code, Mechanism of translation (prokaryotes and eukaryotes); Regulation of gene expression in prokaryotes— Operon model (lac operon and tryptophan operon); Regulation of gene expression in eukaryotes— promoters and enhancers, activators and repressors, Role of chromatin in regulating gene expression.

### **Suggested Readings:**

1. Cell and Molecular Biology: Concepts and Experiments by Gerald Karp and Nancy L Pruitt
2. Molecular Biology of the Cell by Bruce Alberts
3. Lewin's GENES XII by Elliott S. Goldstein, Jocelyn E. Krebbs, and Stephen T. Kilpatrick
4. The Cell: A Molecular Approach by Geoffrey M. Cooper
5. Cell Biology By David E. Sadava
6. Molecular Cell Biology by Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; Kelsey C. Martin; Michael Yaffe; Angelika Amon Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter.
7. Molecular Biology of the Cell by Daniel L. Hartl and Maryellen Ruvolo.
8. Genetics: Analysis of Genes and Genomes, Burlington, Mass.: Jones & Bartlett Learning.
9. Cell and Molecular Biology: Concepts and Experiments, Gerald Karp.
10. Molecular Biology of the Gene by James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick.
11. Biochemistry by Stryer, Lubert.

### **e-resources**

- [https://onlinecourses.nptel.ac.in/noc22\\_bt33/preview](https://onlinecourses.nptel.ac.in/noc22_bt33/preview)
- [https://onlinecourses.swayam2.ac.in/cec20\\_ma13/preview](https://onlinecourses.swayam2.ac.in/cec20_ma13/preview)
- [https://onlinecourses.swayam2.ac.in/cec19\\_bt12/preview](https://onlinecourses.swayam2.ac.in/cec19_bt12/preview)
- [https://onlinecourses.nptel.ac.in/noc22\\_bt33/preview](https://onlinecourses.nptel.ac.in/noc22_bt33/preview)

### **Practical Work based on BR23105DCE:**

1. Microscopy in study of cell structure.
2. Comparative study of Prokaryotic & eukaryotic cells and Plant & animal cell.
3. Study Membrane stability Index.
4. Centrifugation for separation of cell organelles.
5. Study of stages of Meiosis and Mitosis from permanent slides.
6. Study pollen mother cell meiosis.
7. Study meiotic stages during gamete formation in grasshopper
8. Study stages of mitosis from root tips.
9. Extraction of Nuclear DNA.
10. Extraction and estimation of proteins



## SEMESTER I

Course No.: BR23106DCE

Total Credits: 4 (4 L + 0 T + 0 P)

Course Title: Immunology and Drug Targeting

Maximum Marks: 100 (20 + 80)

### Learning objectives

- Advanced knowledge of principle functions of the mammalian immune system.
- Identify the various classifications of drug products.
- Understand the basic concepts of new drug development with emphasis on design and conduct of clinical trials and interpretation of their results.

### Learning Outcome

- Understanding of the interaction of the innate and adaptive immune system in defending pathogenic microorganisms.
- Insights into the origin of immune pathological processes as well as into therapeutical strategies for their treatment. Insights into basic immunological techniques.
- Use antimicrobials judiciously for therapy and prophylaxis.

### Unit: I

(16 lectures)

**Introduction to immunology:** History and timeline of immunology related developments. Brief overview of Pioneering Immunologists; Immune system as defense mechanism; Overview of Infections and Diseases, organs of Immune system (Primary and secondary lymphoid organs), Cells of immune system, Lymphocytes (T-cells and B-cells). Antigen presenting cells and their types.

### Unit: II

(16 lectures)

**Immunity and its types:** Natural Immunity (Physiological, anatomical and cellular barriers to infections), Cells and factors of natural immunity, Mechanism of Innate immunity, Phagocytosis, Acquired Immunity as second line of defense, Characteristics of Acquired immunity, PAMPS, PRRs and TLRs. Types and characteristics of TLRs.

### Unit: III

(16 lectures)

**Drugs and their mode of action:-** Introduction to drugs, Structure, Chemical and Biological properties of some important drugs. Anticancer drugs (Vincristine, Vinblastine, Doxorubicin, Adipiline). Drug discovery, Relation of Drug structure and its chemical and biological properties, Structure, activity; Drug targets: Classification, structure, drug-receptor interaction (G-protein, Ion channels and Ion channel linked receptors, nuclear receptors).

### Unit: IV

(16 lectures)

**Drug Simulation:-** Computer-aided drug designing, selection of targets, Docking and Molecular Docking Simulations. Antimicrobial drugs: Antibacterials: Discovery and development of Penicillin's, Tetracyclins, Antiviral agents and Anti-cancerous drugs; Drug repurposing: progress, challenges and recommendations

### **Suggested Readings**

1. Cellular and Molecular Immunology: 7th Updated Edition by Abul K. Abbas Andrew H. Lichtman & Shiv Pillai.
2. Veterinary Immunology: 7th Edition by Ian R Tizard.
3. Delves P, Martin S, Burton D, Roitt IM 2011 Roitt's Essential Immunology. 12th Ed. Wiley-Blackwell Scientific Publication, Oxford.
4. Pharmacology for Technicians: 6th edition, Ballington, Laughlin, and McKennon- Paradigm, 2017 – EVC Book Store
5. An Introduction to Mechanisms in Pharmacology and Therapeutics, Howard Rogers and Roy Spector publisher Elsevier.
6. Kuby Immunology by Jenni Punt, Sharon Stranford, Patricia Jones, Judith A Owen.

### **e-Resources**

<https://bmcbiol.biomedcentral.com/articles/10.1186/1741-7007-9-71>

<https://www.careers360.com/university/indian-institute-of-science-education-and-research-pune/medicinal-chemistry-certification-course>

### **Swayam Moocs**

[https://onlinecourses.swayam2.ac.in/cec20\\_bt05/preview](https://onlinecourses.swayam2.ac.in/cec20_bt05/preview)

[https://onlinecourses.nptel.ac.in/noc20\\_bt43/preview](https://onlinecourses.nptel.ac.in/noc20_bt43/preview)

<https://www.classcentral.com/course/swayam-immunology-14117>

### **Practical Work BR23106DCE:**

1. Determination of the bleeding time and TLC and DLC of human blood.
2. Permanent mount preparation of parasitic Protozoa.
3. Study the differential morphology of human leucocytes.
4. Study the cell count using a haemocytometer.
5. Demonstration of phagocytosis.
6. Demonstration of Hemagglutination.
7. MTT and Tryphon blue tests for viability of cells.
8. Demonstration of ELISA.
9. Determination of Blood grouping.
10. Drug efficacy assays



**DEPARTMENT OF BIORESOURCES**

**School of Biological Sciences**

**UNIVERSITY OF KASHMIR**

**MODIFIED CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME**

**TO BE IMPLEMENTED FROM ACADEMIC SESSION 2023 AND ONWARDS**

<b>SEMESTER II</b>						
<b>Course Code</b>	<b>Course Name</b>	<b>Paper Category</b>	<b>Hours per week</b>			<b>Credits</b>
			<b>L</b>	<b>T</b>	<b>P</b>	
<b>BR23201CR</b>	Plant Resource Regeneration	Core	4	0	0	4
<b>BR23202CR</b>	Animal Resource Regeneration	Core	4	0	0	4
<b>BR23203CR</b>	Bioenergy and Biofuels	Core	4	0	0	4
<b>BR23204CR</b>	Lab Course II (Based on BR23201CR, BR23202CR, BR23203CR)	Core	0	0	4	2
<b>BR23205DCE</b>	Inheritance Biology	Discipline Centric Elective	3	0	2	4
<b>BR23206DCE</b>	Biofertilizers & Biopesticides	Discipline Centric Elective	3	0	2	4

## SEMESTER II

**Course No.: BR23201CR**

**Total Credits: 4 (4 L + 0 T + 0 P)**

**Course Title: Plant Resources Regeneration**

**Maximum Marks: 100 (20 + 80)**

**Course Description:-**This course aims at making students acquainted with the fundamentals of regeneration in plants. The present understanding of the mechanisms associated with development, differentiation, structure, modes of reproduction and the metabolic, physiological and molecular changes occurring in them.

### LEARNING OBJECTIVES:

- Learning the basics of reproduction in plants (both sexual and asexual), structure and function of reproductive organs with emphasis on pollination and fertilization. The importance of reproduction and utility of various anomalies for crop improvement strategies.
- It also aims at the concept, scope, and various types of plant tissue cultures. It emphasized on the instrumentation, basic requirements and applied aspects of plant tissue culture.

### LEARNING OUTCOMES:

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

- Understand growth, development and reproduction in plants.
- Understand the basics of plant tissue culture and apply the technical skills for mass propagation, conservation and product development from variety of plants (normal and endangered).

#### Unit:I

(16 lectures)

**Asexual reproduction in plants:** Types of vegetative propagation; Importance of vegetative reproduction; Apomixes (adventive embryony, apospory, apogamy, parthenocarpy). Floral evocation-- Transition to flowering (Endogenous factors-circadian Rhythms, Phase Change and hormones, external factors-Photoperiod and temperature); Floral organ development in *Arabidopsis* and *Antirrhinum*.

#### Unit:II

(16 lectures)

**Sexual reproduction in angiosperms:** Structure and development of anther; Role of tapetum; Structure and development of male gametophyte; Female gametophyte; Structure, development and types of ovules; Structure and development of female gametophyte; Types of embryo sacs in angiosperms, Nutrition of embryo sac.

### Unit:III

(16 lectures)

**Pollination and fertilization:** Pollination mechanisms and vectors; Double fertilization; Endosperm development, types of endosperm; Embryogenesis (monocot and dicot embryos); Fruit development; Seed dispersal; Self incompatibly, molecular basis of self-incompatibility; Male sterility and pollen viability.

### Unit:IV

(16 lectures)

**In-vitro regeneration:** Cellular totipotency (organogenesis, somatic embryogenesis), Tissue culture media, callus and suspension culture; Single cell clones; Somaclonal variation; clonal propagation and virus free plants; Hardening of *in vitro* plants; Embryo culture; Embryo rescue; Cryopreservation (synthetic seeds, germplasm conservation); Production of haploids (anther and ovule culture); protoplast culture, somatic hybrids or cybrids;

### Suggested Readings:

- Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
- Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer -Verlag, New York.
- Howell, S.H. 1998, Molecular Genetics of Plant Development. Cambridge University Press, Cambridge.
- Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
- Fosket, D.E. 1994. Plant Growth and Development. A molecular Approach. Academic Press, San Diego.
- Raven, P.H., Evert, R.F. and Eichhorn, S.E. 1992. Biology of Plants (5th Edition).worth, New York.
- Harder LD & Barrett SCH (2006) Ecology and Evolution of Flowers, Oxford Univ. Press.
- Proctor, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London.
- Barrett SCH (2008) Major Evolutionary Transitions in Flowering Plant Reproduction. Univ.of Chicago Press.
- Dodds. J.H and L.N. Roberrtis (1985) Experiments in plant tissue culture, Cambridge University Press New York. –
- Kalyan Kumar D.E.1992. Plant tissue culture, Agrobios, New Delhi.
- Narayanaswamy, S. 1994. Plant cell and tissue culture. Tata McGraw Hill Publishing company, Ltd. New Delhi.
- Purohit, S.S and S.K. Mathur, 1993. Fundamentals of Biotechnology. Agrobotanical publishers, India.

### Web sources

- [https://onlinecourses.swayam2.ac.in/cec21\\_bt22/preview](https://onlinecourses.swayam2.ac.in/cec21_bt22/preview)
- [https://onlinecourses.nptel.ac.in/noc19\\_bt17/preview](https://onlinecourses.nptel.ac.in/noc19_bt17/preview)
- [https://onlinecourses.swayam2.ac.in/cec22\\_bt04/preview](https://onlinecourses.swayam2.ac.in/cec22_bt04/preview)
- <https://nptel.ac.in/courses/102103016>

## **SEMESTER II**

**Course No.: BR23202CR**

**Total Credits: 4 (4 L + 0 T + 0 P)**

**Course Title: Animal Resource Regeneration**

**Maximum Marks: 100 (20 + 80)**

### **Learning Objectives:**

This course will introduce students to the molecular and cellular mechanisms that underlie the early development of organisms.

The focus will be on the genes and proteins involved in controlling the behavior of cells in the processes of differentiation, morphogenesis and growth.

Developmental mechanisms and processes will be examined in genetic model organisms

### **Learning Outcomes:**

Students who successfully complete the course will be able to:

- Name, describe and order the main stages of development common to most multicellular organisms.
- Describe the main anatomical changes that occur during development.
- Identify the cellular behaviors that lead to morphological change during development.
- Understand how gene activation plays a role in differentiation and development.
- Describe the main signaling pathways that play important roles in development.

### **Unit: I**

**(16 lectures)**

Principles of animal development: Basic concepts of development (potency, and commitment), specification and its types; induction, competence, determination, and differentiation; Cytoplasmic determinants; Morphogenetic gradients; Cell fate and cell lineages; Model organisms in development (Introduction); Stem cells (Introduction).

### **Unit: II**

**(16 lectures)**

Early embryonic development: Role of hormones in embryonic development. Gametogenesis (Production of male and female gametes) Spermatogenesis and Oogenesis; Types of eggs, Fertilization and Zygote formation, Mechanism of cleavage; Blastula formation and implantation; Placenta and its types; Gastrulation and formation of germ layers. Fat maps of germinal layers, Extra embryonic membranes.

**Unit: III****(16 lectures)**

Morphogenesis and organogenesis: Morphogenetic movements; Axis and pattern formation in *Drosophila* and amphibia; Organogenesis—vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrate, Specification of limb identity and limb axis. Role of Bone morphogenetic proteins (BMP) and HOX genes in limb development.

**Unit: IV****(16 lectures)**

Hormones in Reproduction: Hormonal control of pregnancy, parturition and Lactation. Ovarian cycles (Oestrus and Menstrual cycle) and ovarian hormones. Female infertility (Ovarian abnormalities). Male reproductive hormones and their function: Abnormalities of the male sexual function (Prostrate, hypogonadism).

**Suggested readings:**

1. Developmental Biology (9th or later editions) by Scott Gilbert
2. Instant Notes in Developmental Biology By Dr Richard Twyman
3. Life\_The\_Science\_Of\_Biology\_by David\_Sadava,\_William\_K\_Purves,\_Craig\_Heller,\_Gordon\_H\_Orians
4. Principles of Developmental Biology by Fred Huffman Wilt and Sarah Hake

**Course Links:**

[https://onlinecourses.nptel.ac.in/noc20\\_bt35/preview](https://onlinecourses.nptel.ac.in/noc20_bt35/preview)

<https://www.youtube.com/watch?v=CAPjx4etS1g>

[https://www.youtube.com/watch?v=Zd5-7\\_Ydn08](https://www.youtube.com/watch?v=Zd5-7_Ydn08)

<https://www.youtube.com/watch?v=dTjK9e6MvXw>

## 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 provides knowledge 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);



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; Jatropha, 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. Prabir Basu, Biomass Gasification and Pyrolysis - Practical Design and Theory Academic Press, 2010.
5. Vijayalakshmi, Meena Devi, Nagendra Prasad, Fuels and Biofuels Agrobios, 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.

## **SEMESTER II**

**Course No.: BR23204CR**

**Total Credits: 2 (L + 0 T + 2P)**

**Course Title: Lab Course II**

**Maximum Marks: 100 (20 + 80)**

**(Based on BR23201CR, BR23202CR, BR23203CR)**

### **Practical Work Based on BR23201CR**

- Study the types of placentation.
- Study the types and structure of ovule in angiosperms.
- Study the pollen mother cell meiosis.
- Study the structure of dicot and monocot embryos.
- Test for seed and pollen viability.
- Study the *in vitro* pollen germination.
- Preparation of tissue culture media
- Preparation of Explant and their inoculation

### **Practical Work Based on BR23202CR**

- Permanent slides of mammalian gametes.
- Study the various stages of chick embryo (24 h, 48 h, 72 h and 96 h).
- Comparative estimation of soluble and structural proteins in embryonic and extra embryonic layers of different stages (48, 72, and 96 hours) of development in chick.
- Study the meiosis in grasshopper.
- Study the bar body in buccal swab/drumstick in neutrophil.

### **Practical Work Based on BR23203CR**

- Determination of saponification value of fat/oil.
- Preparation of biodiesel from various oils.
- Comparison of time of flow and density of biodiesel and vegetable oils.
- Determination of iodine number of oil/fat and biodiesel.
- Study of some important algal sources of biofuel.
- Study the importance of jatropha, maize and sugarcane as major bioenergy crops.
- Demonstrate the fermentation process for ethanol production.

## SEMESTER II

Course No.: BR23205DCE

Total Credits: 4 (4 L + 0 T + 0 P)

Course Title: Inheritance Biology

Maximum Marks: 100 (20 + 80)

### Course objective

Describe the basic principles of inheritance at the molecular, cellular, organismal, and population levels. Students will have the Concept building of mendelian Inheritance, Mendelian disorders in Humans. Presents the fundamentals of human genetics. Includes physical basis of inheritance, the mechanics of inheritance, probability, sex chromosomal abnormalities, autosomal anomalies, gene structure and function

### Course learning outcomes

1. Explain the basic principles of how genetic material is arranged and transmitted
2. Describe how a change in genetic material influences function
3. Apply knowledge of genetic material to its manipulation
4. The ability to evaluate conclusions that are based on genetic data.

### Unit: I

(16 lectures)

**Mendalism and its extension:** Dominance, segregation and independent assortment; Codominance, Incomplete dominance; Gene interaction— epistasis and pleiotropy; Multiple alleles, Pseudo alleles, Complementation test; Penetrance and expressivity; Inheritance of mitochondrial and chloroplast genes; Maternal inheritance; Mechanism of sex determination.

### Unit: II

(16 lectures)

**Recombination and Mapping:** Homologous and non-homologous recombination; Linkage, linkage maps (2 point & 3 point cross); tetrad analysis; Lod score for linkage testing; Gene mapping by transduction and Conjugation and somatic cell hybrids; Fine structure of gene (rII locus).

### Unit: III

(16 lectures)

**Mutations:** Spontaneous and induced mutations, Mutagens (chemical and physical), molecular mechanism of mutations; Suppressor, missense, nonsense, lethal mutations, conditional, loss of function,

gain of function, germinal versus somatic mutants and silent mutations and their genetic implications. Structural and numerical alterations of chromosomes— Deletion, duplication, inversion, translocation, polyploidy and their genetic implications. Gene therapy - somatic and germline Somatic (SCID).

#### Unit: IV

(16 lectures)

**Human and population genetics:** Pedigree analysis (sex-linked, autosomal and mitochondrial traits); Genetic disorders (Klinefelter -, Turner-, Patau-, Down- & Edward's syndrome). Sex-linked, sex-limited and sex influenced inheritance; Gene pool; Hardy-Weinberg principle, factors affecting Hardy- Weinberg equilibrium (natural selection, migration and genetic drift); Molecular divergence and molecular clocks.

#### Practical Work:

- Karyotype study of mammals using permanent slides.
- Karyotype analysis and development of karyogram
- Construction of Linkage maps from given data.
- Study sex chromatin in somatic cells (Barr body).
- Study of giant chromosomes (polytene chromosomes and lampbrush chromosomes).
- Determining allele frequencies using *Hardy-Weinberg principle*.
- Use  $\chi^2$  test to compare obtained phenotype ratio in F2 generation with expected ratio.
- Study cases of aneuploidy and polyploidy.

#### Suggested readings

1. Genetics: Analysis & Principles, By Robert J. Brooker.
2. Genetic: A Conceptual Approach, By Benjamin Pierce
3. Abc of Clinical Genetics By Helen M Kingstons
4. Principles Of Genetics By D. Peter Snustad And Michael J. Simmons
5. Life\_The\_Science\_Of\_Biology\_By  
David\_Sadava,\_William\_K\_Purves,\_Craig\_Heller,\_Gordon\_H\_Orians

#### Course Links:

[https://onlinecourses.swyam2.ac.in/cec21\\_bt05/preview?](https://onlinecourses.swyam2.ac.in/cec21_bt05/preview?)

[https://onlinecourses.swyam2.ac.in/cec22\\_bt05/preview?](https://onlinecourses.swyam2.ac.in/cec22_bt05/preview?)

<https://www.classcentral.com/course/swyam-principles-of-genetics-23082>

<https://www.youtube.com/watch?v=unI9rHr8vqM>

[https://onlinecourses.nptel.ac.in/noc21\\_bt02/preview](https://onlinecourses.nptel.ac.in/noc21_bt02/preview)

## 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;

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.

#### Web Sources

- <https://www.classcentral.com/course/swayam-plant-pathology-and-soil-health-14236>
- [https://onlinecourses.swayam2.ac.in/cec21\\_ag03/preview](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.



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<b>SEMESTER III</b>						
<b>Course Code</b>	<b>Course Name</b>	<b>Paper Category</b>	<b>Hours per week</b>			<b>Credits</b>
			<b>L</b>	<b>T</b>	<b>P</b>	
<b>BR23301CR</b>	Biomolecules	Core	4	0	0	4
<b>BR23302CR</b>	Secondary Metabolites	Core	4	0	0	4
<b>BR23303CR</b>	Biostatistics & Biotechniques	Core	4	0	0	4
<b>BR23304CR</b>	Lab Course III (Based on BR23301CR, BR23302CR, BR23303CR)	Core	0	0	4	2
<b>BR23305DCE</b>	Biological Interactions	Discipline Centric Elective	3	0	2	4
<b>BR23306DCE</b>	Wood Resource Utilization	Discipline Centric Elective	3	0	2	4
<b>BR23307DCE</b>	Cellular and Molecular Immunology	Discipline Centric Elective	3	0	2	4

## Semester III

**Course No.: BR23301CR**

**Course Title: Biomolecules**

**Total Credits: 4 (4 L + 0 T + 0 P)**

**Maximum Marks: 100 (20 + 80)**

**Course Description:** The course “Biomolecules” deals with the classification, structure, isomerism and role of major biomolecules. It provides know how about the spontaneity and catalysis of biochemical reaction and the classification, mechanism of action and regulation of enzyme action. It gives idea about the importance of water, pH and buffer systems in biology. It also deals with structure and packaging of genetic material, its defects and repair.

### Learning Objectives

1. To study the basic diversity in biomolecules and biological importance of water, pH and buffers.
2. To discuss about the classification, structure and isomerism in carbohydrates, lipids and their biological role.
3. To study about the classification and structure of amino acids and proteins, protein folding.
4. To study about the types of DNA, its damage and repair, packaging of genetic material and RNA splicing.

### Learning Outcomes

1. To acquaint students with the understanding of basic structural properties of biomolecules, the importance of properties of water as solvent, reactant, thermal buffer and as a medium of life
2. To acquaint students with the structural diversity and role of lipids and carbohydrates as structural elements, as energy substrate, signaling and other related processes.
3. To understand various levels of proteins structure and their role as structural elements, enzymes and in other processes. Also, understand importance of catalysis and regulation of enzyme action in maintaining cellular processes.
4. To understand variation in forms of nucleic acids, their importance and the importance of folding genetic material and processing of nucleic acids in general.



**Unit: I****(16 Lectures)**

**Basic in biomolecules and Water:** Biomolecules— functional groups in biomolecules; Spontaneity of biochemical reactions (Free energy change, enthalpy and entropy); Role of water in the biological systems; Water as a solvent; Colligative Properties; pH and Buffer systems and their importance in biological systems

**Unit: II****(16 Lectures)**

**Carbohydrates and Lipids:** Classification of Carbohydrates; Isomerism in monosaccharides; Chemical reactions of monosaccharides and their derivatives; Oligosaccharides- Maltose, Lactose, Sucrose and Trehalose (structure and importance); Polysaccharides—Structure of Starch, glycogen, cellulose, hemicelluloses; Classification of lipids; Properties of triacylglycerols; Functions of triacylglycerols, phospholipids, glycolipids, sphingolipids and cholesterol.

**Unit: III****(16 Lectures)**

**Proteins and Enzymes:** Structure and classification of amino acids; Properties of amino acids; Protein structure (Primary secondary and tertiary structure); Fibrous and globular proteins ( $\alpha$ -keratin, collagen, hemoglobin); Enzymes— Classification, Mechanism of enzyme action; Kinetics of single substrate enzyme-catalyzed reactions (Michaelis-Menton equation); Enzyme inhibition and allosteric regulation.

**Unit: IV****(16 Lectures)**

**Nucleic acids:** Structure of DNA double helix, Forms of DNA (A, B, Z and H DNA); Packaging of genetic material (Nucleosome model- chromosome level); Euchromatin and heterochromatin; C value Paradox; Cot value of DNA; DNA damage and repair mechanisms; RNA splicing; Transposable elements (Examples bacteria and maize).

**Suggested Readings:**

1. D. L. Nelson and M.M. Cox. Lehninger Principles of Biochemistry. W.H. Freeman.
2. Donald Voet, Judith G. Voet, Charlotte W. Pratt, Fundamentals of Biochemistry: Life at the Molecular Level.
3. Lubert Stryer; Jeremy Berg; John Tymoczko; Gregory Gatto, Biochemistry,

4. U. Satyanarayana, U. Chakrapani. Biochemistry. Elsevier, 2021.
5. Ferrier Denise R. Lippincott's Illustrated Reviews Biochemistry. CCH, a Wolters Kluwer Business. 2013
6. S. P. Singh. Textbook of Biochemistry. CBS Publication. 2015.
7. J. L. Jain, Sunjay Jain and Nitin Jain. Fundamentals of Biochemistry, S. Chand.
8. Prasad Manjeshwar. Biochemistry Simplified. Textbook of Biochemistry. Zain Books. 2018.
9. PankajaNaik. Essentials of Biochemistry. Jaypee Brothers Medical Publishers (P) Ltd. 2016.
10. Trevor Palmer and Philip Bonner. Enzymes: Biochemistry, Biotechnology, and Clinical Chemistry. Wiley. 2008.
11. Gerald Karp, Janet Iwasa, Wallace Marshall Karp. Cell and Molecular Biology.
12. Krebs, Jocelyn E., Goldstein, Elliott S., Kilpatrick, Stephen T. Lewin's genes XII. Jones & Bartlett Learning, LLC. 2018.
13. Gupta. P.K. Cell and Molecular biology. Rastogi Publications, India. 2005.
14. Rastogi, S.C. Cell and Molecular Biology. New age International Publishers, India. 2012.

## Semester III

Course No.: BR23303CR

Course Title: Secondary Metabolites

Total Credits: 4 (4 L + 0 T + 0 P)

Maximum Marks: 100 (20 + 80)

**Course Description** This course aims at educating student about the various metabolic processes/pathways leading to the formation of important molecules. It focuses upon the vital roles played by these molecules in plant growth, development and adaptations. The course provides the student with:

### LEARNING OBJECTIVES:

- Knowledge on the biogenesis and chemical structure of the bioactive secondary metabolites and their therapeutic potential.
- Awareness on the potential of biotechnology in the commercial exploitation of these compounds
- Understanding on the eco-physiological role of such metabolites in the plants
- Learning the importance of secondary metabolites for the human welfare

### LEARNING OUTCOMES:

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

- Enrich themselves with the phenomenon of metabolism of primary and secondary metabolites and their role in plants.
- Conceptualize and realize about the economic potential of secondary metabolites

### Unit:I

(16 Lectures)

**Phenolic compounds and Terpenoids:** Introduction, occurrence, structure, classification and Biogenesis of phenolic compounds; Shikimic acid pathway for synthesis of phenolic compounds (Cinnamic acid, Lignans and lignins, coumarins, flavonoids, isflavonoids and quinones); Terpenoids (Isoprenoids)-Introduction, occurrence, structure and biogenesis of terpenoids; Classification based on isoprene rule (mono, sesqui, di and triterpinoids);

**Unit:II****(16 Lectures)**

**Alkaloids and Steroids:** Alkaloids-Introduction, occurrence, classification based on nitrogen heterocyclic ring; Use of alkaloids by humans from historical perspective; Nomenclature (true, proto and pseudo-alkaloids); Alkaloids derived from ornithine, lysine, nicotinic acid, tyrosine and tryptophan; Steroids-Introduction, types, occurrence and structure.

**Unit:III****(16 Lectures)**

**Plant pigments:** Classification; Chlorophyll—structure, biosynthesis and properties; Carotenoids—structure, occurrence and biological function of carotenes and xanthophylls; Flavonoids—structure, occurrence and biological function of anthocyanins; Indole derivatives—structure, occurrence and function (betalains).

**Unit:IV****(16 Lectures)**

**Importance of secondary metabolites:** Perspectives in human welfare (fragrance, flavor, pigments, medicine); Effect of biotic and abiotic stresses on secondary metabolites in plants; Allelopathic effects of secondary metabolites; Taxonomic significance of secondary metabolites, Bioreactors- Types and application, culture immobilization, elicitation and permeation.

**Suggested Readings**

- **Shukla, Jitendra, Dhruve (2009).** Plant Secondary Metabolites, **Publisher:** NIPA, ISBN: 9788190851220.
- David S. Seigler. Plant secondary metabolism (1<sup>st</sup> edition).**Publisher:** Springer, ISBN: 9780412019814.
- Lincoln Taiz, Eduardo Zeiger, Ian M. Moller & Angus Murphy. Plant Physiology & Development (6<sup>th</sup> edition). **Publisher:** Oxford University Press, ISBN: 9781605357454.
- William G. Hopkins, Norman P. A. Hüner. Introduction to Plant Physiology (4<sup>th</sup> edition). **Publisher:** Wiley, ISBN: 9780470461426.
- Michael Wink. Annual Plant Reviews: Biochemistry of Plant Secondary Metabolism (2<sup>nd</sup> edition). **Publisher:** Wiley-Blackwell, ISBN: 9781405183970.
- Voet and Voet, 1992. Biochemistry, John Wiley & Sons, Inc., New York, USA.
- Nelson DL and Cox MM. (2004) Lehninger Principles of Biochemistry, 4th Edition, W.H.Freeman and Company, New York, USA

- Bowsler et al., 2008. Plant Biochemistry, Garland Science, New York
- Mathews, Van Holde and Ahern. 2007, Biochemistry (3rd Ed), Pearson Education, Delhi
- Dey PM and Harborne JR. 2000, Plant Biochemistry, Harcourt Asia Pvt. Ltd., Singapore
- Buchanan B, Gruissem G and Jones R. (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, USA.
- Sadasivam. S. and A. Manickam: Bio Chemical methods 2nd edition. New Age International Pvt. Ltd. New delhi.
- Dennis D.T., Turpin, D.H. Lefebvre, Layzell D.D and D.B. (eds) 1997. Plant Metabolism (Second Edition) Longman, Essex, England.

**Web resources:**

- <https://www.classcentral.com/course/swayam-plant-biochemistry-and-plant-biotechnology-23080>
- <https://nptel.ac.in/courses/102103016>
- <https://www.classcentral.com/course/swayam-plant-cell-bioprocessing-14234>

## Semester III

**Course No.: BR23303CR**

**Course Title: Biostatistics and Biotechniques**

**Total Credits: 4 (4 L + 0 T + 0 P)**

**Maximum Marks: 100 (20 + 80)**

**Course Description:** The course “Biostatistics and Biotechniques” is designed to abreast students with the use of statistical tools and information Technology for learning and research in the field of biological science. It provides know about the various methods used in research design, sampling, collection and analysis of data.

### Learning Objectives

- To abreast students with basic types of data and analysis of measures of central tendency and dispersion.
- To know the methods of sampling and analysis of variance and comparison of treatments used in basic research designs.

### Learning Outcomes

- To learn methods of data collection, their limitation and basic measures of analysis.
- To learn use of various methods of sampling, application of research designs and methods of testing of significance and their limitations.
- To learn the basic use of the statistical tools for problem solving in the field of biological science.

### Unit: I

**(16 Lectures)**

**Measures of central tendency and dispersion and Tests of Significance:** Data on ratio, interval, ordinal and nominal scales; Primary data and secondary data— their limitations; Mean, mode, median; Mean deviation, variance, standard deviation, coefficient of variation; Hypothesis testing (t-Test, F- test and Chi Square test).

### Unit: II

**(16 Lectures)**

**Sampling techniques and Experimental designs:** Simple, systematic, stratified and cluster random sampling; Principles of experimentation; Layout, and analysis of variance in completely randomised design and randomised complete block design; Simple linear correlation; Simple linear regression.

### Unit: III

**(16 Lectures)**

**Microscopy and spectroscopy:** Principle, working & application of fluorescence, phase contrast, scanning electron and transmission electron microscopy; Concept and application of UV-visible,

and NMR spectroscopy in biology; Principle and working of a spectrophotometer; Radioisotopes— applications in biology. Centrifugation (principle and its types). Introduction to Microtome.

**Unit: IV**

**(16 Lectures)**

**Chromatography and Mass spectrometry:** Principle and applications of Paper, Thin layer, Ion exchange, adsorption and molecular exclusion chromatography, High performance liquid chromatography (HPLC); MALDI-TOF, LCMS and GCMS (Principle and Applications)

**Suggested Readings**

1. Basic Biostatistics: Statistics for Public Health Practice by B. Burt Gerstman
  2. Fundamentals of Biostatistics by Bernard Rosner.
  3. Biostatistics for the Biological and Health Sciences by Marc Triola.
  4. Principles of Biostatistics by Marcello Pagano and Kimberlee Gauvreau.
  5. Fundamentals of Biostatistics by Khan and Khanum.
  6. Principles of Gene Manipulation and Genomics, by Sandy B. Primrose, Richard Twyman
  7. Gene Cloning And DNA Analysis An Introduction By T. A Brown .
  8. Biotechniques (Theory & Practice ) Rastogi Publications by Prof. S.V.S. Rana
  9. Modern Biotechniques and Biotechnology by Gupta Neelima.
  10. Practical Techniques in Molecular Biotechnology By B.R Singh and R.Kumar
- Basic Biotechnology, Cambridge University Press by Bjorn Kristiansen, Colin Ratledge

## Semester III

Course No.: BR23304CR

Course Title: Lab Course III

Total Credits: 2 (0 L + 0 T + 2P)

Maximum Marks: 100 (20 + 80)

**BR23304CR: (Based on BR23301CR, BR23302CR, BR23303CR)**

### **Practical Work Based on BR23301CR**

1. Extraction and estimation of total titrable acidity in plant extract.
2. Effect of various physical and chemical treatments on membrane permeability.
3. Preparation of calibration graph for the estimation of starch and proteins.
4. Determination of the time course of diastase action on starch.
5. Determination of polyphenol oxidase activity.
6. Extraction of proteins from fresh material.
7. Separation of pigments from leaf extract using phase separation method.
8. Detection of presence of phenolics, alkaloids and flavonoids in plant material.
9. Preparation of calibration graph for the estimation of total phenols.
10. Estimation of free radical scavenging activity of plant extract.
11. Study the effect of pH on the anthocyanins from fruit extracts.

### **Practical Work Based on BR23302CR**

1. Extraction and estimation of total titrable acidity in plant extract.
2. Effect of various physical and chemical treatments on membrane permeability.
3. Preparation of calibration graph for the estimation of starch and proteins.
4. Determination of the time course of diastase action on starch.
5. Determination of polyphenol oxidase activity.
6. Extraction of proteins from fresh material.
7. To determine the effect of stresses on SM induction in plants.

### **Practical Work Based on BR23303CR**

- Collection of data from field and construction of frequency tables.
- Diagrammatic and graphical representation of data.
- Comparison of populations on the basis of mean value of parameters, standard deviation and standard error.
- Analysis of variance (One Way and Two Way).
- Introduction to softwares (SPSS and R package)
- Isolation of pigments using Paper and TL Chromatography
- Demonstration of HPLC (at FS&T)
- Demonstration of microscopy (Inverted and fluorescence microscopy)
- Staining methods for microscopy
- Histological studies of tissues using microtome



## Semester III

**Course No.: BR23305DCE**

**Total Credits: 4 (4 L + 0 T + 0 P)**

**Course Title: Biological Interaction**

**Maximum Marks: 100 (20 + 80)**

**Course Description** This course aims at educating student about complexities of mutualism and antagonism between plants, animals and microbes. The course focusses on the various metabolic processes, molecular mechanisms supporting those interactions. The course provides the student with:

### LEARNING OBJECTIVES:

- Knowledge on the plant communities, their stability and defense against predators, parasites and herbivores.
- Knowledge on the social and community interaction in animals, their behavior, communication, migration and navigation.
- Understanding on the molecular mechanism of signal transduction.
- Understanding the basic molecular signaling in plants and microbes including sensor/regulator system, circadian rhythms, chemotaxis and quorum sensing.

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

- Fathom the complexity of interactions amongst the organisms and the molecular mechanisms underlying the different types of interactions.
- Conceptualize and realize about the key biological aspects of interaction in plants, animals and microbes.

### Unit: I

**(16 Lectures)**

**Plant interactions:** Biotic community— structure and dynamics; Factors contributing to community stability (successional model and climax pattern model); Keystone species; Symbioses, mycorrhizal association; Plant defence and chemical warfare— plant-insect, plant-vertebrate and plant-plant interactions (brief concept); Parasitic and insectivorous plants; Pollination and seed dispersal by animals.

### Unit: II

**(16 Lectures)**

**Social and community interactions of animals:** Heritable basis of behaviour; Learned behaviour; Communication signals; Courtship, mating, parental care; Benefits and costs of living in a social group; Altruism; Migration and navigation; Factors affecting community structure— mutualism, commensalism, competitive interaction, predation, parasitic interactions; Co-evolution; Man animal conflict.

### Unit: III

(16 Lectures)

**Biosignaling-I:** Signal transduction pathways (General Features); Diversity of basic signaling cascades (brief idea) with emphasis on Protein kinases, Phosphoinositides, G- protein complex, Receptor Enzymes, Gated ion channels and Calcium mediated signaling; Secondary messengers; Cyclic Nucleotides-cAMP and cGMP mediated signaling.

### Unit: IV

(16 Lectures)

**Biosignalling-II:** Plant and microbial signaling-Two component sensor-regulator system in bacteria and plants (one example each). Ethylene perception and signaling in plants. Bacterial chemotaxis; Periplasmic sensing histidine kinases in bacteria. Quorum sensing in Gram-positive and gram-negative bacteria, Quorum sensing molecules and inhibitors in fungi.

#### Practical work:

- Field exercises to study various types of behaviour in animals
- Collection and identification of different types of insects and their larvae.
- Study of different casts in Honey bee, Ants and Termites
- Study of various types of bird nests.
- Collection of hives of different social insects (Bees and Wasps).
- Study ammensalism using bacterial cultures.
- Computation of frequency, density, abundance and cover of constituent species of different communities.
- Visit to local National park for the study of behavior in different captive and wild animals.
- Use of GPS and its use in Biodiversity studies.

#### Suggested Readings (Biological Interaction):

- Alberts, B., Bray, D., Lewis, J. Raff, M., Roberts, K. and Watson, J.D. 1989. Molecular Biology of the cell, Garland Publishing Inc., New York.
- Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publ., New Delhi. 688Pp.
- David L. Nelson; Michael M. Cox. Lehninger Principles of Biochemistry

#### Course Links:

- <https://alison.com/course/diploma-in-ecology-and-ecological-interactions>
- [https://onlinecourses.nptel.ac.in/noc21\\_ge16/preview](https://onlinecourses.nptel.ac.in/noc21_ge16/preview)

## 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.

**Unit: II****(16 Lectures)**

**Wood properties:** Physical properties of wood— Colour, luster, odour, weight, density and specific gravity; Tensile strength; Electrical, acoustical and thermal properties of wood; Wood water relationship —fibre saturation point, equilibrium moisture content; Effect of moisture loss in the dimensional stability; Chemical properties of wood— Structure & chemical properties of cellulose, hemi-cellulose, lignin; Wood extractives.

**Unit: III****(16 Lectures)**

**Wood deterioration and preservation:** Wood boring insects— termites and carpenter ants. Wood destroying fungi; Bacterial decay of wood (symptoms and causes); Heart rot in timber and its management; Natural decay resistance and natural durability; Wood preservation processes— non pressure and pressure processes; Wood seasoning, Special seasoning methods— drying by boiling in oily liquids and vacuum drying.

**Unit: IV****(16 Lectures)**

**Wood products:** Wood resources for wicker works and sports items; Plywood— Principles of manufacture, composition with regard to veneer thicknesses and species; Properties and defects of plywood; Preservative treatments of plywood; Veneer, production; Defects in peeled veneer, Laminated Veneer Lumber (LVL).

**Practical Work:**

- Herbarium collection and field identification of important wood species of Kashmir Himalayas.
- Study stem anatomy of hard and soft wood species.
- Study various types of wood elements in gymnosperms and angiosperms.
- Determine physical properties such as density moisture content and specific gravity of different wood species.
- Extraction of cellulose from a given sample of plant material.
- Visit to nearby wood processing unit, saw mill etc.
- Visit to a plywood making factory.
- Proximate analysis of various samples wood.
- Life cycle of some important insect pests of wood.

**Suggested Readings:**

1. Jeffryed, E.C., (1985): Anatomy of Woody Plants, International Books & Periodicals Supply Services, New Delhi, India.

2. Pijush Roy (2006): Plant Anatomy, New Central Book Agency(P) ltd, Kolkata-India.
3. Dinwoodie, J.M. (2000): Timber: Its Nature and Behaviour (2nd edition),E&FN Spon, London.
4. Hon, N.S.D and Shirashi, N. Wood and Cellulosic Chemistry (2nd edition), Marcel Dekkar Inc Publications, New York. 2001
5. Roger M Roswell (ed.),(2005): Hand Book of Wood Chemistry and Wood Composites, Taylor & Francis Group Publications, Florida.
6. Erosjostrom, E. (1993): Wood Chemistry Fundamental and Applications (2nd edition), Academic Press inc., California.
7. Kollmann,(1968): Principle of Wood Science and Technology I, Springer-Verlage Publications, New York.
8. Olaf Schmidt, (2006): Wood and Tree Fung- Damage, Protection &Uses, Springer Publication, Germany.
9. Goodell,B.et.al.(ed.),(2003): Deterioration Wood and Preservation – Advanced in Our Changing World, American Chemical Society, Washington.
10. John C.F. Walker,(2006): Primary Wood Processing- Principles and Practices (2nd edition), Springer Publication, Netherland.
11. Kape, W.J. (2013). An introduction to Seasoning of Timber. Pergaman Series Monographs on Furniture and Timber.
12. Nath, S.K. Plywood Manufacturing Practices in India

## SEMESTER III

Course No.: BR23307DCE

Course Title: Cellular and Molecular Immunology

Total Credits: 4 (4 L + 0 T + 0 P)

Maximum Marks: 100 (20 + 80)

### Learning objectives

To promote critical thinking among students;

- to provide students with a foundation in immunological processes.
- be able to compare and contrast humoral versus cell-mediated immune responses and be able to distinguish various cell types involved in immune responses and associated functions.
- be able to distinguish and characterize CD4+ T helper cell lineages Th1, Th2, Th17, and regulatory T cell (Treg).
- be able to distinguish and characterize antibody isotypes, development, and functions.

### Learning Outcome

- Develop basic understanding of Immune mechanisms.
- Understand the significance the Major Histocompatibility Complex in terms of immune response and transplantation.
- Understand the role of cytokines in immunity and immune cell activation; and be able to identify and characterize cytokines of particular immune importance.

### Unit: I

(16 Lectures)

**Antigen Processing And Presentation:** Inflammation and its mechanism. Phagocytosis, Cellular Receptors and their types (Toll Like Receptors, Scavenger receptor etc.); Introduction to Major Histocompatibility Complexes (MHC), Organization of MHC genes. Structure and functions of MHC molecules. Self-MHC restriction. The endogenous and exogenous pathways of antigen processing and presentation,

### Unit II:

(16 Lectures)

**Antigen, antibody and cytokines:** Definition and characteristics of an antigen molecule, Types of antigens (Super antigens, TD and TI antigens), Immunogens, Haptens, Allergens, Tolerogens,

allo-antigens, Tumor antigens, autoantigens, Antibody-Introduction, structure and function, Isoforms of antibodies, Digestion of antibodies and antibody fragments, Introduction to Cytokines and Interferon's.

### **Unit III:**

**(16 Lectures)**

**Cancer Immunology:** Introduction to cancer, its types and mechanistic features. Role of Cyclin dependent kinases (CDK's) in Cancer. Tumor Microenvironment in Cancer and its overall role in tumor progression. Host immune response to tumors; Tumor escape mechanisms; Major diagnostic techniques of cancer. Treatment of Cancer (Radiation Therapy, Chemotherapy, Combination Therapy, Cytokine based therapy, Monoclonal antibodies-based therapy and gene therapy (TNF gene, p53 gene replacement)).

### **Unit IV:**

**(16 Lectures)**

**Autoimmunity:** Theories of breakdown in self-tolerance; Classification of autoimmune diseases; Auto antibodies, Mechanism of tissue damage and clinical manifestations in selected autoimmune diseases (e.g. Rheumatoid-arthritis, Systemic Lupus Erythematosus, and Graves' disease); Genetic factors in autoimmune diseases.

### **Practical Work Based on BR23402CR**

- Preparation of culture media for animal cells by filter sterilization methods.
- Demonstration of animal cell culture
- Study the antigen-antibody reactions to determine blood groups.
- Study the differential morphology of human leucocytes.
- Study the cell count using a hemocytometer.
- Comparative studies of haemin crystal in mammals: humans, cow and goat.
- Demonstrate phagocytic activity (phagocytosis) in the insect cells.

### **Suggested Readings**

1. Freshney, R. I. (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley-Blackwell, 2010. 6th Edition.
2. Davis, J. M. (2008). Basic Cell Culture. Oxford University Press. New Delhi.
3. Davis, J. M. (2011). Animal Cell Culture. John Willy and Sons Ltd. USA.

4. Freshney R. I. (2005). Culture of Animal Cells. John Willy and Sons Ltd. USA.
5. Butler, M. (2004). Animal Cell Culture and Technology. Taylor and Francis. New York, USA
6. Bernhard O.Palsson, Sangeeta N.Bhatia, "Tissue Engineering" Pearson Publishers 2009.
7. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of Tissue Engineering and Regenerative Medicine.2009.
8. Clemens Van Blitterswijk, Jan De Boer Tissue Engineering. Elsevier Science 2014. ISBN:9780124202108, 0124202101

### **e-Resources**

<https://nptel.ac.in/courses/102104059>

<https://www.youtube.com/watch?v=o0hHD2yjiNI>

<https://www.youtube.com/watch?v=o35ZQq0Uvzs>

<https://www.youtube.com/watch?v=2v9grpx7XyQ>

### **Swayam Moocs**

<https://www.classcentral.com/course/swayam-applied-entomology-17515>

<https://www.classcentral.com/course/swayam-general-sericulture-14089>

<https://www.classcentral.com/course/swayam-applied-and-economic-zoology-20222>

<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>

<https://www.classcentral.com/course/swayam-introduction-to-poultry-farming-14160>





**DEPARTMENT OF BIORESOURCES**  
**School of Biological Sciences**  
**UNIVERSITY OF KASHMIR**  
**MODIFIED CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME**  
**TO BE IMPLEMENTED FROM ACADEMIC SESSION 2023 AND ONWARDS**

<b>SEMESTER IV</b>						
<b>CourseCode</b>	<b>CourseName</b>	<b>PaperCategory</b>	<b>Hoursperweek</b>			<b>Credits</b>
			<b>L</b>	<b>T</b>	<b>P</b>	
<b>BR23401CR</b>	Plant Resources and Biotechnology	Core	4	0	0	4
<b>BR23402CR</b>	Animal Cell and Tissue Technology	Core	4	0	0	4
<b>BR23403CR</b>	Microbial Technology	Core	4	0	0	4
<b>BR23404CR</b>	Lab Course IV (Based on BR23401CR, BR23402CR, BR23403CR)	Core	0	0	4	2
<b>BR23405DCE</b>	Bioinformatics	Discipline Centric Elective	3	0	2	4
<b>BR23406DCE</b>	Project Work	Discipline Centric Elective	-	-	-	4

**Course No.: BR23401CR**

**Course Title: Plant Resources and Biotechnology**

**Total Credits: 4 (4 L + 0 T + 0 P)**

**Maximum Marks: 100 (20 + 80)**

**Semester II: Plant Resources Regeneration BR23201CR**

**COURSE OBJECTIVES:** This course provides the students with an understanding of principles, techniques, concepts and methods associated with development and analysis of transgenic plants. This course is framed for providing a broader context about the advances in the field of recombinant DNA technology.

- Different methods used for genetic transformation of plants, use of *Agrobacterium*, biolistic gun and electroporation for plant transformation and use of different vector system.
- Various case studies related to basic and applied research in plant sciences using transgenic technology.
- Principles and methods used for phenotypic, genetic and molecular analysis of plants.

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

- Learn Basic principles and applications of recombinant DNA technology.
- Learn molecular biology skills along with usage and applications of the instrumentation.
- Learn about the usage of transgenic plants/parts for the production of biochemicals.
- Learn Ethical and legal issues of Recombinant DNA Technology.

**Unit:I**

**(16 Lectures)**

**Genetic engineering:** Introduction, scope and applications; Cloning vectors; Expression vectors; Recombinant DNA technology—Restriction enzymes, ligation, transformation and selection; Molecular cloning: Plant DNA isolation; Construction of genomic and cDNA libraries; Gene transfer methods in plants—*Agrobacterium* mediated gene transfer; Physical methods of gene transfer; Reporter genes; Expression strategies for heterologous genes

**Unit:II**

**(16 Lectures)**

**Molecular markers:** Types of markers; genetic markers (ISSR, RFLP, RAPD, AFLP, SSR(cp SSRs), SNPs, SCARs and Retrotransposons (IRAP, REMAP, RBIP, iPBS, CAPS); Molecular cytogenetic markers— FISH and GISH. Quantitative trait loci (QTL) mapping— introduction and types of mapping populations; MAS/MAB- Marker assisted selection or marker assisted breeding.

**Unit:III**

**(16 Lectures)**

**Gene editing:** Gene addition and gene replacement in plants; methods of gene editing CRISPR/Cas9, TALENs, modified nucleases, Recombineering, genome shuttling. Advantages and disadvantages of gene editing. RNAi based technologies for gene expression (siRNA, miRNA). Mutagenesis (site detected, insertional, signature tagged, transposon).

#### Unit:IV

(16 Lectures)

**Genetically modified crops:** Transgenics for biotic and abiotic stress (insect resistance, virus resistance, herbicide resistance); Modification of plant nutritional content (vitamins, aminoacids, lipids, Iron, biodegradable plastics); GMO's— ecological and ethical concerns, GMO product detection and analysis, Transgenic ornamentals (flower color, variegation). Biotransformation: Plants as Bioreactors; Transgenic plants for biochemical production— edible vaccines, secondary metabolites.

#### Suggested Readings:

- Cooper Jeffrey M-2013: Cell-A Molecular Approach, 6th Edition. Sinauer Assoc. Inc. USA
- Jocelyn E Krebs et al. 2010. Lewin's Gene X. Jones And Bartlett Publishers, Inc USA.
- Watson and others – 2004 : Molecular Biology of the gene ( V); Peares Educatias, Inc India
- P.C. Turner and others – 2002 : Molecular Biology (II); Viva Books, Pvt. Ltd., New Delhi.
- W. Ream and KG. Field – 1999 : Molecular Biology Techniques ; Academic Press, London.
- Bruce Alberts et al – 1983 : Molecular Biology of the cell ; Garland Publ. Inc., New York.
- Buchanan B, Gruissem G and Jones R. (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Rockville, USA.
- C. K. Matthews, K. E. Van Holde and K. G. Ahern. (2007). Biochemistry, 3rd Edition, Pearson Education, New Delhi
- Nelson DL and Cox MM. (2004) Lehninger Principles of Biochemistry, 4th Edition, W.H. Freeman and Company, New York, USA.
- D. R. Ferrier. (2015). Lippincott's illustrated Reviews: Biochemistry, 6th Edition. Wolters Kluwer (India) Pvt Ltd, New Delhi.
- Desmond S T Nicholl. 2008. An Introduction to Genetic Engineering. Cambridge Univ. press, USA.

#### Web sources

- [https://onlinecourses.swayam2.ac.in/cec21\\_bt22/preview](https://onlinecourses.swayam2.ac.in/cec21_bt22/preview)
- [https://onlinecourses.nptel.ac.in/noc19\\_bt17/preview](https://onlinecourses.nptel.ac.in/noc19_bt17/preview)
- <https://www.classcentral.com/course/swayam-plant-biochemistry-and-plant-biotechnology-23080>
- [https://onlinecourses.swayam2.ac.in/cec22\\_bt04/preview](https://onlinecourses.swayam2.ac.in/cec22_bt04/preview)
- <https://nptel.ac.in/courses/102103016>

**Course No.: BR23402CR**

**Course Title: Animal Cell and Tissue Technology**

**Total Credits: 4 (4 L + 0 T + 0 P)**

**Maximum Marks: 100 (20 + 80)**

### **Learning objectives**

- The goal of this course is to provide the necessary theoretical knowledge on animals cells for in vitro studies, maintenance of animal cells in vitro, manipulation of animal cells in vitro, and application of molecular techniques to in vitro situations.
- 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.

### **Learning Outcome**

- Develop basic aseptic skills for animal cell culture.
- Understand media constituents and media formulation strategies for animal cell culture.
- Apply cell and molecular techniques to in vitro situations.
- Students will learn how to apply tissue culture and tissue engineering principles to the solution of medical problems requiring the regeneration of tissue, and the methods for the fabrication of tissue-engineered products.

### **Unit: I**

**(16 lectures)**

**Animal cell and tissue culture:** Different tissue culture techniques; Types of primary culture; Chick embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc. Development of cell lines; Characterization and maintenance of cell lines. Commercial scale production of animal cells.

### **Unit: II**

**(16 lectures)**

**Culture products:** Somatic cell fusion, hybridoma technology and production of monoclonal antibodies. Cell cultures in the antibiotics production (Penicillin, Streptomycin, Tetracycline), amino acids (Lysine, Glutamic acid), hormones, vaccines (viral vaccines) and therapeutics (interferons, hybrid antibodies). Downstream processing of products. Stem cell lines— origin and types, stem cell therapy and its applications.

### **Unit: III**

**(16 lectures)**

**Tissue engineering:** Introduction, Concept, approaches, prospects and limitations; Biomaterials and their types (Polymeric, Bioceramic, Metallic, Biocomposite and Biological); Tissue engineering of skin and hemoglobin-based blood substitutes (Blood, Plasma Volume Expanders, Oxygen Therapeutics).

#### **Unit: IV**

**(16 lectures)**

**Animal cloning** –Introduction and types of animal cloning: reproductive cloning (Dolly- nuclear transplantation), therapeutic cloning (Xenotransplantation). Gene manipulation in animals- cloning vectors and expression vectors. Gene transfer methods (transfection and its types): chemical methods-CaPO<sub>4</sub> co-precipitation, DEAE dextran mediated, lipofaction; physical - microinjection, electroporation; biological method – retroviral infection. Transgenic and knockout animals. Artificial womb technology.

#### **Suggested Readings**

1. Freshney, R. I. (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley-Blackwell, 2010. 6th Edition.
2. Davis, J. M. (2008). Basic Cell Culture. Oxford University Press. New Delhi.
3. Davis, J. M. (2011). Animal Cell Culture. John Willy and Sons Ltd. USA.
4. Freshney R. I. (2005). Culture of Animal Cells. John Willy and Sons Ltd. USA.
5. Butler, M. (2004). Animal Cell Culture and Technology. Taylor and Francis. New York, USA
6. Bernhard O.Palsson,Sangeeta N.Bhatia, "Tissue Engineering" Pearson Publishers 2009.
7. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of Tissue Engineering and Regenerative Medicine.2009.
8. Clemens Van Blitterswijk, Jan De Boer Tissue Engineering. Elsevier Science 2014. ISBN:9780124202108, 0124202101

#### **e-Resources**

<https://nptel.ac.in/courses/102104059>

<https://www.youtube.com/watch?v=o0hHD2yjjNI>

<https://www.youtube.com/watch?v=o35ZQq0Uvzs>

<https://www.youtube.com/watch?v=2v9grpx7XyQ>

**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.

**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<sub>2</sub>), 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 by Stuart Hogg

**Course Links:**

**[https://onlinecourses.nptel.ac.in/noc20\\_bt35/preview](https://onlinecourses.nptel.ac.in/noc20_bt35/preview)**

**[https://onlinecourses.swayam2.ac.in/cec21\\_bt15/preview](https://onlinecourses.swayam2.ac.in/cec21_bt15/preview)**

**<https://www.futurelearn.com/courses/introduction-to-microbiology/7/steps/1058594>**

**<https://dth.ac.in/medical/courses/Microbiology/block-1/1/index.php>**

**<https://www.classcentral.com/course/youtube-general-microbiology-bio-221-97377>**

**<https://www.classcentral.com/course/swayam-advanced-microbiology-95280>**

**<https://www.classcentral.com/course/youtube-introduction-to-microbiology-97371>**



**Course No.: BR23404CR**

**Course Title: Lab Course IV**

**Total Credits: 2 (0 L + 0 T + 2 P)**

**Maximum Marks: 100 (20 + 80)**

**(Based on BR23401CR, BR23402CR, BR23403CR)**

**Practical Work Based on BR23401CR**

1. Demonstration of plant tissue culture technique (sterilization, media preparation and inoculation).
2. Isolation of plant genomic DNA by CTAB method.
3. Visualization of DNA by Agarose Gel Electrophoresis.
4. Demonstration of Polymerase Chain Reaction.
5. Preparation of mitotic chromosome preparation from root tips.
6. Agrobacterium tumefaciens culture and co-culture.
7. Isolation of plasmid DNA and its restriction digestion.

**Practical Work Based on BR23402CR**

1. Preparation of culture media for animal cells by filter sterilization methods.
2. Establishment of primary cell culture - chick embryo.
3. Study the antigen-antibody reactions to determine blood groups.
4. Study the differential morphology of human leucocytes.
5. Study the cell count using a haemocytometer.
6. Comparative studies of haemincrystalin mammals: humans, cow and goat.
7. Demonstrate phagocytic activity (phagocytosis) in the insect cells.
8. Demonstrate the presence of natural biomaterial chitin in the insect integument.

**Practical Work Based on BR23403CR**

1. Microbial growth culture, preparation and sterilization.
2. Estimation of CO<sub>2</sub> in water samples obtained at different stages of Sewage Treatment Plant (STP).
3. Estimation of dissolved oxygen in given water sample.
4. Check the efficacy of antibiotics on a given microbial sample using different techniques.
5. To grow bacteria from cheek sample of mouth on nutrient medium.
6. Study the preparation of yogurt.
7. Study the procedure to ascertain the milk quality.

**Course No.: BR23405DCE**

**Course Title: Bioinformatics**

**Total Credits: 4 (4 L + 0 T + 0 P)**

**Maximum Marks: 100 (20 + 80)**

**Course Description** The course pertains to the utilization of information technology (IT) in biology. It focuses on the biological informations in the form of biomolecules including nucleic acids, proteins, metabolites and morphological data and the usage of various tools and softwares for studying biological processes.

### **LEARNING OBJECTIVES:**

- Learn about importance of bioinformatics in biological data management and analysis.
- Learn about the methods for characterizing and managing the different types of biological data.
- Learn about the different types of biological Databases including some organism specific databases.
- Introduction to the basics of sequence alignment and analysis.

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

- They will learn about the hardwares, softwares, networking, processing of computers.
- They are able to understand the designing and function of various databases and bioinformatic resources
- They are able to select specific softwares to solve specific biological problems with respect to Nucleotides and Proteins.

**Unit:I**

**(16 Lectures)**

**Bioinformatics databases:** Bioinformatics—concept and application; Types of databases- Genome (NCBI, EBI, TIGR, SANGER), Nucleic acid (EMBL, GeneBank, DDBJ), Protein (SwissProt, TrEMBL, PIR) databases; Structural classification of proteins (SCOP, CATH).

**Unit: II****(16 Lectures)**

**Sequencing:** DNA, RNA and protein sequencing: e.g., Sanger's, Edman's, Shotgun, Maxim gilbert; Basic Concept of sequence similarity; Sequence based database searches (blast, fasta, gcg, msf, nbrf-pir etc.); Sequence alignment (pair-wise and multiple); Transcriptomics: DNA Microarray, Serial analysis of gene expression (SAGE), Qualitative and Quantitative RT-PCR.

**Unit: III****(16 Lectures)**

**Proteomics:** Proteomics—general account, separation, identification of proteins, ESI-MS-MS, Protein microarray- analytical and functional protein microarray; protein expression profiling, protein-protein interaction mapping, Yeast two hybrid system; protein-sugar, protein-DNA, protein-RNA interactions.

**Unit: IV****(16 Lectures)**

**Phylogenetics:** Morphological & molecular phylogeny; Representation of molecular phylogeny; Methods of phylogeny—maximum parsimony, likelihood and Bayesian method; Distance methods (UPGMA, NJ); Softwares (PHYLIP, Tree base, Mesquite, NTSYSpc).

**Suggested Readings**

- Rex A. Dwyer (2004). Genomic Perl: From Bioinformatics Basics to Working Code, Cambridge University Press, 1st South Asian Edition.
- Judd WS, Campbell CS, Kellogg EA, Stevens PA and Donoghue MJ (2002). Plant Systematics: A Phylogenetic Approach. Sinauer Associates, Inc., Massachusetts.
- Nei M and Kumar S (2000). Molecular Evolution and Phylogenetics. Oxford University Press, New York.
- Semple C and Steel MA (2003). Phylogenetics. Oxford University Press, Oxford. 10. Simpson MG (2006). Plant Systematics. Elsevier, Amsterdam.
- Hillis, D.M., Mortiz, C. & Mable, B.K. (eds.) 1996, Mol. Systematics, Sinauer Associates, Sunderland, USA.
- Judd Walter S., Campbell C. S., Kellogg, E. A., Stevens P.F. and M. J. Donoghue 2008. Plant Systematics. Sinauer Associates, INC, Publishers, Sunderland, Massachusetts, USA.
- JD Wale, 2002. From Genes to Genomes: Concepts and Applications of DNA Technology. Wiley-Blackwell Publishers.

- Primrose and Twyman. 2002. Principles of Genome Analysis and Genomics. Blackwell publishing, USA. R.M.Twyman, Principles of Proteomics, BIOS Scientific Publishers, 2004.
- P.Michael Conn, 2003, Handbook of Proteomic Method. Humana Press, Totowa, New Jersey, USA,.
- De Robertis and De Robertis, 1990, Cell and Molecular Biol., Saunders College, Philadelphia, USA 5.
- Weaver, R.F. and Hedrick, P.W., 1989, Genetics. Wm, C. Brown Pub, Dubuque.
- Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor.
- Letovsky, S.I. 1999 Bioinformatics. Kluwer Academic Publishers.
- Baldi, P. and Brunak, S. 2001 Bioinformatics: The machine learning approach, The MIT Press.
- Setubal, J. and Meidanis, J. 1996 Introduction to Computational Molecular Biology. PWS Publishing Co., Boston.
- Lesk, A.M. 2005, 2nd edition, Introduction to Bioinformatics. Oxford University Press.
- Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.
- Mount, D.W., Bioinformatics: 2001, Sequence and Genome Analysis. CSHL Press.
- Durbin R., Eddy S., Krogh A. and Mitchison G. 2007 Biological Sequence Analysis, Cambridge University Press.
- Rastogi et al 2003. Bioinformatics: Concepts, Skills and Applications. CBS
- Rashidi and Buchler 2000. Bioinformatics Basics. CRC Press
- Wilkins, M.R., Williams, K.L., Appel, R.D., Hochstrasser, D.F. (Editors) 1997 Proteome Research: New Frontiers in Functional Genomics. Springer Verlag Berlin Heidelberg.
- Baxevanis, A. and Ouellette, F.B.F (Editors) 1998 Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. John Wiley and Sons, New York.
- Dale and Schartz 2003 From Genes to Genomes. Humana.
- Hawley and Mori 1999 The Human Genome. Academic.
- Primrose and Twyman 2003 Principles of Genome Analysis & Genomics. Blackwell.
- Pasternak 2000 An Introduction to Molecular Human Genetics. Fitzgerald.
- Sudbery 2002 Human Molecular Genetics. Prentice Hall.
- Liebler, D. 2002 Introduction to Proteomics: Tools for New Biology. Human Press Totowa.
- Brown, T.A. 2002 Genome. John Wiley Press, US.
- Campbell, A.M. & Heyer, L.J. 2002 Discovering Genomics, Proteomics and Bioinformatics. Benjamin/Cummings.
- Bourne, P.E., and Gu, J. 2009 Structural Bioinformatics (2nd edition), John Wiley & Sons, New York

- Andreas D. Baxevanis, B. F. Francis Ouellette 2001 Bioinformatics: A Practical Guide to the Analysis of Genes, Wiley-Interscience
- Mount 2003. Bioinformatics: Sequence and Genome Analysis. CBS
- Attwood and Parry-Smith 2002. Introduction to Bioinformatics. Pearson
- Barnes and Gray (ed) 2003. Bioinformatics for Geneticists. Wiley
- Westhead et al 2003. Bioinformatics Instant Notes. Viva Books

### Web Sources

- [https://onlinecourses.swayam2.ac.in/cec21\\_bt04/preview](https://onlinecourses.swayam2.ac.in/cec21_bt04/preview)
- [https://onlinecourses.nptel.ac.in/noc20\\_bt10/preview](https://onlinecourses.nptel.ac.in/noc20_bt10/preview)
- <https://coursesitv.com/free-tutorials-learn/bioinformatics>
- [https://onlinecourses.swayam2.ac.in/cec22\\_bt01/preview](https://onlinecourses.swayam2.ac.in/cec22_bt01/preview)
- <https://www.classcentral.com/course/swayam-evolutionary-biology-17599>
- [https://onlinecourses.nptel.ac.in/noc21\\_bt26/preview](https://onlinecourses.nptel.ac.in/noc21_bt26/preview)
- [https://onlinecourses.nptel.ac.in/noc21\\_bt39/preview](https://onlinecourses.nptel.ac.in/noc21_bt39/preview)

[https://onlinecourses.nptel.ac.in/noc21\\_bt25/preview](https://onlinecourses.nptel.ac.in/noc21_bt25/preview)

### Practical Work:

1. Role of NCBI, EBI, TIGR and SANGER in maintaining sequence data.
2. Demonstration of BLAST and FASTA.
3. Study Pairwise and Multiple sequence alignments.
4. Primer designing techniques/tools
5. Construction of Phylogenetic trees using morphological and molecular data.
6. Tools for obtaining information about primary structure of proteins.
7. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE)

**Course No.: BR23406DCE**

**Course Title: Project Work**

**Total Credits: 4 (4 L + 0 T + 0 P)**

**Maximum Marks: 100 (20 + 80)**

**Project work of 4 credits shall be taken by a student in 4<sup>th</sup> Semester. The Project work may be in the form of field surveys/practicals etc. A student is required to carry out Project work under the guidance of a supervisor and submitted his work in the Department that shall be evaluated as per guidelines.**

**Course Description** Each student shall complete a dissertation on a topic mutually agreed between him/her and a faculty member, who acts as a mentor.

**LEARNING OBJECTIVES:**

- The objective is to train students in basics of research, literature survey, analysis and expression of their understanding of the topic in their own words.
- To create research oriented thought process and basic training.

**LEARNING OUTCOMES:** On completion of the research project the students will be able to-

- Design and conduct the experiments of his/her interest.
- Have training and handling of basic and advanced instruments required in their projects.
- Generate, compile, analyze and interpret the data.
- Develop presentation skill.
- Work in any research and development (R&D) setup

**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.

5. Aruga H. 1994. Principles of Sericulture. Oxford & IBH, New Delhi.

### **e-Resources**

www.amis.org <sup>TM</sup>

www.FAO.org <sup>TM</sup>

### **Swayam Moocs**

<https://www.classcentral.com/course/swayam-applied-entomology-17515>

<https://www.classcentral.com/course/swayam-general-sericulture-14089>

<https://www.classcentral.com/course/swayam-applied-and-economic-zoology-20222>

<https://www.classcentral.com/course/swayam-dairy-and-food-process-and-products-technology-13980>



**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.

**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 fodder for 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 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.

**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

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<sup>rd</sup> ed., 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 3<sup>rd</sup> 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/cec19_bt11/preview)
- [https://onlinecourses.swayam2.ac.in/cec20\\_ag09/preview](https://onlinecourses.swayam2.ac.in/cec20_ag09/preview)

**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.

**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; Sacred 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.: 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 of traditional 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.

**Unit: I****(16 lectures)**

**Traditional systems of medicine and Bioprospecting:** 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 heterophyllum*, *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 Enclopaedia. 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:



978-0917256394

9. Robert Russell Monteith Paterson. Nelson Lima
10. Bioprospecting: Success, Potential and Constraints. Springer. 2016. ISBN: 978-3-319-47933-0
11. Sampath Padmashree Gehl. Regulating Bioprospecting. United Nations University. ISBN: 9789280811124
12. Yogesh Urdukhe. BIOPROSPECTING. Educational Publishers & Distributors. 2020. ISBN: 9789390005123
13. Aphrodite Smagadi. Medicinal bioprospecting : policy options for access and benefit-sharing. London: British Institute of International and Comparative Law. 2009. ISBN: 9781905221363

**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;

## Suggested Readings:

- Agrios GN. Plant Pathology. Academic press, San Diego,
- Singh RS. Plant Diseases Management. Oxford & IBH, New Delhi.
- Glick BR, Pasternak JJ, and Patten CL Molecular Biotechnology ASM Press
- Atlas RM and Bartha R. Microbial Ecology: Fundamentals & Applications. Benjamin/Cummings Science Publishing, USA
- Maier RM, Pepper IL and Gerba CP. Environmental Microbiology. Academic Press
- Barton LL & Northup DE Microbial Ecology. Wiley Blackwell, USA
- Campbell RE. Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
- Coyne MS. Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
- Altman A Agriculture Biotechnology, Marcel decker Inc.
- Mahendra K. Rai Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. NY
- Reddy, S.M. et al. Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers
- Saleem F and Shakoori AR. Development of Bioinsecticide, Lap Lambert Academic Publishing.
- Rangaswamy G. Diseases of crop plants in India 14. Glick B.R. Beneficial Plant Bacterial Interactions, Springer.
- Burges HD & Hussey NW. (Eds). 1971. Microbial Control of Insects and Mites. Academic Press, London.
- De Bach P. 1964. Biological Control of Insect Pests and Weeds. Chapman & Hall, NY
- Dhaliwal GS & Arora R. 2001. Integrated Pest Management: Concepts and Approaches. Kalyani Publ., New Delhi.
- Gerson H & Smiley RL. 1990. Acarine Biocontrol Agents – An Illustrated Key and Manual. Chapman & Hall, New York.
- Huffaker CB & Messenger PS. 1976. Theory and Practices of Biological Control. Academic Press, London.
- Ignacimuthu SS & Jayaraj S. 2003. Biological Control of Insect Pests. Phoenix Publ., New Delhi. Saxena AB. 2003.
- Biological Control of Insect Pests. Anmol Publ., New Delhi. Van Driesche & Bellows TS. Jr. 1996. Biological Control. Chapman & Hall, New York.

## Web Sources:

<https://www.swayamprabha.gov.in/index.php/program/archive/18>

**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.

### **Suggested Readings:**

1. Heather A.E. Benson , Michael S. Roberts, Vânia Rodrigues Leite-Silva, Kenneth A. Walters. *Cosmetic Formulation: Principles and Practice*. CRC Press. 2021. ISBN: 978-1032093079
2. Gail Francombe . *A-Z of Natural Cosmetic Formulation: The definitive beginners' guide to the essential terminology, theories and ingredient types needed to formulate professional cosmetic products*. Goodness & Wonder Ltd. 2019. ISBN: 978-1916074200.
3. Gaurav Kumar Sharma, Jayesh Gadhiya, Meenakshi Dhanawat. *Textbook of Cosmetic Formulations*. Pothi.com. ISBN: 9781365355912.
4. B Carli ·*Cosmetic Formulations: A Beginners Guide*. Institute of Personal Care Science. 2020.
5. Tharwat F. Tadros. *Formulations: In Cosmetic and Personal Care*. De Gruyter. 2016. ISBN: 978-3110452365
6. [Shailendra Saraf Swarnlata Saraf](#). *Cosmetics A Practical Manual*. [Pharmamed Press](#). 2014. ISBN: 9789383635023.
7. Jess Arnaudin. *Plant-Based Beauty*. Aster Publications. 2019. ISBN : 978-1783253234.
8. Hiroshi Iwata, Kunio Shimada. *Formulas Ingredients and Production of Cosmetics Technology of Skin And Hair Care Products In Japan*. Springer. 2014. ISBN: 9784431546696.
9. Damjan Janeš and Nina Kočevar Glavač. *Modern Cosmetics Ingredients Of Natural Origin*. Širimo dobro besedo, d.o.o. Velenje. 2018. ISBN: 978-961-285-016-6
10. Vimaladevi M. *Textbook of Herbal Cosmetics*. CBS Publisher. 2017. ISBN: 978-8123925028

**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 composting**—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://onlinecourses.swayam2.ac.in/cec21_ag03/preview)
- <https://nptel.ac.in/courses/126/105/126105014/>

**Course No.: BR22009GE**

**Course Title: Hormones in Human Health**

**Total Credits: 2 (2 L + 0 T + 0 P)**

**Maximum Marks: 50 (10 + 40)**

### **Learning Objectives**

By the end of this section, students will be able to:

- Identify the three major classes of hormones on the basis of chemical structure
- Mechanism of Hormone action.
- Understand the structure and functions of endocrine systems.
- Disorders due to endocrine system

**Learning outcome:** The students shall utilise the knowledge in understanding the working of different hormones, their mechanisms and disorders.

### **Unit: I Hormones:**

Introduction, Classification and Characteristics of Hormones, Functions of hormones from Pituitary Gland, Pineal gland, Thyroid Gland, Parathyroid Gland, Adrenal Gland, Pancreas. Physiologic Effects of Ovarian Hormones, Menstrual cycle and its regulation. Physiologic Effects of Androgens at Target Organs.

### **Unit: II: Hormonal Disorders:**

Feedback mechanism of hormonal regulation, Endocrine Disorders their types, causes, symptoms, diagnosis and treatment (Hyperthyroidism, Thyroiditis, Goiter, Obesity, Gigantism, Diabetes, PCOS, Hypoglycemia, Addison's Disease, Cushing Disease), Hormones and therapeutic agents, role of hormones in postmenopausal disorders (ovarian cancer, breast cancer). Hormone replacement therapy.

### **Suggested Books / Reading Material**

1. Animal Physiology – Adaptation and Environment by Knut Schmidt Nielsen
2. Animal Physiology by Eckert & Randall
3. Animal Physiology by James Anderson
4. Comparative Physiology by B. T. Scheer
5. Essentials of anatomy and physiology by Seeley, Stephans and Tate
6. Essentials of Animal Physiology by S. C. Rastogi
7. General & Comparative Physiology by William S. Hoar
8. Textbook of Animal Physiology by R. Nagabhushanam

**Course No.: BR22001OE**

**Course Title: Human Health and Plant Diet**

**Total Credits: 2 (2 L + 0 T + 0 P)**

**Maximum Marks: 50 (10 + 40)**

**Course Description:** The course “Human Health and Plant Diet” gives an idea about how plants and humans have evolved a symbiotic relationship and how plant based diets are important for leading a healthy life. It deals with plants as diet of hunter gatherers and plants as a part of modern diet. It explains the nutritional value, health benefits and myths related to plant diet. It highlights the importance of plant diet as a part of special diets during pregnancy and prevention and disease control.

### **Learning Objectives**

- To familiarize the students about the relationship between food, nutrition, health and diseases which would make them aware about the role of macro and micro nutrients in diet
- To familiarize the students about the food servings (meal planning) and understand the nutrient metabolism as well as nutrient-microbe interaction.
- To familiarize the students about the benefits of consuming phytochemicals on regular bases and also develop the concept of food spoilage and safety.

### **Learning Outcomes**

- On completion of the course the students are expected to have rational and critical knowledge associated with plant based diets and their uses by society.
- The students will be able to apply the scientific Knowledge of plant based diets for promotion of health by getting rid of the so called diseases of civilization.

### **Unit: I**

**(16 lectures)**

**Plants as healthy diet:** Plants in the diet of hunter gatherers; Food matrix; Plants in modern western diet; Plants as sources of proteins, carbohydrates, fats, vitamins and minerals, fibre, antioxidants; Algae and fungi as source of healthy food; Health benefits of ginger, garlic, fennel and turmeric; Dry fruits and nuts in healthy diet.

### **Unit: II**

**(16 lectures)**

**Plants in special diet and Disease management:** Gut microbiotome; Role of phytonutrients in



influencing gut microbiotome; Plant diet in pregnancy and lactation; Plant diet in infancy, childhood and adolescence; Plant diet and disease management— diabetes, heart disease, cancer, obesity; Plants diet in fitness and sports; Food poisoning.

**Suggested Reading:**

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2009). Textbook of Human Nutrition, 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.
2. Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.
3. Srilakshmi (2005), Dietetics, Revised 5th edition. New Age International Ltd.
4. Wardlaw MG, Paul M Insel Mosby (1996). Perspectives in Nutrition, Third Edition.
5. Codex Guidelines on Nutrition Labelling (CAC/GL 2\_1985) (Rev.1\_1993). Rome, Food and Agriculture Organisation of the United Nations / World Health Organisation, 1993.
6. Food Safety and Standards Authority of India portal, Government of India
7. Gopalan, C (1990). NIN, ICMR. Nutritive Value of Indian Foods.
8. Seth V, Singh K (2005). Diet planning through the Life Cycle: Part 1. Normal Nutrition. A Practical Manual, Fourth edition, Elite Publishing House Pvt Ltd.

**Course No.: BR22002OE**  
**2 (2 L + 0 T + 0 P)**

**Course Title: Infectious Diseases and Human Health Total Credits:**  
**Maximum Marks: 50 (10 + 40)**

### **Learning objectives**

- Identify and explain the mechanisms by which infectious diseases may be transmitted to and among humans.
- To equip learners with the knowledge of possible risk factors and preventive measures of infectious diseases.

### **Course Outcomes**

Upon completion of the lesson, students will be able to:

- identify and describe the common transmission mechanisms for infectious diseases
- identify common infectious diseases
- describe types of prevention and treatment methods for infectious diseases

### **Unit: I**

**(16 lectures)**

**Introduction to Infectious Diseases:** Basic concepts in pathophysiology of infectious diseases, Infectious disease transmission, Infection and immunity, Inflammation, Acute and chronic infections, Major infectious diseases of humans.

**Bacterial Infections:** Pathogenesis, mechanisms of pathogenesis; transmission, diagnosis, prophylaxis and treatment of Tuberculosis.

### **Unit: II**

**(16 lectures)**

**Viral, Fungal and Protozoan Diseases:** Pathogenesis, transmission, lifecycle, epidemiology, diagnosis, prophylaxis and anti-retroviral therapy of Human immune deficiency virus (HIV/AIDS); Candidiasis (Fungal Infection); *Plasmodium falciparum* causative agent of Malaria (Protozoan infection). Sexually transmitted diseases

## **Suggested Books / Reading Material**

1. Comprehensive Textbook of Infectious Diseases by MI Sahadulla Sayenna A Uduman Jaypee Publishers
2. Atlas of Human Infectious Diseases, by Heiman F. L. Wertheim, Peter Horby, John P. Woodall , Blackwell Publishing Ltd.
3. Infectious Diseases of Humans by Anderson Roy M.).
4. Parasitology (Protozoology & Helminthology) by K. D. Chatterjee
5. General parasitology by Thomas C. Cheng

## **e-Resources**

<https://www.mooc-list.com/course/tropical-parasitology-protozoans-worms-vectors-and-human-diseases-coursera>

<https://www.coursera.org/learn/epidemics>

<https://research.pasteur.fr/en/course/mooc-modeling-of-infectious-diseases/>

**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 their 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

## **e-Resources**

<https://www.mooc-list.com/course/tropical-parasitology-protozoans-worms-vectors-and-human-diseases-coursera>

<https://www.coursera.org/learn/epidemics>

<https://research.pasteur.fr/en/course/mooc-modeling-of-infectious-diseases/>

**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

