Department of BioresourceS
School of Biological Sciences
UNIVERSITY OF KASHMIR, SRINAGAR-190006
NAAC Accredited Grade A++ University

No: F(Ph.D. Academic background)Bres/KU/25
Date: 01-07-2025

To Whom It May Concern

This is to certify that the following scholars enrolled/awarded in the Department of Bioresources, University of Kashmir under the supervision of Dr. Manzoor Ahmad Mir belong to diverse academic backgrounds such as Biotechnology, Zoology, Botany, and Bioresources.

Name of Scholar	Parent Subject
Dr. Umar Mehraj	Zoology
Dr. Basharat Ahmad Bhat	Bioresources
Dr. Bashir Ahmad Sheikh	Zoology
Dr. Hina Qayoom	Bioresources
Dr. Hafsa	Bioresources
Dr. Wajahat Rashid Mir	Botany
Ms. Shazia Shafi	Bioresources
Ms. Nusrat Jan	Bioresources
Mr. Burhan Ul Haq	Biotechnology
Mr. Aijaz Ahmad Mir	Zoology
Mr. Gowhar Nazir Masoodi Pirzada	Zoology

HEAD
Dept. of Bioresources
University of Kashmir

Head
Department of Bioresources

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DEPARTMENT OF BIORESOURCES
School of Biological Sciences
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List of Ph.D / I.Ph.D Scholars of Dr. Manzoor Ahmad Mir, Enrolled/Registered/Awarded from 2018-2025

S. No.	Name of the Scholar	Date of Reg.	Reg. No.	Title	Date of Joining for	Date of Submission	Date of Award	Name of the Supervisor	Name of the Co-supervisor (if any)	Name of Expert
1	Mr. Umar Mehraj	08-02-2020	45542-a-2010	Elucidation of therapeutic potential of combinatorial approach of chemotherapeutic agents in triple negative breast cancer	04-01-2018 (I-Ph.D)	27-04-2022	12-07-2022	Dr. Manzoor A. Mir	Dr. Nisar Ahmad Wani & Dr. Abid Hussain Dar Deptt. of Biotechnology, Central University of Kashmir	Prof. Mohammad Afzar Zargar, Central University of Kashmir Ganderbal
2	Mr. Basharat Ahmad Bhat	08-02-2020	42007-s-2008	DNA Fingerprinting, Phytochemical SCREENING AND cytotoxicity effects of some medicinal plants of J&K	29-10-2018 (Ph.D)	27-04-2022	01-07-2022	Dr. Manzoor A. Mir	Dr. Tanvir ul Hassan Dar BGSBU, Rajouri	Prof. Joydeep Kaur, (PGIMER-Chandigarh)
3	Mr. Bashir Ahmad Sheikh	08-02-2020	18901-ic-2004	Design and biological evaluation of 2-Phenylaminomethylene-cyclohexane-1,3-diones as new generation antituberculosis drugs	29-10-2018 (I-Ph.D)	27-04-2022	22-07-2022	Dr. Manzoor A. Mir	Dr. Zahoor Ahmad Parray Scientist C, IIIM Sanatnagar.	Prof. Mohd Altaf Bhat, SKUAST-Kashmir
4	Ms. Hina Qayoom	01-08-2019	3055-IC-20211	"Targeting breast cancer using some natural compounds as anti-cancer therapeutics"	01-08-2019 (I-Ph.D)	28-11-2023	15-04-2024	Dr. Manzoor A. Mir	Dr. Mehboob-ul-Hussain, deptt. of Biotechnology Univ. of Kashmir	Dr. Mohd Jamal Dar, CSIR-IIM, Jammu
5	Ms. Hafsa Qadri	03-08-2019	57610-W-2010	Analysis of factors contributing to drug resistance in Candida species and interaction with human host	03-08-2019 (I-Ph.D)	11-12-2023	24-05-2024	Dr. Manzoor A. Mir	Dr. Peer Abdul Haseeb Shah (Deptt. Bioresources)	Dr. Saif Hameed, Amity Institute of Biotechnology, Gurgaon-122413
6	Mr. Wajahat Rashid Mir	03-08-2019	12776-KC-2011	"Phytochemical screening and evaluation of biological activities of Delphinium roylei and Geranium wallichianum"	03-08-2019 (I-Ph.D)	28-11-2023	15-04-2024	Dr. Manzoor A. Mir	Dr. Showakat Ahmad Ganie, Clinical Biochemistry	Dr. Riyaz Ahmad Mir, all India Institute of Medical Sciences, New Delhi
7	Ms. Shazia Shafi	18-10-2021	64380-w-2013	Combating therapentic resistance in triple negative cancer using combination of chemotherapeutic agents	18-10-2021 (Ph.D)	-	-	Dr. Manzoor A. Mir	-	-
8	Nusrat Jan	05-01-2023	31383-bc-2012	Investgating novel retionoids for triple-negative breast cancer using drug repurposing approach.	05-01-2023 (Ph.D)	-	-	Dr. Manzoor A. Mir	-	-
9	Burhan-ul_Haq	26-07-2023	139-bph-2015	Combating breast cnacer progression by using novel pharmaceuticals in combination through in vitro, and in vivo analysis. (Tentative)	26-07-2023 (Ph.D)	-	-	Dr. Manzoor A. Mir	-	-
10	Aijaz Ahmad Mir	02-07-2024	1724-pgd-2020	Targeting chemoresistance in breast cancer: Unraveing molecular mechanisms and exploring novel therapeutic strategies to overcome drag resistance (Tentative)	02-07-2024 (Ph.D)	-	-	Dr. Manzoor A. Mir	-	-
11	Gowhar Nazir	26-06-2024	18801-kc-2016	Targeting chemoresistance in TNBC: Investigating the stabilization of mutant-P53 by cryptolepine and its syneogistic potential with cisplatin. (Tentative)	26-06-2024 (Ph.D)	-	-	Dr. Manzoor A. Mir	-	-

Dr. Manzoor Ahmad Mir
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P. G. PROGRAMME IN BIORESOURCES

UNIVERSITY OF KASHMIR, SRINAGAR

MODIFIED CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME

TO BE IMPLEMENTED FROM ACADEMIC SESSION 2018 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 2018 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 7 Discipline Centric Elective Courses, each having 4 credits and Project Work of 4 credits. **Project Work** is to be taken by the students in 4^{th} 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.

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

A student has to obtain 2 credits from GE and OE courses per Semester.

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**

P. G. PROGRAMME IN BIORESOURCES

UNIVERSITY OF KASHMIR, SRINAGAR

MODIFIED CHOICE BASED CREDIT SYSTEM (CBCS)

SCHEME AND COURSE STRUCTURE

TO BE IMPLEMENTED FROM ACADEMIC SESSION 2018 AND ONWARDS

SEMESTER I						
Course Code	**Course Name**	**Paper Category**	**Hours per week**			**Credits**
			L	**T**	**P**	
BR18101CR	Biodiversity and Bioresources	Core	4	0	0	4
BR18102CR	Plant Resources	Core	4	0	0	4
BR18103CR	Animal Resources	Core	4	0	0	4
BR18104CR	Lab Course I (Based on BR18101CR, BR18102CR, BR18103CR)	Core	0	0	4	2
BR18105DCE	Cellular & Molecular Biology	Discipline Centric Elective	3	0	2	4
BR18106DCE	Basic and Applied Immunology	Discipline Centric Elective	3	0	2	4

Core Courses

Semester I

BR18101CR: Biodiversity and Bioresources

Unit: I

Biodiversity and Bioresources: Concept and scope; Levels of biodiversity— organisational (genetic, species and ecosystem), spatial (alpha, beta and gamma); Valuing biodiversity— direct- and indirect use values; Concept and conservation of agro-biodiversity; Mega-biodiverse countries; Global biodiversity hotspots (criteria, distribution and conservation implications).

Unit: II

Global, national and local magnitude of biodiversity: Floral, faunal and microbial diversity; Measurement of biodiversity— Methods of survey and inventorization of biodiversity, sampling procedures, biodiversity measures and indices, biodiversity surrogates; Biodiversity informatics— concept and applications; Biodiversity monitoring— global biodiversity targets and indicators.

Unit: III

Biodiversity loss and conservation: Factors of biodiversity loss— ultimate and proximate causes; IUCN threat categories and criteria; Biodiversity and climate change— concerns and challenges; *In situ* conservation strategies— Protected Area Network (National parks, Wildlife sanctuaries and Biosphere reserves); *Ex situ* conservation strategies (Botanical gardens, Zoos, Aquaria, Cryo-banks).

Unit: IV

Role of taxonomy in biodiversity studies; Role of Remote Sensing and Geographical Information System in biodiversity studies; Indian Bioresources Information Network— organisation and role; Biodiversity conservation policy and programmes— International and national efforts; National Biodiversity Action Plan (a brief summary).

SEMESTER I

BR18102CR: Plant Resources

Unit: I

Plant resources: Archeo-ethnobotany; Origin of agriculture; Centres of origin and domestication of cultivated plants as proposed by de Candolle and Vavilov; Green revolution— benefits and adverse consequences.

Cereals and pseudocereals: Cultivation and utility of rice (*Oryza sativa*), wheat (*Triticum aestivum*), maize (*Zea mays*), buckwheat (*Fagopyrum* spp.).

Unit: II

Fodder and oil crops: General account of fodder crops, methods of domestication and utility of alfalfa (*Medicago sativa*); Origin & evolution of *Brassica juncea* and *Brasica compestris*; Extraction and processing of mustard and sunflower oil.

Fibre crops: Plant fibres, types; Origin, evolution and processing of cotton and jute.

Fruits: Cultivation and commercial importance of some fruits grown in Kashmir (apple, pear, walnut, almond, apricot).

Unit: III

Vegetables, spices and condiments: Methods of cultivation of vegetables grown in Kashmir; Wild vegetables of Kashmir (overview); Spices and condiments; Origin, distribution, cultivation and importance of saffron.

Extractives: Gums and resins**,** classification, important sources and their commercial value; Dyes and tannins, extraction, processing and use.

Unit: IV

Medicinal plants: Morphology, ethnobotanical and medicinal importance of *Arnebia benthamii*, *Aconitum heterophylum*, *Atropa acuminata*, *Podophyllum hexandrumn*, *Saussurea costus*, *Rheum emodi*, *Digitalis purpurea*, *Valeriana jatamansii*, *Viola odorata*, *Picrorhiza kurroa*, *Dioscorea deltoidea* and *Hippophae rhamnoides.*

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

SEMESTER I

BR18103CR: Animal Resources

Unit: I

Insect resources: Importance and scope of insect based industries; Silkworm breeds, synthesis of silk and cocooning, harvesting and grainage; Apiculture products and apitherapy (honey, beeswax, bee pollen, propolis, royal jelly, bee venom); Lac products, properties and their uses (lac dye, lac wax, shellac, bleached shellac, dewaxed bleached shellac, aleuritic acid); Edible insect industry.

Unit: II

Aquaculture: Fish monoculture, polyculture and composite culture; Pearl and shellfish farming; Integration of aquaculture with agriculture and animal husbandry; Natural and artificial breeding in fish; Genetic approach to fisheries; Fish as a food commodity; Fish by-products; Processing and preservation of fish and its products.

Unit: III

Livestock domestication: History of domestication; Important 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 and poultry birds; Genetic and phenotypic consequences and applications of inbreeding and out-breeding; Genetic basis of heterosis and its use.

Unit: IV

Animal products and processing: Principles and practices for production of high quality milk; Pasteurization and sterilization; Utilization of various animal and poultry by-products: blood, fat, hides, bones, wool, hair, and feather; Use of biotechnological tools in improving animal productivity; Scope of meat, fish and poultry processing industry in India.

SEMESTER I

BR18104CR: Lab Course I

(Based on BR18101CR, BR18102CR, BR18103CR)

Practical Work Based on BR18101CR

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

Practical Work Based on BR18102CR

- Study the diagnostic features of some economically important angiosperm families (Asteraceae, Apiaceae, Brassicaceae, Fabaceae, Caryophyllaceae, Rosaceae, Lamiaceae and Poaceae).
- Study various types of plant fibres.
- Study the presence and structure of starch granules and oil bodies in various food crops.
- Study some commonly used spices and condiments.
- Pseudocereal- Buckwheat: Morphological features and seed structure; Test for presence of starch and proteins.
- Study the diagnostic features and medicinal importance of native medicinal plants of Kashmir Himalaya.

Practical Work Based on BR18103CR

- Study of modifications in legs of honey bees.
- Study of life history of silk worm by rearing.
- Dissection of silk glands of the silk worm larva.
- Preparation of permanent slides of mouth parts, spiracles and appendages of larva.
- Identification of culturable fishes in Kashmir valley.
- Demonstration of induced-breeding technology in cultured fishes.
- Study of growth and age in fishes.
- Field trips to an organised fishery.
- Identification of various breeds of cattle, buffalo, sheep and goat.
- Quality analysis of honey.
- Bacteriological examination of milk by clot on boiling test and methylene blue reduction MBR test.
- Structure of wool.

DISCIPLINE CENTRIC ELECTIVE COURSES

SEMESTER I

BR18105DCE: Cellular and Molecular Biology

Unit: I

Membrane structure: Structure and composition of biomembranes (Fluid Mosaic Model); Membrane fluidity, membrane rafts; Cell adhesion molecules (overview), tight junctions, gap junctions and plasmodesmata; Extracellular matrix; Cytoskeleton— microtubules, actin filaments, intermediate filaments.

Unit: II

Intracellular organelles: Structural organization of nucleus (nuclear membrane and nuclear pore complex), mitochondria, chloroplast, golgi bodies, endoplasmic reticulum, ribosome, lysosomes, peroxisomes, vacuoles; Genome organization in mitochondria and chloroplast.

Cell division and cell cycle: Mitosis and meiosis; Phases of cell cycle, cell cycle check points and control of cell cycle.

Unit: III

Nucleic acids: Structure of DNA double helix; Various forms of DNA (A, B, Z and H DNA); Packaging of genetic material (Nucleosome organization); DNA replication— enzymes, mechanism of DNA replication; RNA synthesis— promoters, transcription factors, mechanism of transcription; Structure of mRNA & tRNA.

Unit: IV

Protein synthesis: Genetic code; Aminoacylation of tRNA, initiation, elongation & termination of translation; Post translational modifications and protein trafficking.

Regulation of gene expression: Operon model in prokaryotes (lac operon, tryptophan operon and arabinose operon); Transcription attenuation; Regulation of transcription in eukaryotes— promoters and enhancers, activators and repressors, Role of chromatin in regulating gene expression; DNA methylation, miRNAs.

Practical Work:

- Microscopy in study of cell structure.
- Comparative study of Prokaryotic & eukaryotic cells and Plant & animal cell.
- Study Membrane stability Index.
- Centrifugation for separation of cell organelles.
- Study of stages of Meiosis and Mitosis.
- Study pollen mother cell meiosis.
- Study meiotic stages during gamete formation in grasshopper
- Study stages of mitosis from root tips.
- Extraction of Nuclear DNA.

SEMESTER I

BR18106DCE: Basic and Applied Immunology

Unit: I

Immune System and its organs: Introduction to immune system, Immune system as defense, Timeline of immunology related developments, Overview of Infections and Diseases, Detailed overview of Immune organs, Composition of Blood and types of immune cells, Structure & function of Immune cells. Hypersensitivity and complement system.

Unit: II

Natural and acquired Immune Response: Immunity and types of Immunity, Natural Immunity (Physiological, anatomical and cellular barriers to infections),Cells and factors of natural immunity, Mechanism of Innate immunity, Acquired Immunity as second line of defense, Characteristics of Acquired immunity, Phagocytosis, opsonization and PAMPS, PRRs and TLRs

Unit: III

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, auto antigens, Antibody structure (regions, domains and various chains), Isoforms of antibodies,Types of Antibodies (Structure, presence and functions), Digestion of antibodies and antibody fragments, Mechanism of Inflammation, introduction to Cytokines and Interferon's.

Unit: IV

Serological techniques: Theory and principles of routine clinical immunology procedures; Serology, Materials and methods necessary for basic serology tests (Collection, preparation and preservation of specimen), Complement inactivation, Serial dilution, determinations of end point and titer. HCG and pregnancy, Pregnancy test, Factors affecting pregnancy tests; Disease characteristics, clinical manifestation and laboratory diagnosis of AIDS.

Practical Work:

- Determination of the bleeding time and TLC and DLC of human blood.
- Permanent mount preparation of parasitic Protozoa.
- Demonstration of phagocytosis.
- Demonstration of Haemagglutination.
- Demonstration of ELISA .
- MTT and Tryphon blue tests for viability of cells.

P. G. PROGRAMME IN BIORESOURCES

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MODIFIED CHOICE BASED CREDIT SYSTEM (CBCS)

SCHEME AND COURSE STRUCTURE

TO BE IMPLEMENTED FROM ACADEMIC SESSION 2018 AND ONWARDS

SEMESTER II						
Course Code	**Course Name**	**Paper Category**	**Hours per week**			**Credits**
			L	**T**	**P**	
BR18201CR	Plant Resource Regeneration	Core	4	0	0	4
BR18202CR	Animal Resource Regeneration	Core	4	0	0	4
BR18203CR	Bioenergy and Biofuels	Core	4	0	0	4
BR18204CR	Lab Course II (Based on BR18201CR, BR18202CR, BR18203CR)	Core	0	0	4	2
BR18205DCE	Inheritance Biology	Discipline Centric Elective	3	0	2	4
BR18206DCE	Biofertilizers & Biopesticides	Discipline Centric Elective	3	0	2	4

Core Courses

Semester II

BR18201CR: Plant Resource Regeneration

Unit: I

Asexual reproduction in plants: Types of vegetative propagation; Importance of vegetative reproduction; Apomixes; Adventive embryony; Apospory and apogamy; Parthenocarpy.

Floral evocation: Transition to flowering; Homoeotic mutations; Floral organ development in *Arabidopsis* and *Antirrhinum.*

Unit: II

Sexual reproduction in angiosperms: Structure and development of anther; Role of tapetum; Structure and development of male gametophyte; Structure, development and types of ovules; Structure and development of female gametophyte; Types of embryosac in angiosperms.

Unit: III

Pollination and fertilization: Pollination mechanisms and vectors; Double fertilization; Endosperm development, types of endosperm; Embryo development (monocot and dicot embryos); Fruit development; Seed dispersal; Importance of sexual reproduction in plants; Self incompatibly, molecular basis of self incompatibility; Male sterility.

Unit: IV

In-vitro regeneration: Cellular totipotency; Micro propagation- cell and organ differentiation, Somatic embryos, synthetic seeds; Advantages of Micropropagation; Somaclonal variation; Production of haploids (anther and ovule culture); protoplast culture, cytoplasmic hybrids or cybrids; Plant growth regulators in tissue culture.

SEMESTER II

BR18202CR: Animal Resource Regeneration

Unit: I

Principles of animal development: Basic concepts of development— potency, commitment, specification and its types, induction, competence, determination and differentiation; Morphogenetic gradients; Cell fate and cell lineages; Genomic equivalence and the cytoplasmic determinants; Genomic Imprinting; Mutants and transgenics in analysis of development.

Unit: II

Early embryonic development: Gametogenesis (Production of male and female gametes) Spermatogenesis and Oogenesis;Types of eggs,Fertilization and Zygote formation, Mechanism of cleavage; Blastula formation; Gastrulation and formation of germ layers. Fat maps of germinal layers.

Unit: III

Morphogenesis and organogenesis: Axis and pattern formation in *Drosophila* and amphibia; Organogenesis—vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; Environmental regulation of normal development.

Unit: III

Hormones in Embryonic Development: Reproduction and hormonal functions of the male and female: physiologic anatomy of the male and female sexual organs. Testosterone and other male sex hormones, abnormalities of the male sexual function (Prostrate, hypogonadism), Pineal gland. Ovarian cycle and functions of the ovarian hormones. Abnormalities of secretion by ovaries. Hormonal factors in pregnancy.

SEMESTER II

BR18203CR: Bioenergy and Biofuels

Unit: I

Introduction: Concept of bioenergy; Biomass as energy source; Biomass feedstocks and biomass feedstock characterization; Biomass fuel analysis; Wood pellet technology; Pyrolysis and gasification of biomass; History and classification of biofuels (first, second, third and fourth generation biofuels).

Unit: II

Liquid biofuels: Vegetable oils as fuels; Biodiesel, concept & history; Biodiesel production by transesterification; Properties of biodiesel; Algae as a source of biodiesel; Production of bioethanol; Lignocellulosic biomass as feedstock for ethanol production; Ethanologens.

Bioenergy crops: Jatropa, Sugarcane, Sweet sorghum, Pongamia and Maize.

Unit: III

Gaseous biofuels: Biogas production process; Biogas processing technologies for anaerobic digestion; Biohydrogen; Green algae and cyanobacteria as powerhouses of biohydrogen; Biohydrogen from biorenewable feedstocks; Artificial photosynthesis; Hydrocarbon biofuels.

Unit: IV

Biofuel economy and policy: Estimation of biofuel prices; Biodiesel and bioethanol economy; Current status of biodiesel production in India; Biorenewable energy costs and biohydrogen economy; Bioenergy policy and impact of bioenergy programmes in India (Overview); Global biofuel projections.

SEMESTER II

BR18204CR: Lab Course II

(Based on BR18201CR, BR18202CR, BR18203CR)

Practical Work Based on BR18201CR

- 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.

Practical Work Based on BR18202CR

- 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 BR18203CR

- 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.

DISCIPLINE CENTRIC ELECTIVE COURSES

SEMESTER II

BR18205DCE: Inheritance Biology

Unit: I

Laws of inheritance: Dominance, segregation and independent assortment; Types of dominance; Lethal alleles; Multiple alleles; Test of allelism; Gene interaction— complementation, epistasis and pleiotropy.

Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes; Maternal inheritance.

Unit: II

Linkage and Recombination: Linkage, linkage maps, 3 point test cross; Homologous and non homologous recombination; Gene mapping in prokaryotes through transduction and conjugation; Sex-linked inheritance— sex limited and sex influenced traits; Mechanism of sex determination.

Quantitative inheritance: Genes and environment— heritability, penetrance and expressivity.

Unit: III

Mutations: Spontaneous and induced mutations, molecular mechanism of mutations (chemical mutagens and physical mutagens); Suppressor, missense, nonsense and silent mutations.

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation; Auto- and allo-polyploidy and their genetic implications.

Unit: IV

Human genetics: Pedigree— gathering family history, construction of pedigree; Pedigrees of sex-linked, autosomal and mitochondrial traits; Genetic disorders (Klinefelter -, Turner-, Patau-, Down- & Edward's syndrome).

Population genetics: 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.
- Carryout karyotype analysis and develop a karyogram of onion.
- Construction of Linkage maps from given data.
- Study sex chromatin in somatic cells.
- 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.

SEMESTER II

BR18206DCE: Biofertilizers and Biopesticides

Unit: I

Biofertilizers: Concept, types and prospects; Bacterial biofertilizers— morphology, life cycle, isolation, cultivation, association, inoculation and methods of application of *Azotobacter, Rhizobium* and *Frankia*.

Phosphorous Solubilising Microorganisms (PSMs): Introduction, isolation, culture, mass production and inoculation.

Unit: II

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 (AM): Morphology, association, cultivation, inoculation, role and application.

Unit: III

Biopesticides: Definition, types, merits and demerits; Biofungicides— fungal fungicides, bacterial fungicides, fungal nematicides (role and application).

Bioherbicides: Concept, current status and prospects; Mass production and commercial formulations; Role of biocontrol in Integrated Pest Management.

Unit: IV

Bacterial insecticides: Classification and mode of action with special reference to *Bacillus thuringenesis;* Methods of uses and symptoms of infection.

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.

Practical Work:

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

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SEMESTER III						
Course Code	**Course Name**	**Paper Category**	**Hours per week**			**Credits**
			L	**T**	**P**	
BR18301CR	Biomolecules	Core	4	0	0	4
BR18302CR	Secondary Metabolites	Core	4	0	0	4
BR18303CR	Biostatistics & Biotechniques	Core	4	0	0	4
BR18304CR	Lab Course III (Based on BR18301CR, BR18302CR, BR18303CR)	Core	0	0	4	2
BR18305DCE	Biological Interactions	Discipline Centric Elective	3	0	2	4
BR18306DCE	Wood Resource Utilization	Discipline Centric Elective	3	0	2	4
BR18306DCE	Cellular and Molecular Immunology	Discipline Centric Elective	3	0	2	4

CORE COURSES

SEMESTER III

BR18301CR: Biomolecules

Unit: I

Water: Properties of water and its role in the biological systems; pH and its significance in biological systems; Buffer systems and their importance.

Biological membranes: Solute transport across the membranes; Membrane potential; Vesicular transport— coat proteins, cargo selection, vesicle budding and vesicle fusion.

Unit: II

Carbohydrates: Classification, chemical and optical properties of carbohydrates; Role of monosaccharides in important biological reactions; Oligosaccharides and polysaccharides (sucrose, starch, cellulose, hemicelluloses, pectins).

Lipids: Classification; Biological functions of triacylgycerols, phospholipids, glycolipids, sphingolipids and cholesterol.

Unit: III

Amino acids: Occurrence, structure and classification of amino acids; Properties of amino acids, stereoisomerism in amino acids.

Proteins: Protein structure; Protein folding (concept of chaperones); Fibrous and globular proteins (α-keratin, collagen, haemoglobin); Actin, myosin and molecular motors (overview).

Unit: IV

Enzymes: Mechanism of enzyme action; Kinetics of single substrate enzyme catalyzed reactions— Michaelis-Menton equation; Enzyme inhibition and allosteric regulation.

Nucleic acids: Nucleotides, Phosphoryl group transfer and ATP; RNA splicing; DNA damage and repair mechanisms; Transposable elements in prokaryotes and eukaryotes (examples from bacteria and maize).

SEMESTER III

BR18302CR: Secondary Metabolites

Unit: I

Phenolic compounds and isoprenoids: Phenolic compounds— occurrence and classification; Shikimic acid pathway for synthesis of phenolic compounds; Terpenes— Occurrence; Classification based on isoprene rule; Biosynthesis of terpenes; Importance of rubber as a bioresource;

Steroids: Occurrence, structure and biological functions of major plant and fungal steroids.

Unit: II

Alkaloids: Introduction, occurrence, classification based on nitrogen heterocyclic ring; Use of alkaloids by humans from historical perspective; Nomenclature (true, proto and pseudo-alkaloids); Biological functions of alkaloids; Non protein amino acids; Glycosylated N-containing toxins.

Unit: III

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, flavonols, flavones; Phenolics and Quinoids— structure, occurrence and function (napthaquinones, anthraquinones, tannins, lignins); Indole derivatives— structure, occurrence and function (betalains, phytomelanins, indigo).

Unit: IV

Importance of secondary metabolites: Perspectives in human health; Effect of biotic and abiotic stresses on secondary metabolites in plants; Allelopathic effects of secondary metabolites; Taxonomic significance of secondary metabolites.

SEMESTER III

BR18303CR: Biostatistics and Biotechniques

Unit: I

Data types and collection: Data on ratio, interval, ordinal and nominal scales; Continuous and discrete data; Methods of primary and secondary data collection and their limitations.

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

Unit: II

Testing of hypothesis: Basic concept, procedure for hypothesis testing, test of difference between means— independent and paired samples, test of proportions and test of goodness of fit.

Sampling techniques: Principles and steps in sample survey; Procedures and practices involved in simple random sampling, systematic, stratified and cluster sampling.

Unit: III

Design and analysis of experiments: Principles of experimentation; Experimental designs— layout, analysis of variance and comparison of treatments in completely randomised design, randomised complete block design and factorial experimental designs.

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

Unit: IV

Microscopy & spectroscopy: Principle, working & application of fluorescence, phase contrast, scanning electron and transmission electron microscopy; Principle and working of a spectrophotometer; Application of spectroscopic techniques (UV-visible, IR, NMR).

Chromatography: Paper, thin layer, Gas-liquid chromatography; Ion exchange, adsorption and molecular exclusion chromatography; High performance liquid chromatography (HPLC); Radioisotopes— applications in biology.

SEMESTER III

BR18304CR: Lab Course III

(Based on BR18301CR, BR18302CR, BR18303CR)

Practical Work Based on BR18301CR

- Extraction and estimation of total titrable acidity in plant extract.
- Effect of various physical and chemical treatments on membrane permeability.
- Preparation of calibration graph for the estimation of starch and proteins.
- Determination of the time course of diastase action on starch.
- Determination of polyphenol oxidase activity.
- Extraction of proteins from fresh material.

Practical Work Based on BR18302CR

- Separation of pigments from leaf extract using phase separation method.
- Detection of presence of phenolics, alkaloids and flavonoids in plant material.
- Preparation of calibration graph for the estimation of total phenols.
- Estimation of free radicle scavenging activity of plant extract.
- Study the effect of pH on the anthocyanins from fruit extracts.

Practical Work Based on BR18303CR

- 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).
- Demonstration of scanning electron microscopy (SEM).
- Use of paper and thin layer chromatography for the separation of plant pigments.
- Study the principal and working of colorimeter and UV- Visible spectrophotometer.

DISCIPLINE CENTRIC ELECTIVE COURSES

SEMESTER III

BR18305DCE: Biological Interactions

Unit: I

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

Social and community interactions of animals: Heritable basis of behaviour; Learned behaviour; Communication signals; Courtship, mating, parenting and individual reproductive success; 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

Biosignaling: General features of signal transduction pathways; Diversity of basic signaling cascades (brief idea) with emphasis on Protein kinases, Phosphoinositides, G-protein complex and Calcium mediated signaling; Two component sensor-regulator system in bacteria, plants and animals (one example each). Bacterial chemotaxis and quorum sensing.

Unit: IV

Applied Immunology: Immune system; antigens and antibodies; Types of immunoglobulins (overview); structure of antibody, Immune response system, antibody mediated responses; Allergic disorders (introduction, diagnosis and clinical manifestations); Aeroallergens (identification, isolation and impact on human health); Role of immunotherapy in allergic disorders.

Practical work:

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

SEMESTER III

BR15306DCE: Wood Resource Utilization

Unit: I

Introduction: Wood as a resource; Wood Structure- Wood elements in gymnosperms, monocots and dicots; Formation of wood in gymnosperms and dicots.

Wood growth: Formation of wood cambium and its derivatives, secondary xylem; Growth rings, Properties of secondary xylem; Soft wood and hard wood, sap wood and heartwood, knots; Reaction wood.

Unit: II

Physical properties of wood: Colour, luster, odour, weight, and density; Variation in density of early and late wood constituents, effect of growth rings on density.

Chemical properties of wood: Cellulose & hemi-cellulose— structure, chemical properties, effect of acids and bases; Lignin— structure and chemical properties; Wood extractives.

Unit: III

Wood deterioration and preservation: Wood boring insects— termites and carpenter ants; Wood destroying fungi; Wood preservation processes — non pressure and pressure processes; Wood preservative.

Wood seasoning: Concept & importance; Air seasoning— air drying, accelerated air drying; Special seasoning methods— drying by boiling in oily liquids and vacuum drying.

Unit: IV

Commercially important wood species in Kashmir: Description, habitat, type of wood and uses of pine, deodar, silver fir, willow, poplar and walnut.

Wood products: Wood as fuel; Saw dust and its uses, wood pellet technology, Wicker works and their importance as sources of income in Kashmir; Wood resources and sports items; Water resistant woods, Wood as timber, Plywood.

Practical Work:

- Morphology of important wood species of Kashmir Kashmir Himalayas.
- Study stem anatomy hard and soft wood species.
- Study various types of wood elements in gymnosperms and angiosperms.
- Study resin canals in gymnosperms.
- Study Physical properties of wood.
- Extraction of cellulose from a given sample of plant material.
- Proximate analysis of various samples wood.

SEMESTER III

BR15307DCE: Cellular and Molecular Immunology

Unit I: Antigen Processing And Presentation

Phagocytosis and inflammation, Generation of anti microbial mechanisms, Receptors (TLR, Scavenge receptor etc.) of the innate immunity, Structure and functions of MHC molecules, Organisation of MHC genes & MHC molecules, expression patterns, The endogenous and exogenous pathways of antigen processing and presentation, Self-MHC restriction, Signal transduction pathways in activation of innate immunity. Presentation of non peptide antigen.

Unit II: Hypersensitivity

Hypersensitivity and Allergy - Definition, Classification, Distinguishing Features of Immediate and Delayed Hypersensitivity, IgE Mediated Hypersensitivity (Type 1), Method used for Detection. Antibody Mediated Cytotoxicity (Type II) Hypersensitivity, Mechanism and Examples, Immune Complex (Type III) Hypersensitivity: Localized and Generalized Type III Reactions, Mechanism, Anybody Mediated Cell Stimulation (Type V) Hypersensitivity. Mechanism, Delayed (Type IV) Hypersensitivity Mechanism and Important Aspect in Diagnosis of Diseases

Unit III: Tumor Immunology

Theory of Immune surveillance; Host immune response to tumors; Tumor escape mechanisms; Tumor immune therapy: Cytokine based therapy, Monoclonal antibodies based therapy, Chemo therapy; Immunology in detection of cancer.

Unit IV: Autoimmunity

Theories of breakdown in self-tolerance; Classification of autoimmune diseases; Autoantibodies, 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.

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SEMESTER IV						
Course Code	**Course Name**	**Paper Category**	**Hours per week**			**Credits**
			L	**T**	**P**	
BR18401CR	Plant Resources and Biotechnology	Core	4	0	0	4
BR18402CR	Animal Cell and Tissue Technology	Core	4	0	0	4
BR18403CR	Microbial Technology	Core	4	0	0	4
BR18404CR	Lab Course IV (Based on BR18401CR, BR18402CR, BR18403CR)	Core	0	0	4	2
BR18405DCE	Bioinformatics	Discipline Centric Elective	3	0	2	4
BR18406DCE	Term Work	Discipline Centric Elective	-	-	-	4

Core courses

Semester IV

BR18401CR: Plant Resources and Biotechnology

Unit: I

Plant tissue culture: Concept and applications of plant tissue culture; Cellular totipotency; Cell culture and cell cloning; Micropropagation— regeneration through callus cultures, adventitious buds and non adventitious systems (apical and axillary buds); Production of somatic embryos; synthetic seeds (concept); Somatic hybrids & cybrids (Brief idea).

Unit: II

Genetic engineering: Introduction, scope and applications; Cloning vectors— Plasmids, cosmids, phages, artificial chromosomes; Expression vectors; Recombinant DNA technology— Restriction enzymes, ligation, transformation and selection; Construction of genomic and cDNA libraries; Gene transfer methods in plants— *Agrobacterium* mediated gene transfer; Physical methods of gene transfer; Reporter genes.

Unit: III

Molecular markers: PCR— principle and applications, RFLP, RAPD, AFLP, SSR, SNPs, SCARs & their applications; Molecular cytogenetic markers— FISH and GISH, their applications; Quantitative trait loci (QTL) mapping— introduction and types of mapping populations.

Unit: IV

Genetically modified crops: Transgenics for biotic and abiotic stress (insect resistance, virus resistance, herbicide resistance); Modification of plant nutritional content (vitamins, aminoacids, lipids, Iron); GMO's— ecological and ethical concerns.

Biotransformation: Plants as Bioreactors; Transgenic plants for biochemical production— edible vaccines, and secondary metabolites.

SEMESTER IV

BR18402CR: Animal Cell and Tissue Technology

Unit: I

Animal cell and tissue culture: History, scope and applications; Culture media, culture procedures and techniques; Transfection, targeted transfection, transient and stable transfections; Large scale culture of cell lines for production of biomolecules (viral vaccines, interferons, recombinant proteins and hybrid antibodies).

Unit: II

Culture products: Somatic cell fusion, hybridoma technology and production of monoclonal antibodies.

Stem cells: Stem cell lines– origin and types, stem cell therapy and its applications.

Immunodiagnostics: Blood grouping; Rh typing; Immuno electrophoresis; Enzyme linked Immuno Sorbent Assay (ELISA); Radio Immuno Assay (RIA).

Unit: III

Tissue engineering: Concept, approaches, prospects and limitations; Biomaterials for tissue engineering; Tissue engineering of skin and haemoglobin-based blood substitutes; Artificial womb technology.

Unit: IV

Animal cloning: *In vitro* fertilization and embryo transfer; Cloning livestock by nuclear transplantation; Production of transgenic animals with special reference to transgenic mice, cow and sheep; Identification and transfer of genes influencing milk quality and disease resistance.

SEMESTER IV

BR18403CR: Microbial Technology

Unit: I

Microbial genome: Bacterial genome structure, replication (DNA and plasmid); Genetic exchange (transformation, transduction and conjugation); Recombination (hosts, vectors and mechanism); Replication of Bacteriophages: Viral multiplication (lytic and lysogenic).

Unit: II

Culturing of microbes: Isolation and screening of microorganisms; Cultivation of microbes- nutritional requirements and factors affecting microbial growth (pH, temperature, water, oxygen, CO_2); Culture types— static cultures, suspension cultures; synchronous cultures, growth curve, generation time, growth kinetics; Storage and transportation of microbes.

Unit: III

Fermentation technology: Introduction; Types of fermentation (aerobic, anaerobic), fermentors 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

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

SEMESTER IV

BR18404CR: Lab Course IV

(Based on BR18401CR, BR18402CR, BR18403CR)

Practical Work Based on BR18401CR

- Demonstration of plant tissue culture technique (sterilization, media preparation and inoculation).
- Isolation of plant genomic DNA by CTAB method.
- Visualization of DNA by Agarose Gel Electrophoresis.
- Demonstration of Polymerase Chain Reaction.
- Preparation of mitotic chromosome preparation from root tips.

Practical Work Based on BR18402CR

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

Practical Work Based on BR18403CR

- Estimation of CO_2 in water samples obtained at different stages of Sewage Treatment Plant (STP).
- Estimation of dissolved oxygen in given water sample.
- Check the efficacy of antibiotics on a given microbial sample.
- To grow bacteria from cheek sample of mouth on nutrient medium.
- Study the preparation of yogurt.
- Study the procedure to ascertain the milk quality.

DISCIPLINE CENTRIC ELECTIVE COURSES

SEMESTER IV

BR17405DCE: Bioinformatics

Unit: I

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

Sequencing: Conventional and next generation sequencing; Basic Concept of sequence similarity, identity and homology; Sequence based database searches (blast, fasta, gcg, msf, nbrf-pir etc.); Homologues, orthologues, paralogues; Sequence alignment (pair-wise and multiple); Gene finding and genome annotation; **Transcriptomics:** DNA Microarray, Serial analysis of gene expression, Qualitative RT PCR.

Unit: III

Emerging areas of bioinformatics: Computational systems biology, semantic web; Bioontologies (types, application, softwares), annotations; Proteomics— separation, identification of proteins, MS-MS, protein microarray, protein expression profiling, protein- protein interaction mapping; Metabolomics, cheminformatics, phenomics.

Unit: IV

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, NTSY Spc).

Practical Work:

- Role of NCBI, EBI, TIGR and SANGER in maintaining sequence data.
- Demonstration of BLAST and FASTA.
- Study Pairwise and Multiple sequence alignments.
- Demonstration of MSA.
- Construction of Phylogenetic trees using morphological and molecular data.
- Tools for obtaining information about primary structure of proteins.

SEMESTER IV

BR17406DCE: Project Work

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.

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GENERIC ELECTIVES (GE)						
Course Code	**Course Name**	**Paper Category**	**Hours per week**			**Credits**
			L	**T**	**P**	
BR18001GE	Industrial Entomology	Generic Elective	2	0	0	2
BR18002GE	Algal Resources	Generic Elective	2	0	0	2
BR18003GE	Microbial Resources	Generic Elective	2	0	0	2
BR18004GE	Bioresource Management	Generic Elective	2	0	0	2
BR18005GE	Biomedicine & Bioprospecting	Generic Elective	2	0	0	2
BR-18006GE	Biocontrol and Crop Management	Generic Elective	2	0	0	2
BR-18007GE	Biocosmetics	Generic Elective	2	0	0	2
BR18008GE	Organic Farming	Generic Elective	2	0	0	2
BR19007GE	Hormones in Human Health	Generic Elective	2	0	0	2

BR18001GE: Industrial Entomology

Unit: I

Apiculture: Importance and scope; Bee species (biology, morphology, behaviour, and habitat); Bee keeping equipment, hives, bee pasturage and seasonal management; Honey extraction; Factors affecting honey yield; Properties and uses of honey; Granulation, fermentation and storage of honey; Uses of other bee products; Bee enemies including diseases and their control.

Unit: II

Sericulture: Silkworm species, systematic position and salient features; Rearing techniques of mulberry, muga, eri and tassar silkworms; Nutritional requirements of silkworms; Sericulture rearing house and appliances; Grainage technology and cocoon marketing; Enemies and diseases of silkworms and their management; By-products of sericulture.

Unit: III

Lac culture: Lac insect, biology and habitat; Host trees— pruning, inoculation, lac cropping techniques and harvesting; Enemies of lac insect and their control; Processing techniques of lac (traditional and modern); Physical and chemical characteristics of lac.

Unit: IV

Beneficial Insects: Insects as pollinators and biocontrol agents; Insects as soil fertility improving agents and scavengers; Use of insects and insect products in medicine; Use of insects in scientific investigations; Use of insects as food source.

BR18002GE: Algal Resources

Unit: I

Algae: Introduction, habit and habitat, micro and macro-algae; Distribution in soil, freshwater and marine habitats; Contribution in primary productivity; Immobilized and inactivated algal biomass for metal and nutrient removal.

Unit: II

Algae as food and fodder: Algae as a source of vitamins, proteins, lipids, carbohydrates, minerals and iodine; Algae as fodder for cattle and poultry, seaweeds as animal feed**;** Agar agar, alginates and carrageenin.

Unit: III

Algae in pharmaceuticals: Algae as source of antimicrobials, antivirals and antifungals, neuroprotective proteins, therapeutic proteins and drugs; Use of algae in the light of modern research— as antioxidants and anticancer agents; Use of algae in forensic medicine research and HIV vaccine model.

Unit: IV

Algal biofuels and biofertilizers: Energy and chemicals; Biodiesel, hydrogen production-mechanism, progress and prospects; Mechanism of biological nitrogen fixation by cyanobacteria; Cyanobacteria as biofertilizers for paddy cultivation, reclamation of usar lands.

BR18003GE: Microbial Resources

Unit: I

Microbial resources— historical perspective; Types of microbial resources (algal, fungal, bacterial, viral); Approaches for the assessment of microbial diversity (culture dependent and independent); Morphology and ultrastructure of bacteria and viruses (bacteriophages); Microbial growth and growth curve.

Unit: II

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: III

Bioremediation; Role of microbes in bioremediation of soil and water; Role of microbes in waste water treatment (processes based on attached microbial growth, activated sludge process).

Unit: IV

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

BR18004GE: Bioresource Management

Unit: I

Bioresource management: Exploitation of bioresources and sustainable development; Forest resource management (social forestry, agro forestry and NWFPs); Grassland management; Freshwater & marine bioresource management; Wildlife management.

Unit: II

Monitoring biodiversity: Methods for monitoring biodiversity trends; Mega biodiversity zones and global biodiversity hotspots; Threats to biodiversity, species extinction; IUCN threat categories, Red data book.

Unit: III

Conservation programmes: Principles and strategies of biodiversity conservation; *In situ* and e*x situ* conservation strategies; Role of remote sensing and geographical information system in biodiversity studies; Principles and methodologies for soil conservation and restoration; Biovillages.

Unit: IV

Acts and policies: Forest Conservation Act 1981; Environment (protection) Act 1986; Hazardous waste (Management and Handling) Rules 1989; Bio-Medical Waste (Management and Handling) Rules 1998; Environmental Impact Assessment (EIA); Environmental Management Plan (EMP) and Environmental Clearance for Establishing Industry (ECEI); National Biodiversity Action Plan National Biodiversity Act 2002.

BR18005GE: Biomedicine and Bioprospecting

Unit: I

Biomedicine: Introduction, present scenario & future prospectus; Sources of drugs (plants, animals, microorganism, drugs from organic synthesis); Historical development and present status of Chinese/ Amchi, Ayurvedic, Unani Sidha and Homeopathic systems of medicine.

Unit: II

Ethnobotany: Concept; Ethnobotanical and medicinal importance of some important medicinal plants of Kashmir viz. *Arnebia benthamii*, *Aconitum heterophylum*, *Atropa acuminata*, *Podophyllum hexandrum*, *Saussurea costus*, *Rheum emodi*, *Digitalis purpurea*, *Valeriana jatamansii*, *Viola odorata*, *Picrorhiza kurroa*, *Dioscorea deltoidea* and *Hippophae rhamnoides.*

Unit: III

Herbal crude medicines: Classification, collection and processing; Various separation techniques for extraction of crude medicine, advantages and limitations; Plant drug standardization; Quality control and quality assurance of herbal drugs; Drug acts and rules.

Unit: IV

Bioprospecting: Concept and methods of bioprospecting; Role of traditional knowledge in bioprospecting; Biopiracy, case studies of biopiracy (Basmati, Neem, Turmeric, Periwinkle, Enola bean); Traditional Knowledge Digital Library (TKDL)— concept and importance.

BR18006GE: Biocontrol and Crop Management

Unit: I

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 methods and effective evaluation techniques of biocontrol agents.

Unit: II

Plant disease management: Principles of plant disease management; Organic amendments and botanicals to control plant disease; Disease resistance and molecular approach for disease management; Fungicides, bactericides and antibiotics in disease management; Nature, properties and mode of action of antifungal, antibacterial and antiviral chemicals.

Unit: III

Post harvest diseases: Concept of post harvest diseases; Importance with reference to environment and health; Postharvest management; Cultural practices in perpetuation of pathogens; Phytoextracts in controlling post-harvest diseases and improving the shelf life of produce.

Unit: IV

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; Economic Threshold Levels (ETL), Economic Injury Levels (EIL) and their determination.

BR18007GE: Biocosmetics

Unit: I

Biocosmetics: History of biocosmetics; Importance of plant and animal resources in biocosmetics; Global market of biocosmetics; Manufacture and import of biocosmetics; Labelling, packaging and standardization of biocosmetics; Scope of biocosmetics industry in Jammu and Kashmir.

Unit: II

Skin cosmetics: Skin and hand creams; Facial skin care; Body lotions and bath time herbs; Sun screen products, skin tonics and anti-acne creams; Botanicals in skin care.

Unit: III

Hair cosmetics: Formulation of shampoos, surfactants and conditioners; Types of shampoos with emphasis on herbal shampoos; Hair colourants, fixers, sprays and gels; Botanicals in hair care.

Unit: IV

Perfumes and fragrances: Selection of fragrance; Raw material used in the preparation of fragrance; Fragrance and allergenicity, water soluble fragrances; Aromatherapy (Historical perspective, essential oils, aromatherapy for stress relief, weight loss and beauty aid).

BR18008GE: Organic Farming

Unit: I

Organic agriculture: Principles of organic agriculture; Objectives and requirements of organic standards; Criteria for substances used in organic production and processing; Standard for organic production and processing; Organic certification; Organic farming and food security.

Unit: II

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; Breeding of organic varieties.

Unit: III

Organic animal husbandry: Animal management; Animal origin and conversion period; Breeds and breeding; Mutilations; Animal nutrition; Veterinary medicine; Transport and slaughter; Bee keeping.

Unit: IV

Vermiculture and vermicompositing: Species selection, environmental requirements; Vermicompositing—methods, materials and advantages; Role in soil fertility, plant growth promotion and disease management.

BR19007GE HORMONES IN HUMAN HEALTH **Credits: Two (02)**

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 theraphy.

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OPEN ELECTIVES						
Course Code	**Course Name**	**Paper Category**	**Hours per week**			**Credits**
			L	**T**	**P**	
BR18001OE	Human Health and Plant Diet	Open Elective	2	0	0	2
BR18002OE	Infectious Diseases and Human Health	Open Elective	2	0	0	2
BR18003OE	Infectious Diseases and Livestock Health	Open Elective	2	0	0	2
BR18004OE	Bioindustries	Open Elective	2	0	0	2

BR18001OE: Human Health and Plant Diet

Unit: I

Introduction: Plants in the diet of hunter gatherers; Plants in modern western diet; Plants as sources of proteins, carbohydrates, fats, vitamins and minerals.

Unit: II

Good things from plants in the diet: Fibre, Antioxidants; Gut microbiotome; Role of phytonutrients in influencing gut microbiotome.

Unit: III

Plants as source of healthy diet: Natural health products; Algae and fungi as source of human food; Plant diet in pregnancy, lactation, infancy, childhood and adolescence.

Unit: IV

Plant diet and diseases: Impact of food matrix and phytonutrients against chronic diseases; Plant diet and disease management— diabetes, heart disease, cancer, obesity; Plants in nutrition fitness and sports; Food safety; Food poisoning.

BR18002OE: Infectious Diseases and Human Health

Unit: I

Introduction to Infectious Diseases: Basic concepts in pathophysiology of infectious diseases, Outline of physiological mechanisms leading to diseased state, Infectious disease transmission, Infection and immunity, Acute and chronic Infections, Major infectious diseases of humans.

Unit: II

Bacterial Infections: Pathogenesis, mechanisms of pathogenesis; transmission, epidemiology, public health implications, diagnosis, prophylaxis and treatment of major human infections (Tuberculosis, Cholera, Typhoid).

Unit: III

Viral Diseases: Pathogenesis, mechanisms of pathogenesis; transmission, life cycle, epidemiology, public health implications, diagnosis, prophylaxis and anti-retroviral therapy of Human immunodeficiency virus (HIV/AIDS); Sexually transmitted diseases.

Unit: IV

Fungal and Protozoan Diseases:

Pathogenesis, mechanisms of pathogenesis; transmission, life cycle, epidemiology, public health implications, diagnosis, prophylaxis and treatment of major Fungal human pathogens: (Dermatophytes, Candida, Aspergillus); Protozoal human pathogens (Plasmodia and Trypanosoma).

BR18003OE: Infectious Diseases and Livestock Health

Unit: I

Nature and Consequences of Parasitism: Parasitology, types of parasites, life cycle of different parasites, Host Parasitic associations; Parasitic adaptations; morphological and physiological adaptations; Host parasite interaction, Effects on the Parasite, Effects on the host; Zoonosis- Classification (reservoir host, etiological agent and type of life cycle).

Unit: II

Bacterial Diseases in Livestock: Anthrax Aetiology, Pathogenesis, Diagnosis and Control; Salmonellosis (Gastroenteritis) Pathogenesis, Diagnosis and Control; Avian Cholera Aetiology, Pathogenesis, Diagnosis and Control; Brucellosis, Pathogenesis, Diagnosis and Control.

Unit: III

Viral and Fungal Diseases in Livestock: Foot & Mouth Disease Distribution, Pathogenesis and Control; Bluetongue disease Distribution, Pathogenesis and Control; Bird flu Distribution, Pathogenesis and Control; Aspergillosis, Aetiology, Epidemiology, Pathogenesis, Diagnosis and Control.

Unit: IV

Protozoan And Helminth Diseases in Livestock: Parasitic protozoans of Livestock with special reference to Pathogenicity and Prophylaxis of Babesia; Nematode parasites of Sheep with special reference to life cycle, pathogenicity and control of *Haemonchus contortus;* Morphology life cycle, Pathogenicity, prophylaxis and control of *Fasciola hepatica;* Cestode parasites of ruminants with reference to the life cycle, pathogenicity, prophylaxis and control of *Moneiza expensa*.

BR18004GE: Bioindustries

Unit: I

Industrial revolution: Causes and consequences; Industrial economic sectors: Primary, Secondary, Tertiary and Quaternary Sectors; Small scale industries and their importance; Entrepreneurship— concept, entrepreneurial skills; Self employment.

Unit: II

Bioindustries: Concept and scope; Role of natural resources in economic development.

Bioindustries in India: Status and scope of agriculture, fisheries, sericulture, forest and dairy industry.

Unit: III

Fruit industry in J & K: Status and scope; Fresh and dry fruits—harvest, processing & storage and marketing.

Potential bioindustries in J & K: Apiculture, tannery, pisciculture, ornamental horticulture and herbal drug industry.

Unit: IV

Sustainable development: Concept, indicators of sustainable development; Quality assurance and quality control; Policies responsible for development of bioindustries. Intellectual Property Rights— concept and importance.

Undergraduate Syllabi –NEP 2020 Based

Introduced in all J&K Colleges

B.Sc. General
Bioresources

Type-I Courses

SEMESTER-I		SEMESTER-II	
(BRS122M)	**Bioresources-I** (Fundamentals of Bioresources)	**(BRS222M)**	**Bioresources-II** (Plant Resources)
(BRS022I)	**Bioresources-MD** Bioindustries		
SEMESTER-III		**SEMESTER-IV**	
(BRS322M)	**Bioresources-III** (Animal Resources)	**(BRS422M)**	**Bioresources-IV** (Microbial Resources)
SEMESTER-V		**SEMESTER-VI**	
(BRS522M)	**Bioresources-V** (Herbal Technology)	**(BRS622M)**	**Bioresources-VI** (Industrial Entomology)
SEMESTER-VII		**SEMESTER-VIII**	
(BRS722M)	**Bioresources-VII** (Bioresource Technology)	**(BRS822M)**	**Bioresources-VIII** (Biotechniques and Biostatistics)

Type-II Courses

SEMESTER-IV		SEMESTER-V	
(BRS422II)	**Bioresources-IV** (Bioresources in Immune Modulation)	**(BRS522II)**	**Bioresources-V** (Fungal Resources and Diseases Management)
SEMESTER-VI		**SEMESTER-VII**	
(BRS622II)	**Bioresources-VI** (Livestock Product Technology)	**(BRS722II)**	**Bioresources-VII** (Bioresource in Health Management)
SEMESTER-VIII			
(BRS822II)	**Bioresources-VIII** (Drug Discovery and Development)		

Type-III Courses

SEMESTER-IV		SEMESTER-V	
(BRS422III)	**Bioresources-IV** (Biomolecules)	**(BRS522III)**	**Bioresources-V** (Cell Biology)
SEMESTER-V		**SEMESTER-VI**	
(BRS622III)	**Bioresources-VI** (Molecular Biology)	**(BRS722III)**	**Bioresources-VII** (Human Genetics)
SEMESTER-VIII			
(BRS822III)	**Bioresources-VIII** (Research/Project)		

BACHELOR OF SCIENCE
BIORESOURCES SEMESTER 1st (Major/Minor: NEP-2020)

Course Code: (UGBRS22M101); Course Title: FUNDAMENTALS OF BIORESOURCES; Session 2022

CREDITS: THEORY: 4; PRACTICAL: 2
MAX MARKS: THEORY: 60; PRACTICAL: 30
CONTACT HOURS: THEORY (60); PRACTICALS:(45)

Learning objectives:
Students will be able to

1. Know about the diversity and values of important plant, animal and microbial resources.
2. Gain understanding about the methods of *in-situ* and *ex-situ* conservation strategies.
3. About the importance of biological resources in the management of livelihood and sustainable development.

Learning outcomes:
After the completion of the syllabus the student will acquire knowledge of.

1. Importance of biodiversity and its relationship with bio-resources.
2. Conservation of biodiversity and bio-resources for present and future generations.
3. Role of bio-resources and biodiversity in managing and sustaining livelihood.

Unit 1:-Bioresources (15 Lectures)

1.1 Bioresources— Plant, animal and microbial diversity (brief concept);
1.2 Concept and levels of Biodiversity
1.3 Mega-biodiversity countries
1.4 Biodiversity hotspots (concept and distribution)
1.5 Biodiversity and climate change— concerns and challenges
1.6 Valuing biodiversity— direct- and indirect use values.

Unit 2:- Biodiversity conservation (16 Lectures)

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

Unit 3:-Bioresources and Livelihood (14 Lectures)

2.1 Livelihood and its relation with bioresources management;
2.2 Threats to traditional livelihood, food insecurity
2.3 Impact of globalization and urbanization on livelihood
2.4 Sustainable development
2.5 Energy crisis and need for green energy
2.6 Concept of green Building, vertical gardens
2.7 Eco-labelling (concept and examples)

Unit 4:-Bioresources Management policies (15 Lectures)

4.1 Indian Bioresources Information Network— organization and role
4.2 Convention on Biological Diversity (CBD)- Aims and objectives
4.3 Ramsar Convention; Biological Diversity Act (2002)
4.4 Environment Impact Assessment (EIA)- Concept and stages of EIA
4.5 Biodiversity conservation and public participation

Practical Work: 2 Credits

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

Suggested Readings:

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

BACHELOR OF SCIENCE
BIORESOURCES SEMESTER 2nd (Major/Minor: NEP-2020)
Course Code: (UGBRS22M201); Course Title: PLANT RESOURCES; Session 2022

CREDITS: THEORY: 4; PRACTICAL: 2
MAX MARKS: THEORY: 60; PRACTICAL: 30
CONTACT HOURS: THEORY (60); PRACTICALS:(45)

Learning objectives:

Students will be able to

1. Understand about the classification and origin of plants in addition to the concept of bioprospection and biopiracy.
2. Acquire knowledge about underutilized food and fodder, their cultivation practices and utilization.
3. About the morphology and medicinal importance of wild vegetables and medicinal plants.

Learning outcomes:

After the completion of the syllabus the student will acquire knowledge of.

1. Origin and domestication of important crop plants and how bioprospection plays its role.
2. Morphology, cultivation and utilization of important food and fodder crops.
3. Important medicinal and aromatic plants of Kashmir region and their medicinal and aromatic use.

Unit 1: Plant resources (15 Lectures)

1.1 Introduction to Cryptogams and Phanerogams
1.2 Origin of agriculture
1.3 Centres of origin and domestication of cultivated plants (proposed by Vavilov)
1.4 Green revolution.
1.5 Bioprospecting— Concept
1.6 Role of traditional knowledge in bioprospecting
1.7 Biopiracy, case studies of biopiracy (Basmati, Neem, Turmeric)
1.8 Traditional Knowledge Digital Library (TKDL).

Unit 2: Food and fodder crops (16 Lectures)

2.1 Underutilised crops– importance as future food
2.2 Morphology, cultivation practice and limitations of buckwheat (*Fagopyrum* spp.) and foxtail millet (*Setaria italica*)
2.3 Morphology, cultivation and utility of rice (*Oryza sativa*) and maize (*Zea mays*)
2.4 Cultivation, extraction and processing of mustard oil
2.5 Fodder crops, cultivation and utility of alfalfa (*Medicago sativa*)
2.6 Pulses— *Cicer arietum* (Morphology and nutritional importance)

Unit 3: Fruits, vegetables and spices (15 Lectures)

3.1 Cultivation, storage and packaging of fruits (apple, walnut, Cherry and apricot)
3.2 Morphology and importance of wild vegetables (*Taraxacum officinale, Cichorium intybus, Rumax, Malva sylvestris*)
3.3 Spices and condiments, Saffron (Cumin, coriander, Fennel)
3.4 Non woody forest products (NWFP's): Important sources of gums, resins and dyes their economic importance.

Unit 4: Medicinal plants of Kashmir Himalaya (14 Lectures)

4.1 Morphology, ethnobotanical and medicinal importance of
- 4.1a *Artemesia absenthum*
- 4.1b *Arnebia benthamii*
- 4.1c *Atropa acuminate*
- 4.1d *Saussurea costus*
- 4.1e *Rheum emodi.*

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

Practical Work: 2 Credits

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

Suggested Readings:

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

BACHELOR OF SCIENCE

MULTI-DISCIPLINARY INTRODUCTORY COURSE (BIORESOURCES)
SEMESTER-I (NEP-2020)

Course Code: (UGBRS22D102); Course Title: BIOINDUSTRIES; Session 2022

CREDITS: THEORY: 3
MAX MARKS: THEORY: 45
CONTACT HOURS: THEORY (45)

Learning objectives:

This course is designed to acquaint the student with:

1. Concept, scope and status of bioindustries at local and regional level.
2. Different types of waste utilization and bio-energy sources
3. Green economy, entrepreneurship and intellectual property rights

Learning outcomes:

After successful completion of the course the students will be able to elucidate:

1. Establishment of bioindustries and their role in economic growth.
2. Waste utilization and energy production from natural sources.
3. Marketing strategies and value addition.

Unit 1: Introduction to Bioindustry (15 Lecture)

1.1 Bioindustry- Concept and recent trends in the development of Bioindustry
1.2 Scope and status of Bioindustries in India (Dairy, Sheep, Floricuture)
1.3 Scope and status of Bioindustries in J &K (Dairy, Sheep, Aquaculture, Horticulture, Cosmetics, Fertilizers, Leather, aquaculture, Ornamental horticulture and Herbal Medicine)
1.4 Agriculture crop production trends and demand for staple food.

Unit 2: Bio-based waste utilization (15 Lecture)

2.1 Composting, vermicompositing- methods, materials and advantages
2.2 Pulping (mechanical and chemical pulping)
2.3 Municipal wastes- segregation and uses
2.4 Bio-based plastics and fibres
2.5 Biomass as energy source, Biogas production, Bio-fuels- Concept and classification
2.6 Concept of Bio-villages and biotechnological parks.

Unit 3: Green economy and Entrepreneurship (15 Lecture)

3.1 Marketing strategies for Bioresources products- Product launching, evaluation and advertisements, value addition
3.2 Entrepreneurship, Small Scale Industries, Self employment schemes in relation to bioindisutries;
3.3 Status and scope and of establishing bio-based small scale industries
3.4 Concept of Green entrepreneurship.
3.5 Intellectual property rights (Patents, Copy Rights, & Trademarks)

Suggested Readings:

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

DEPARTMENT OF BIORESOURCES
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BACHELOR OF SCIENCE
3rd SEMESTER
DISCIPLINE SPECIFIC COURSE – 3 (CORE - 3)
BRS321C: BIORESOURCES: ANIMAL RESOURCES

Credits: Theory: 4; Practical: 2
Max Marks: Theory: 60; Practical: 30
Min Marks: Theory: 24; Practical: 12
Theory (Lectures: 60)

Unit: I **(14 Lecture)**

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

Unit: II **(14 Lecture)**

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

Unit: III **(16 Lectures)**

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

Unit: IV **(16 Lectures)**

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

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Practical Work: 2 Credits

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

Suggested Readings:

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

BACHELOR OF SCIENCE
BIORESOURCES SEMESTER 4th

Course Code: (BRS422III); Course Title: Biomolecules;

CREDITS: THEORY: 4; PRACTICAL: 2
MAX MARKS: THEORY: 60; PRACTICAL: 30; INTERNAL MARKS: 10
MIN MARKS: THEORY: 24; PRACTICAL: 12

Unit: I **Lectures 17**

Carbohydrates and Lipids: Introduction and Classification of carbohydrates; Isomerism (D & L and R & S system); Optical properties of carbohydrates; Reducing and Non-reducing sugars; Storage and structural polymers and their importance (starch, glycogen cellulose, hemicelluloses); Introduction and classification of lipids; Biological functions of triacylgycerols, phospholipids, glycolipids, sphingolipids and cholesterol.

Unit: II **Lectures 17**

Proteins and Enzymes: Structure and classification of amino acids; Stereoisomerism in amino acids, Protein structure (primary and secondary structure of proteins); Fibrous and globular proteins (α-keratin, collagen, haemoglobin); Nomenclature and types of enzymes; Mechanism of enzyme action (Michaelis-Menton Equation); Enzyme inhibition (reversible and irreversible inhibition).

Unit: III **Lectures 14**

Nucleic acids: Structures of Nucleotides**;** DNA double helix (Watson and Crick Model); Forms of DNA (A, B, Z and H DNA); Types of RNA; Structure of tRNA and mRNA; Packaging of genetic material (Nucleosome model); Chromosome structure; Euchromatin and heterochromatin; Polytene and Lampbrush chromosomes.

Unit: IV **Lectures 16**

Secondary metabolites: Types of secondary metabolites; Phenolic compounds—occurrence and classification; Terpenes— Occurrence and classification based on isoprene rule; Steroids— structure and occurrence; Alkaloids—Occurrence and classification based on nitrogen heterocyclic ring; Importance of secondary metabolites in food and medicine.

Practical work:

- Preparation of calibration graph for the estimation of starch and proteins.
- Determination of saponification value of fat/oil.
- Extraction of proteins from fresh material.
- Determination of the time course of diastase action on starch.
- Determination of polyphenol oxidase activity.
- Extraction and estimation of total titrable acidity in plant extract.
- Separation of pigments from leaf extract using phase separation method.
- Detection of presence of phenolics, alkaloids and flavonoids in plant material.
- Preparation of calibration graph for the estimation of total phenols.
- Study the effect of pH on the anthocyanins from fruit extracts.

Suggested Readings:

1. D. L. Nelson and M.M. Cox. Lehninger Principles of Biochemistry. W.H. Freeman. 8th Edition. 2021.
2. Donald Voet, Judith G. Voet, Charlotte W. Pratt. Fundamentals of Biochemistry: Life at the Molecular Level. 5th Edition. 2016.
3. Lubert Stryer, Jeremy Berg, John Tymoczko, Gregory Gatto. Biochemistry. 8th Edition. 2015.
4. U. Satyanarayana, U. Chakrapani. Biochemistry. Elsevier, 2021.
5. S. P. Singh. Textbook of Biochemistry. CBS Publication. 2015.
6. J. L. Jain, Sunjay Jain and Nitin Jain. Fundamentals of Biochemistry, S. Chand. 7th Edition. 2014.
7. Gerald Karp, Janet Iwasa, Wallace Marshall Karp. Cell and Molecular Biology. 9th Edition. 2019.
8. Krebs, Jocelyn E., Goldstein, Elliott S., Kilpatrick, Stephen T. Lewin's genes XI. Jones & Bartlett Learning, LLC. 2018.
9. Gupta. P.K. Cell and Molecular biology. Rastogi Publications, India. 2005.
10. Rastogi, S.C. Cell and Molecular Biology. New age International Publishers, India. 2012.

Type-II: Bioresources in immune Modulation-IV (BRS422M) Semester 4th Credits 4 (theory 3 +practical 1)

Bioresources in Immune Modulation

Theory
Lectures: 60

Unit: I **(16 Lecture)**

Basics of Immunology: Introduction to immune system: Cells and organs of immune system; Antigens, haptens, and monoclonal antibodies; B and T lymphocytes, phagocytosis, complement system, cytokines, chemokines, inflammatory mediators. Immunoglobulins: Types, Structure and function; Immunology in health and disease-Immunological disorders and concept of immunotherapy.

Unit: II **(16 Lecture)**

Immunomodulatory leads from medicinal plants: *Andrographis paniculata, Curcuma longa, Echinacea purpurea, Withania somnifera, Tinospora cordifolia, Ocimum sanctum, Azadirachta indica, Boswellia serrata, Momordica charantia, Panax ginseng* and *Boerhaavia diffusa*.

Major groups of plant-derived nutraceuticals; Polysaccharides, Fatty Acids, Labdane Diterpenes: Chemical Features, Natural Occurrence, Pharmacological Properties and Clinical studies.

Unit: III **(14 Lecture)**

Immunomodulation by food: Enhancement of immune responses by food; Probiotics and other microorganisms, Prebiotics and bacterial metabolites; Polysaccharides, Vitamins, Fatty acids, amino acids and other micronutrients.

Immune Inhibition by functional food: Hypoallergic food and use of oral tolerance; Prebiotics and bacterial metabolites; Polyphenols, Peptides, proteins and related substances.

Unit: IV **(14 Lecture)**

Immunomodulatory Compounds from Marine Organisms: Immunomodulatory Proteins and Amino Acid; Hemocyanins, Lectins, Taurine. Immunomodulatory Peptides; Callinectin, crustin, Myticin, Mytillin, Mytimycin.

Immunomodulatory Protein Hydrolysates: Chlorella Protein Hydrolysate, Ecklonia Protein Hydrolysate, Porphyra Protein Hydrolysate, Edible Red Algae Protein Hydrolysate, Edible Microalgae Spirulina Protein Hydrolysate, Oyster Peptide-Based Enteral Nutrition Formula, Shellfish Mytilus and shark Protein Hydrolysate

Type-I: Microbial Resources-IV (BRS422M) Semester 4th Credits 6 (theory 4 +practical 2)

Microbial Resources

Theory
Lectures: 60

Unit: I **(16 Lecture)**

Introduction to Microbial Resources: Historical perspective; General characteristics of microbial resources (bacteria, algae, and viruses). Ultrastructure of Bacteria: (Internal Structure, Cell wall and External Structure); Viruses: general structure and viral classification. Gene transfer in bacteria (Different modes of gene transfer).

Unit: II **(16 Lecture)**

Microbial Growth: Principle and procedure of sterilization (moist heat, filtration and chemical treatment); Microbial culture and its growth kinetics; Growth rate parameters - specific growth rate, doubling time. Measurement of microbial growth, factors affecting microbial growth.

Unit: III **(14 Lecture)**

Microbial resources and crop productivity: Production and application of *Rhizobium, Azospirillum, Azotobacter;* Plant growth promoting Rhizobacteria (PGPR's) and their uses; Biofilmed fertilizers.

Microbes of industrial importance: Probiotics in promoting human health; Microbial cells as food (single cell proteins).

Unit: IV **(14 Lecture)**

Bioactive microbial agents: Biopolymer and bio-surfactant production from microbial resources; Medicine from microbes.

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

Practical Work:

- Basic bacterial staining, capsule staining, flagella staining and algal staining.
- Preparation and sterilization of solid and liquid culture media for bacterial cultivation.
- To check the efficacy of antimicrobial agents
- Streak plate and spread plate, isolation of single colonies of bacteria.
- Preparation of slides of rhizobium isolated from leguminous plants.
- Alcohol production by fermentation of sugars.
- Isolation of lactobacillus from milk products and observation of bacilli under microscope.

Suggested Readings:

- Microbiology by Nina Parker, Mark Schneegurt, Anh-Hue Thi Tu, Brian M. Forster, Philip Lister, by ASM Press and OpenStax. 2017, ISBN-13, 978-0-9986257-0-6
- Essential Microbiology by Stuart Hogg, John Wiley & Sons Ltd 2005, ISBN 0471497533
- The handbook of microbial bioresources. Eds: Gupta, V. K., Sharma, G. D., Tuohy, M. G., Gaur, R. (2016) ISBN 9781780645216.
- Biotechnology of Biofertilizers Editors: Kannaiyan, Sadasivam (Ed.) (2002) Springer Netherlands ISBN: 978-1-4020-0219-9.
- Microbiology: Pelczar, M. J., Chan, E. C. S. and Krieg, N. R. – McGraw-Hill.
- Industrial Microbiology, Casida - New Age International Private Limited
- Microbes as Bio-fertilizers and their Production Technology S. G. Borkar (2015) Woodhead Publishing India in Agriculture. ISBN 9789380308579.
- Bioremediation of Wastewater: Factors and Treatment. Ed: Olga Sanchez (2017) Apple Academic Press; 1st ed. (2015). ISBN-13: 978-177188162.
- General Microbiology: Stanier, R. Y., Ingraham, J. L., Wheelis, M. L. and Painter, P. R. – Macmillan Press Ltd., UK. 4.
- Microbiology: Prescott, L. M., Harley, J. P. and Klein, D. A. – McGraw-Hill.

Expected Learning Outcomes:

1. Understanding of microbial growth, kinetics and measurement.
2. Detailed understanding of bacteria/viruses and gene transfer methods in bacteria.
3. Brief idea of bioremediation and biodegradation of organic pollutants
4. Understanding of industrial and economic importance of microbes.

Syllabus: K.U. Bioresources for 5th Semester **Course Code: BRS522J1**

Course Title: Herbal Technology

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

Learning Objectives

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

Learning Outcomes

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

Unit: I **(15 Lecture)**

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

Unit: II **(15 Lecture)**

Herbs in medicine: Historical perspective of herbs in traditional health management; Ethno-botanical and medicinal importance of *Atropa acuminate, Aconitum heterophyllum, Saussurea costus, Arnebia benthami, Catharanthus roseus, Digitalis purpurea;* Herbal nutraceuticals and their role in managing Diabetes, CVS diseases, Cancer, and various Gastro intestinal diseases.

Unit: III **(15 Lecture)**

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

Practical Work:

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

Suggested Readings

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

Syllabus: K.U. Bioresources for 5th Semester **Course Code: BRS522J2**

Course Title: Fungal Resources & Diseases

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

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

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

Unit: I **(14 Lecture)**

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

Unit: II **(16 Lecture)**

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

Unit: III **(16 Lecture)**

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

Unit: IV **(14 Lecture)**

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

Fungi as biocontrol agents (mycofungicides, mycoherbicides, mycoinsecticides, myconematicides); Mycorrhizas (Endo- and ecto-mycorrhiza) role in plant health; Lichen: Classification& Economic Importance.

Practical Work:

➢ Alcohol production by fermentation of sugars.

➢ Identification of permanent slides of penicillium, yeasts,

➢Study of fungal diseases in the field: Blast of rice, Tikka disease of ground nut, powdery mildew of locally available plants and white rust of crucifers.

➢Agaricus: Specimens of button stage and full grown mushroom; sectioning of gills of Agaricus, and fairy rings are to be shown.

➢Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)

➢ Preparation of solid and liquid culture fungal growth media.

➢ Streak plate and spread plate, Isolation of single colonies of fungi on solid media.

Suggested Readings:

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

➢Aspergillus fumigatus and Aspergillosis (2014) Jean-Paul Latge (Editor), William J. Steinbach (Editor) ISBN: 978-1-683-67138-1, ASM Press

➢Cellular and Molecular Biology of Filamentous Fungi (2014) Katherine A. Borkovich (Editor), Daniel J. Ebbole (Editor) ISBN: 978-1-683-67129-9, ASM Press

➢Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press,Cambridge.3rd edition.

➢Deacon, J.W. (2013). Fungal Biology, 4th edition, John Wiley &Sons Ltd

➢Candida and Candidiasis, 2nd Edition (2014) Richard A. Calderone (Editor), Cornelius J. Clancy (Editor) ISBN: 978-1-683-67095-7, ASM Press

➢The Fungal Kingdom (2017) Joseph Heitman, Barbara J. Howlett, Pedro W. Crous, Eva H. Stukenbrock, Timothy Yong James, Neil A. R. Gow ISBN: 978-1-683-67082-7 ASM Press

Course Title: Cell Biology

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

Learning Objectives:

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

Learning Outcomes:

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

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

Unit: I **(15 Lecture)**

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

Unit: II **(15 Lecture)**

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

Unit: III **(15 Lecture)**

Intracellular organelles: Structural organization of endoplasmic reticulum,golgi bodies, ribosome, lysosomes, peroxisomes, vacuoles; Structural organization and genome organization in mitochondria and chloroplast; Structural organization of nucleus—nuclear membrane and nuclear pore complex, Nucleolus, Nuclear matrix;

Unit: IV **(15 Lecture)**

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

Practical Work:

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

Suggested Redaings:

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

Syllabus: K.U. Bioresources for 6th Semester **Course Code: BRS622J1**

Course Title: Industrial Entomology

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

Course objectives:

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

Course outcome:

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

Unit: I **(15 Lecture)**

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

Unit: II **(15 Lecture)**

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

Unit: III **(15 Lecture)**

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

Practical Work: 1 Credits

- Collection, preservation and identification of economically important insects.
- Study of life history of silk worm by rearing.
- Dissection of silk glands of the silk worm larva.
- Mounting: sting apparatus of Honey bees.
- Study of different castes of honey bee.
- Honey extraction and processing methods of hive products extraction.
- Quality analysis of honey.

Suggested Readings:

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

Syllabus: K.U. Bioresources for 6th Semester **Course Code: BRS622J2**

Course Title: Livestock Product Technology

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

Learning objectives:

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

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

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

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

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

Unit II: Packaging of animal products (15 Lectures)

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

Unit III: Quality control and Marketing (15 Lectures)

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

Unit IV: Post Harvest Technology (15 Lectures)

Consumer protection; role of voluntary agencies such as, Agmark, I.S.I. Quality control laboratories of companies ,private testing laboratories, Quality control laboratories of consumer co-operatives,. Standardization of Foods; Definition, Standards of Quality, Milk and milk products, Meat and meat products, poultry and canned fish.
Waste management; solid and liquid wastes; industrial effluents and their management, dairy industry and other food processing industries. Bio-utilization of wastes and by products.

Practicals

Testing adulteration of Milk and products:

A) Adulteration of Milk

Physical Tests; Detergent Test; Filter Test; Flow Test

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

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

Reference Books;

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

Syllabus: K.U. Bioresources for 6th Semester **Course Code: BRS622J3**

Course Title: Molecular Biology

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

Course objectives:

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

Course outcomes:

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

Unit-I **(15 Lecture)**

Structure and Functions of Nucleic Acids:

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

Unit-II **(16 Lecture)**

DNA Synthesis and repair:

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

Unit III **(16Lecture)**

RNA synthesis and processing:

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

Unit-IV **(15 Lecture)**

Protein synthesis and processing:

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

Practical Work:

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

Books Recommended:

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

Syllabus: K.U. Bioresources for 7th Semester **Course Code: BRS722J1**

Course Title: Bioresource Technology

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

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

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

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

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

Unit: I **(15 Lecture)**

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

Unit: II **(15 Lecture)**

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

Unit: III **(15 Lecture)**

Animal cell and tissue culture: History, scope and applications; Transfection methods, Culture of cell lines; Transgenesis (cloning) and its application; Somatic cell fusion –

concept and utility. Cell culture products: Viral vaccines, interferons, recombinant proteins and hybrid antibodies; Hybridoma technology and production of monoclonal antibodies

Practical Work: 2 Credits

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

Suggested Readings:

- *Applied Bioremediation and Phytoremediation.* A. Singh O. P. Ward (Eds), Springer, New York, NY, *2004*
- Desmond S. T. Nicholl (2008). An Introduction to Genetic Engineering, 3rd Edition, Cambridge University press.
- Ruane J, Sonnino A. 2006. The role of biotechnology in exploring and protecting agricultural genetic resources. Food and Agriculture Organization of the United Nations, Rome.
- Singh, B. D. (2007). Biotechnology: Expanding Horizons. Kalyani Publishers.
- Desmond S. T. Nicholl (2008). An Introduction to Genetic Engineering, 3rd Edition, Cambridge University press.
- Cooper 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); PearsesEducatias, Inc India
- P.C. Turner and others – 2002 : Molecular Biology (II); Viva Books, Pvt. Ltd., New Delhi.
- W. Ream and KG. Field – 1999 : Molecular Biology Techniques ; Academic Press, London.
- Bruce Alberts et al – 1983 : Molecular Biology of the cell ; Garland Publ. Inc., New 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
- Freshney, R. I. (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley-Blackwell, 2010. 6th Edition.
- Davis, J. M. (2008). Basic Cell Culture. Oxford University Press. New Delhi.
- Davis, J. M. (2011). Animal Cell Culture. John Willy and Sons Ltd. USA.
- Freshney R. I. (2005). Culture of Animal Cells. John Willy and Sons Ltd. USA.
- Butler, M. (2004). Animal Cell Culture and Technology. Taylor and Francis. New York, USA
- Bernhard O.Palsson,SangeetaN.Bhatia,"Tissue Engineering" Pearson Publishers 2009.
- Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of Tissue Engineering and Regenerative Medicine.2009.

Syllabus: K.U. Bioresources for 7th Semester **Course Code: BRS722J2**

Course Title: Bioresources in Health Management

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

Course objectives

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

Course outcomes

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

Unit: I **(15 Lecture)**

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

Unit: II **(15 Lecture)**

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

Unit: III **(15 Lecture)**

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

Unit: IV **(15 Lecture)**

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

Practicals

- Demonstrate the grouping of plant foods according to ICMR classification.

- Demonstrate and compare the protein quantity in staple foods (Rice, Maize, Wheat).
- Demonstrate and compare the Total sugar in staple foods (Rice, Maize, Wheat).
- Observe the seeds of the staple foods.
- Observe the microscopic structure of different starches (rice, wheat and corn).
- Perform the qualitative tests of plant based foods for phenol and flavinoid
- Extraction of oil from nuts
- Demonstrate and compare the cellulose, lignin and hemicelluloses from important dietary plants

Suggested Reading:

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

Syllabus: K.U. Bioresources for 7th Semester **Course Code: BRS722J3**

Course Title: Human Genetics

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

Course oobjectives:

To give the students an understanding of:

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

Course outcomes:

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

Unit: I (15 Lectures)

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

Unit: II (15 Lectures)

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

Unit: III (15 Lectures)

Clinical Genetics: Scope of clinical genetics; Monogenic diseases- Cystic fibrosis, Tay-Sachs syndrome, Marfan syndrome; Polygenic diseases- Hyperlipidemia, Diabetes mellitus,

Atherosclerosis; Inborn errors of metabolism and their genetic bases- Phenylketonuria, Maple syrup urine syndrome, Mucopolysaccharidosis, Galactosemia.Infertility - genetic basis of male infertility, genetic basis of female infertility; recurrent pregnancy loss.

Unit: IV (15 Lectures)

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

Practicals:

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

References

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

Syllabus: K.U. Bioresources for 8th Semester **Course Code: BRS822J1**

Course Title: Biotechniques and Biostatistics

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

Learning Objectives

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

Learning Outcomes

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

Unit: I **(16 Lectures)**

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

Unit: II **(16 Lectures)**

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

Unit: III **(16 Lectures)**

Microscopyand spectroscopy: Principle, working & application of Compound Microscope, Fluorescence microscope, Scanning electron and Transmission electron microscopy; Principle and working of a spectrophotometer; Radioisotopes— applications in biology.

Unit: IV **(16 Lectures)**

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

Practical Work

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

Suggested Readings

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

Syllabus: K.U. Bioresources for 8th Semester **Course Code: BRS822J2**

Course Title: Drug Discovery and Development

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

Learning objectives

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

Learning Outcome

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

Unit: I **(16 lectures)**

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

Unit: II **(16 lectures)**

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

Unit: III **(16 lectures)**

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

Unit: IV **(16 lectures)**

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

Practicals

1. Handling of laboratory animals.

- Various routes of drug administration.
- Techniques of blood sampling, anesthesia and euthanasia of experimental animals
- Oral glucose tolerance test.

2. Estimation of proteins by Braford/Lowry‟s in biological samples.
3. Protocol design for clinical trial.
4. In-silico docking studies.
5. In-silico pharmacophore based screening.

Suggested Readings

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

Syllabus: K.U. Bioresources for 8th Semester **Course Code: BRS822J3**

Course Title: Medicinal Plants and Phytotherapeutics

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

Learning objectives

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

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

Course outcome:

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

Unit I: Medicinal plants

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

Unit-II Phytomedicine

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

Unit – III Traditional System of Medicine

Introduction, Concept and Principles of Traditional System of Medicine (TSM)- Ayurveda, Unani, Siddha, Homeopathy and Amchi system. Bioprospecting, Biopiracy. Concept and importance of Traditional Knowledge of Digital Library (TKDL). Intellectual property Rights

(IPR)-concept. (copyright, trademarks, patents, geographical indications, plant varieties, industrial designs and Trade secrets).

Unit – IV Phytotherapy

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

Practicals:

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

Suggested Readings:

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