



DEPARTMENT OF BIORESOURCES
UNIVERSITY OF KASHMIR, SRINAGAR

Syllabi: Undergraduate level
Details of Courses

Core Courses

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

Discipline Specific Electives (DSE) Bioresources (Any Two)

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

Skill Enhancement Courses (SEC)

Bioresources

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

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

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

Unit: II (16 Lectures)

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

Unit: III (14 Lectures)

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

Unit: IV (15 Lectures)

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

Practical Work:

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

Suggested Readings:

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

**Plant Resources
Theory
Lectures: 60**

Unit: I**(15 Lectures)**

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

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

Unit: II**(16 Lectures)**

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

Unit: III**(15 Lectures)**

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

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

Unit: IV**(14 Lectures)**

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

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

Practical Work:

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

Suggested Readings:

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

Core Course: Bioresources Paper III

Semester 3rd
Animal Resources
Theory
Lectures: 60

Credits 6(theory 4 +practical 2)

Unit: I

(14 Lecture)

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

Unit: II

(14 Lecture)

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

Unit: III

(16 Lectures)

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

Unit: IV

(16 Lectures)

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

Practical Work:

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

Suggested Readings:

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

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

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

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

Unit: II (16 Lecture)

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

Unit: III (16 Lecture)

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

Unit: IV (14 Lecture)

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

Practical Work:

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

Suggested Readings:

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

DSE

Semester 5th
Bioindustries
Theory
Lecture 60

Credits 6 (Theory 4 + Practical 2)

Unit: I

(15 Lecture)

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

Unit: II

(15 Lecture)

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

Unit: III

(15 Lecture)

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

Unit: IV

(15 Lecture)

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

Tutorials: 2credits

Suggested Readings:

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

DSE

Semester 5th Credits 6 (Theory 4 + Practical 2)

Biomedicine and Biocosmetics

Theory

Lecture: 60

Unit: I

(15 Lecture)

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

Unit: II

(15 Lecture)

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

Unit: III

(14 Lecture)

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

Unit: III

(16 Lecture)

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

Practical Work:

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

Suggested Readings

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

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

DSE

Semester 6th

Credits 6 (Theory 4 + Practical 2)

Biostatistics and Biotechniques

Theory

Lecture: 60

Unit: I

(14 Lecture)

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

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

Unit: II

(14 Lecture)

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

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

Unit: III

(16 Lecture)

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

Unit: IV

(16 Lecture)

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

Practical Work:

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

Suggested Readings:

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

DSE

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

Unit: I **(15 Lecture)**

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

Unit: II **(16 Lecture)**

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

Unit: III **(14 Lecture)**

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

Unit: IV **(15 Lecture)**

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

Practical Work:

- Estimation of DNA
- Estimation of protein by Bradford method
- Effect of pollution on plant bioresources and water quality:
 - a) To calculate the Leaf Area Index of leaf samples collected from different sites to study the effect of pollution on leaf morphology
 - b) To analyze water samples (tap water, stream water and stagnant water) for dissolved CO₂ and dissolved oxygen.
- Estimation of heavy metals in various samples by AAS.
- Demonstration of Biosensors.
- Visit to sewage treatment plants.

Suggested Readings:

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

**Applied Entomology
Theory
Lecture: 30**

Unit: I**(7 Lecture)**

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

Unit: II**(7 Lecture)**

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

Unit: III**(8 Lecture)**

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

Unit: IV**(8 Lecture)**

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

Suggested Readings:

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

**Fish Farming
Theory
Lecture: 30**

Unit: 1**(6 Lecture)**

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

Unit: II**(8 Lecture)**

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

Unit: III**(8 Lecture)**

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

Unit: IV**(8 Lecture)**

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

Suggested Readings:

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

**Dairy Farming
Theory
Lecture: 30**

Unit-I**(8 Lecture)**

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

Unit-II**(8 Lecture)**

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

Unit-III**(7 Lecture)**

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

Unit-IV**(7 Lecture)**

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

Suggested Readings:

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

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

**Poultry Farming
Theory
Lecture: 30**

Unit-I**(7 Lecture)**

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

Unit-II**(8 Lecture)**

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

Unit-III**(7 Lecture)**

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

Unit-IV**(8 Lecture)**

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

Suggested Readings:

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

**Life style Horticulture
Theory
Lecture: 30**

Unit: I**(7 Lecture)**

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

Unit: II**(7 Lecture)**

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

Unit: III**(8 Lecture)**

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

Unit: IV**(8 Lecture)**

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

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

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

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

Unit: II

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

Unit: III

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

Unit: IV

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