DEPARTMENT OF BIORESOURCES

SCHOOL OF BIOLOGICAL SCIENCES

UNIVERSITY OF KASHMIR, SRINAGAR

NAAC Accredited "A^{+}"

Coordinator/Head

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. Hiadayatullah 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, IIIM 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

NAACAccredited 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 4th 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

L	**Lecture**
T	**Tutorial**
P	**Practical**
CR	**Core Course**
DCE	**Discipline Centric Elective**
GE	**Generic Elective**
OE	**Open Elective**

DEPARTMENT OF BIORESOURCES
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MODIFIED CHOICE BASED CREDIT SYSTEM (CBCS)SCHEME AND COURSE STRUCTURE

TO BE IMPLEMENTED FROM ACADEMIC SESSION 2022 AND ONWARDS

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

SEMESTER I

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

Course Description

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

Learning objectives

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

Learning outcomes:

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

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

Unit: I **(16 lectures)**

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

Unit: II **(16 lectures)**

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

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

Unit: III **(16 lectures)**

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

Unit: IV **(16 lectures)**

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

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

Suggested Readings:

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

Swayam Moocs

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

SEMESTER I

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

Learning objectives

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

Course Outcomes

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

Unit: I **(16 lectures)**

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

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

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

Unit: II **(16 lectures)**

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

Unit: III **(16 lectures)**

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

Unit: IV **(16 lectures)**

Animal products and processing:

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

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

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.

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www.poultryhelp.com
www.nddb.org
www.ndri.res.in
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. Gliesmann, 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.

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- 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_lw06/preview
- 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 presenceof 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 inbiodiversity 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.

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- https://onlinecourses.nptel.ac.in/noc22_bt33/preview
- https://onlinecourses.swayam2.ac.in/cec20_ma13/preview
- https://onlinecourses.swayam2.ac.in/cec19_bt12/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 **Course Title: Immunology and Drug Targeting**
Total Credits: 4 (4 L + 0 T + 0 P) **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.

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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.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

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

SEMESTER II

Course No.: BR23201CR **Course Title: Plant Resources Regeneration**
Total Credits: 4 (4 L + 0 T + 0 P) **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 Rythms, 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

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- https://onlinecourses.nptel.ac.in/noc19_bt17/preview
- https://onlinecourses.swayam2.ac.in/cec22_bt04/preview
- https://nptel.ac.in/courses/102103016

SEMESTER II

Course No.: BR23202CR **Course Title: Animal Resource Regeneration**
Total Credits: 4 (4 L + 0 T + 0 P) **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_byDavid_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://www.youtube.com/watch?v=CAPjx4etS1g

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 providess provides know how about the current trending sources of bioenergy, their advantages and bottlenecks faced in commercialization of biofuels.

Learning Objectives

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

Learning Outcomes

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

Unit: I **(16 lectures)**

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

Unit: II **(16 lectures)**

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

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

Unit: III **(16 lectures)**

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

Unit: IV **(16 lectures)**

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

Suggested Readings:

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

SEMESTER II

Course No.: BR23204CR **Course Title: Lab Course II**

Total Credits: 2 (L + 0 T + 2P) **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 jatropa, maize and sugarcane as major bioenergy crops.
- Demonstrate the fermentation process for ethanol production.

SEMESTER II

Course No.: BR23205DCE **Course Title: Inheritance Biology**
Total Credits: 4 (4 L + 0 T + 0 P) **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 verses 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.
- Sudy cases of aneuploidy and polypoloidy.

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.swayam2.ac.in/cec21_bt05/preview?

https://onlinecourses.swayam2.ac.in/cec22_bt05/preview?

https://www.classcentral.com/course/swayam-principles-of-genetics-23082

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

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://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.

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

SEMESTER III

Course Code	Course Name	Paper Category	Hours per week			Credits
			L	T	P	
BR23301CR	Biomolecules	Core	4	0	0	4
BR23302CR	Secondary Metabolites	Core	4	0	0	4
BR23303CR	Biostatistics & Biotechniques	Core	4	0	0	4
BR23304CR	Lab Course III (Based on BR23301CR, BR23302CR, BR23303CR)	Core	0	0	4	2
BR23305DCE	Biological Interactions	Discipline Centric Elective	3	0	2	4
BR23306DCE	Wood Resource Utilization	Discipline Centric Elective	3	0	2	4
BR23307DCE	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 actionin 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 triacylgycerols; Functions of triacylgycerols, 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 (α-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. LubertStryer; 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 (1st edition).**Publisher:** Springer, ISBN: 9780412019814.
- Lincoln Taiz, Eduardo Zeiger, Ian M. Moller & Angus Murphy**.** Plant Physiology & Development (6th edition). **Publisher:** Oxford University Press, ISBN: 9781605357454.
- William G. Hopkins, Norman P. A. Hüner**.** Introduction to Plant Physiology (4th edition). **Publisher:** Wiley, ISBN: 9780470461426.
- Michael Wink**.** Annual Plant Reviews: Biochemistry of Plant Secondary Metabolism (2nd 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

- Bowsher et al., 2008. Plant Biochemistry, Garland Science, New York
- Mathews, Van Holde and Ahern. 2007, Biochemistry (3rd Ed), Pearson Edsucation, 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 radicle 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 **Course Title: Biological Interaction**
Total Credits: 4 (4 L + 0 T + 0 P) **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 ofdifferent communities.
- Visit to local National park for the study of behavior in different captive and wildanimals.
- 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

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, Scavenge 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 an antigens (Super antigens, TD and TI antigens), Immunogens, Haptens, Allergens, Tollerogens,

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=o0hHD2yjjNI

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

TOBEIMPLEMENTEDFROMACADEMICSESSION2023ANDONWARDS

SEMESTERIV						
CourseCode	**CourseName**	**PaperCategory**	**Hoursperweek**			**Credits**
			L	**T**	**P**	
BR23401CR	Plant Resources and Biotechnology	Core	4	0	0	4
BR23402CR	Animal Cell and Tissue Technology	Core	4	0	0	4
BR23403CR	Microbial Technology	Core	4	0	0	4
BR23404CR	Lab Course IV (Based onBR23401CR,BR23402CR, BR23403CR)	Core	0	0	4	2
BR23405DCE	Bioinformatics	Discipline Centric Elective	3	0	2	4
BR23406DCE	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 andRetrotransposons (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 editingCRISPR/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 Jeoffrey 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); Pearses 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 Yorsk.
- 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.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://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-$CaPO_4$ 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_2), Culture types— static cultures, suspension cultures; synchronous cultures, growth kinetics; (growth curve, generation time); Isolation and screening of microorganisms. Metagenomics (introduction and applications).

Unit: III **(16 Lectures)**

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

Unit: IV **(16 Lectures)**

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

Suggested Readings:

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

Course Links:

https://onlinecourses.nptel.ac.in/noc20_bt35/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)**

(BasedonBR23401CR, 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 tumifaciens 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. Establishmentofprimarycellculture - chick embryo.
3. Studytheantigen-antibodyreactions to determineblood groups.
4. Studythedifferential morphologyof human leucocytes.
5. Studythecell countusingahaemocytometer.
6. Comparativestudiesofhaemincrystalinmammals:humans,cowandgoat.
7. Demonstratephagocyticactivity(phagocytosis)intheinsectcells.
8. Demonstratethepresenceofnaturalbiomaterial chitinintheinsectintegument.

Practical Work Based on BR23403CR

1. Microbial growth culture, preparation and sterilization.
2. Estimation of CO_2 inwatersamplesobtainedatdifferentstagesofSewageTreatmentPlant (STP).
3. Estimationofdissolvedoxygenin given watersample.
4. Checktheefficacyof antibioticsonagivenmicrobialsample using different techniques.
5. Togrow bacteriafrom cheek sampleof mouth onnutrient medium.
6. Studythepreparationofyogurt.
7. Studytheproceduretoascertainthemilkquality.

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 Bessian 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 Associaes, 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, Sinaver Associates, Sunderland, USA.
- Judd Walter S., Cmpbell C. S., Kollogg, 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 Jersay, 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 Mithchison 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.nptel.ac.in/noc20_bt10/preview**
- **https://coursesity.com/free-tutorials-learn/bioinformatics**
- **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_bt39/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 4th 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 ™

www.FAO.org ™

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 fodderfor cattle and poultry**;** Algae as source of medicine (antimicrobials, antioxidants, antivirals and therapeutic agents); Use of algae in forensic medicine research and HIV vaccine model.

Unit: II **(16 lectures)**

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

Suggested Readings:

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

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

Web Sources

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

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 e*x situ* conservation strategies; Scared grooves and Bio-villages.

Unit: II **(16 lectures)**

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

Suggested Readings:

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

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

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

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

Learning Objectives

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

Learning Outcomes

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

Unit: I **(16 lectures)**

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

Unit: II **(16 lectures)**

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

Suggested Readings:

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

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 ASMPress
- 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 ThomsonLearning.
- Altman A Agriculture Biotechnology, Marcel decker Inc.
- Mahendra K. Rai Hand Book of Microbial Biofertilizers, The Haworth Press, Inc.NY
- Reddy, S.M. etal.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 compositing—methods, materials and advantages; Role in soil fertility, plant growth promotion and disease management.

Suggested Reading:

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

Web Links

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

Course No.: 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 **Course Title: Infectious Diseases and Human Health Total Credits: 2 (2 L + 0 T + 0 P)** **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 there immune response: Common diseases of livestock diseases: Anthrax Aetiology, Pathogenesis, Diagnosis and Control; Salmonellosis (Gastroenteritis) Pathogenesis, Diagnosis and Control. Foot & Mouth Disease -Distribution, Pathogenesis and Control. Aspergillosis, Aetiology, Epidemiology, Pathogenesis, Diagnosis and Control.

Unit: II (16 lectures)

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

Suggested Books / Reading Material

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

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

3. General parasitology by Thomas C. Cheng

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