Department of Botany
Hemvati Nandan Bahuguna Garhwal University, Srinagar-Garhwal, Uttarakhand

FOUR-YEAR BACHELOR'S DEGREE PROGRAMME WITH HONOURS/RESEARCH (B. Sc. Botany)

Fourth Year-NHEQF Level-6

In the fourth Year of the Four-Year Undergraduate Program (FYUP) two types of programs are offered:
1. U.G. with Honours
2. U.G. Honours with Research

B.Sc. (Honours) Fourth Year [VII Semester]

Fourth Year (VII Semester with Honours)	**Major Subject (Botany)** CoreBotany-5(CB-5) Core Botany-6 CB-6) CoreBotany-7(CB-7)	5+5+5	CB-5 Comparative Account of Cryptogams CB-6 Comparative Account of Phanerogams CB-7 Reproductive Biology, Morphogenesis and Tissue Culture	These courses will be based on the core subject selected by the students for PG
	Major Practical (LC-1)	5	LC-1 Lab Course Based on Core Botany (CB-5, CB-6, & CB-7)	
	Major Elective Botany (EB-1)	2	Elective Course: Any one from EB-1basket	**Major Elective Course Basket(EB-1)** EB 01a: Plant Breeding and Biostatistics EB 01b: Plant Health Management.
	Major Elective Practical (LCE-1)	2	LCE-1 Lab Course Elective Based on EB 01a/ EB 01b	
	Minor Botany (BM-1)	4	Minor Elective Course: For students with Core subjects Other than Botany (Without Practical)	**Minor Elective Course Basket (EBM-1)** EBM-1: Applied Phycology
	TOTAL	**28**		

B.Sc./BOT/CB-5 Comparative Account of Cryptogams [5 Credits]

Unit 1 Algae

i. Algal Classification
ii. Importance of Flagellation, Pigmentation, and storage products in classification,
iii. General characteristics of Major algal classes
iv. Evolutionary tendencies
v. Comparative account of reproduction and life history types of algal classes: Chlorophyceae, Phaeophyceae, Rhodophyceae and Cyanophyceae

Unit 2 Fungi

i. Fungal classification
ii. General characteristics of Major classes of Fungi
iii. Comparative account of structure, reproduction and life cycle types of major fungal classes.
iv. Parasexuality in Fungi, Fungal Hormone and Economic importance of Fungi
v. Symbiotic associations: Biology and Significance of Lichens and Mycorrhiza

Unit 3

Bryophytes

i. General Characteristics and Classification of Bryophyta
ii. Life histories of bryophytes with reference to *Cyathodium*, *Notothylus*, *Sphagnum* and *Polytrichum*
iii. Evolutionary significance of sporophytes in Bryophyta
iv. Significance of anhydrobiosis in bryophytes,
v. Ethnomedicinal values of bryophytes

Unit 4

Pteridophytes

i. General Characteristics and Classification of Pteridophyta
ii. Life history of *Psilotum*, *Lycopodium*, *Isoetes*, *Adiantum* and *Marsilea*
iii. General account on stelar evolution in Pteridophyta
iv. Telome theory and evolutionary significance of heterospory
v. Palaeobotany: types of fossils and the importance of Palaeobotany

Suggested Readings:

1. Van Den Hoek C, Mann, DG, Jahns HM. 1995. Algae: An Introduction to Phycology
2. Smith, G.M. 1955. Cryptogamic Botany. Vol. I and II. Tata McGraw-Hill, New Delhi.
3. Webster, J. 1985. Introduction to Fungi. Cambridge University Press.
4. Dubey HC (2009) An Introduction to Fungi, 3rd edition, Vikash Publication House Pvt Ltd, Noida.
5. Kashyap, S.R. 1968. Liverworts of the Western Himalayas and Punjab Plains. The Chronica Botanic Co. Delhi.
6. Ram Udar. Fifty years of Bryology in India. Golden Jubilee Series. IBS, New Delhi
7. Parihar, N.S. (1991). An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad
8. Vashishta, P.C., Sinha, A.K., Kumar, A.(2010). Pteridophyta, S. Chand. Delhi, India

B.Sc./BOT/CB-6 Comparative Account of Phanerogams [5 Credits]

Unit I

Gymnosperms

i. General account of morphology and reproduction of the following: *Zamia*, *Ginkgo*, *Taxus* and *Gnetum*
ii. General account of *Williamsonia* and *Pentoxylon*
iii. Phylogenetic trends in Gymnosperms
iv. Distribution of living Gymnosperms in India

Unit II

Angiosperms

i. Classification of Angiosperms (Hutchinson) and general account of numerical taxonomy and chemotaxonomy
ii. Distinguishing characters of the following families and their economic importance: Meliaceae, Combretaceae, Rubiaceae, Convolvulaceae, Scrophulariaceae, Verbenaceae, Polygonaceae, Lauraceae, Zingiberaceae, Arecaceae, Cyperaceae
iii. Embryology: General account of polyembryony, apomixis and experimental embryology with reference to anther and embryo culture

B. Sc. / BOT/CB-7 Reproductive Biology, Morphogenesis and Tissue Culture [5 Credits]

Unit I

Microsporogenesis; Cytoplasmic reorganisation during microsporogenesis, Pollen wall and Pollen morphogenesis, Development of male gametophyte, ultrastructure, abnormal male gametophyte, Pollen germination
Megasporogenesis: Development of the embryo sac, subcellular details of constituent cells and their function, major types.

Unit II

Pollen-pistil interaction: Role of pollen wall proteins and stigma surface proteins, pollen tube growth in pistil, fertilization and apomixes; Endosperms functions; Dicot and Monocot embryo, Polyembryony; Embryology in relation to Taxonomy

Unit III

Morphogenetic phenomenon: Symmetry and polarity, concepts of cell differentiation and totipotency; Plant cell and tissue culture: General introduction, history and scope; Tissue culture techniques and culture media; Experimental embryology, anther, ovary and endosperm culture; somatic embryogenesis and androgenesis

Unit V

Somatic hybridization: Protoplast isolation, culture and regeneration, Somatic hybridization and hybrid selection; Possibilities, achievements and limitations of protoplast research; Applications of plant tissue culture: clonal propagation, artificial seed, production of hybrids and soma clones, production of secondary metabolites/ natural products; Cryopreservation and germplasm storage

Suggested readings:

1. Bhojwani, S.S. and Bhatnagar, S.P.(1985), Embryology of Angiosperms, Vikash Publishing House, New Delhi
2. Johri, B.M (1984) Embryology of Angiosperms. Springer-Verlag Berlin Heidelberg.
3. Maheshwari, P. (1950) An Introduction to the Embryology of Angiosperms.Tata McGraw Hill.
4. Pandey, B.P., Angiosperms-Taxonomy, Emrbyology and Anatomy, S. Chand and Co., New Delhi
5. Bhojwani, S.S. and Bhatnagar, S.P., Embryology of Angiosperms, Vikash Publishing House, New Delhi
6. Butenko RG (2000) Plant Cell Culture, University Press of Pacific.
7. Davies PJ (2004) Plant Hormones, Kluwer Academic Publishers, Netherlands.
8. Halford N (2006) Plant Biotechnology - Current and future applications of genetically modified crops, John Wiley and Sons, Engla

LC-1 LabCourse
Based on CoreBotany (CB-5, CB-6, & CB-7) [5 Credits]

1. Morphological study of representative members of Cyanophyceae, Chlorophyceae, Charophyceae, Phaeophyceae, Rhodophyceae, Xanthophyceae and Chrysophyceae.
2. Study of representative genera of Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.
3. Study of Cyathodium, Notothylus, Sphagnum and Polytrichum.
4. Study of *Psilotum, Isoetes, Adiantum, Marsilea* and important fossiltypes.
5. Identification and description of locally available plants belonging to families included in the syllabus from fresh specimens, herbaria or preserved materials.
6. Study of *Zamia*, Ginkgo, *Taxus* and *Gnetum* with suitable preparations.
7. Study of microsporogenesis and megasporogenesis
8. Study of pollen germination and pollen-pistil interaction
9. Plant tissue culture media preparation and callus culture

Major Elective Course Basket (EB-1) [2 Credits]

EB 01a: Plant Breeding and Biostatistics

i. Biological foundation of plant breeding
ii. Reproductive systems and breeding plans
iii. Breeding methods for self-pollinated crop species
iv. Breeding methods for cross-pollinated crop species
v. Phenomenon of Heterosis and Inbreeding depression
vi. Breeding clonally propagated plants
vii. Ploidy breeding and Mutation breeding

Biostatistics

i. Bio-statistics: Definition and Scope.
ii. Methods of representation of statistical data and measurements of central tendencies.
iii. Correlation, regression, curve fitting and ratio of variation.
iv. Probability and use of binomial trials
v. Test of significance, X^2, 't' and 'f' tests.
vi. Statistical software

Suggested Readings:

1. Sharma, J.R. 1994. Principles and Practice of Plant Breeding. Tata McGraw-Hill Publ. Co. Ltd., New Delhi.
2. Singh, B.D. 2002. Plant Breeding Principles and Methods. Kalyani Publ. New Delhi.
3. Allard R.W. 2010. Principles of Plant Breeding. Wiley Indian Edition
4. Bliss, C.I. 1967. Statistics in Biology. 2 Vols. Mc Graw Hill, New York
5. Singh, R.K. 1994. Biometrical Techniques in Breeding and Genetics. Bishen Singh Mahendra
1. Pal Singh. Dehradun

EB 01b: Plant Health Management [2 Credits]

i. Modes of infection
ii. Host-pathogen interaction: toxins and enzymes
iii. Defence mechanisms in plants
iv. Physiology of parasitism
v. Environmental variables regulating disease development, transmission and spread of plant diseases.
vi. Principles of plant disease control: cultural control, chemical control, biological control and integrated disease management.
vii. Molecular aspects of host-pathogen interactions - PR proteins, degradation of phytoalexins, systemic resistance mechanism
viii. Transgenic approach for crop protection, engineering chemicals that elicit a defence response in plants

Suggested Readings

1. Butler, E.J. 1973. Fungi and Disease in Plants, Intern, Book Distributors. Dehradun.
2. Singh, R.S.1983. Plant Diseases. Oxford and IBH Publ. Co. New Delhi.
3. Singh, R.S. Principles of Plant Pathology. Oxford and IBH Publ. Co. New Delhi
4. Agrios GN (2005) Plant Pathology, 5th edition, Academic Press, Landon.
5. John A Lucas, 1998. Plant Pathology and Plant Pathogens, Wiley-Blackwell, CRC Press.

LCE-1 Lab Course Elective Based on EB 01a/ EB 01b

LCE-1 EB 01a [2 Credits]

1. Study of the Floral biology and breeding objectives of the following crop species: Wheat, Rice, Chilly, Mustard, Radish, Potato
2. Floral biology of horticultural crops
3. Practical experience of Emasculation, bagging, and hand pollination techniques
4. Plant breeding research institutes of India
5. Correlation and regression analysis with field-collected data
6. To test the goodness of fit and independent assortment using Chi-square method

LCE-1 EB 01b [2 Credits]

1. Study of fungal pathogens:
   Sclerospora graminicola, Peronospora parasitica, Erysiphe polygoni, Uromyces pisi v. Melampsora lini, Ustilago tritici, Sphacilotheca sorghi/U. hordeii, Tolyposporium penicillariae, Fusarium oxysporum f. sp. lycopersici
2. Isolation of fungal pathogens
3. Description of bacterial diseases and symptoms
4. Description of Viral diseases and symptoms

<u>Minor Elective Course Basket (EBM-1)</u> [4 Credits]

EBM-1: Applied Phycology

1. Algal Biomass Production
2. Commercial potential of *Chlorella*, *Spirulina* and *Porphyra*
3. High-rate algal ponds for the treatment of wastewaters and for the production of useful biomass and energy;
4. Paddy field cyanobacteria: their use as biofertilizer and in reclamation of usar lands
5. Algal blooms and other negative consequences of algae

Suggested Readings:

1. Lee, Robert Edeward, Phycology, Fourth edition, 2008, Cambridge University Press
2. Van Den Hoek C, Mann, DG, Jahns HM. 1995. Algae: An Introduction to Phycology

B.Sc. (Honours) Fourth Year [VIII Semester]

Fourth Year (VIII) Semester with Honours)	**Major Subject** **(Botany)** Core Botany-8 (CB-8) Core Botany-9 (CB-9) Core Botany-10 (CB-10)	**Credit** 5+5+5	**Name of Course** CB-8 Plant Ecology and Environmental Studies CB-9 Plant Biochemistry and Plant Molecular Biology CB-10 Stress Physiology	**Remarks** These courses will be based on the core subject selected by the students for PG
	Major Practical (LC-2)	5	LC-2 Lab Course Based on Core Botany (CB-8, CB-9 & CB-10)	
	Major Elective Botany (EB-2)	2	Elective Course: Anyone from EB-2 basket	**Major Elective Course Basket (EB-2)** EB 02a: Natural Resource Management EB 02b: Recombinant DNA Technology
	Major Elective Practical (LCE-2)	2	LCE-2LabCourseElective BasedonEB 02a/ EB 02b	
	Minor Botany (BM-2)	4	Minor Elective Course: For students with Core subjects Other than Botany (Without Practical)	**Minor Elective Course Basket (EBM-2)** EBM-2 Aquatic Botany
	TOTAL	**28**		
SwayamCourse:*SN:28https://onlinecourses.swayam2.ac.in/cec25_es02/preview				
Note: After completing four years (eight semesters) with abovementioned courses, the student will be awarded a Bachelor of Science degree, B. Sc.(Honours) in Botany.				

CB-8 Plant Ecology and Environmental Studies [5 Credits]

1. Biotic and abiotic components of the environment, primary productivity, trophic levels, ecological niche, ecological pyramids and ecological energetics.
2. Biogeochemical cycles: Carbon, nitrogen and phosphorous cycles. Population ecology: Definition, population characteristics, growth curves, carrying capacity and population fluctuation. Community ecology: Structure and community characteristics, quantitative, qualitative and synthetic features, life forms, biological spectrum and ecological succession.
3. Basic concepts environment and issues, global environmental problems - Ozone depletion, UV-B, greenhouse effect and acid rain due to anthropogenic activities, their impact and biotechnological approaches for management.
4. Environmental pollution - types of pollution, sources of pollution, measurement of pollution, methods of measurement of pollution, fate of pollutants in the environment, bioconcentration, bio/geo magnification.

Recommended Books:

1. Barbour, M.G., Burk, J.H. and Pitts, W.D. 1987. Terrestrial Plant Ecology. Benjamin/ Cummings Publication Company, California
2. Begon, M., Harpor, J.L. and Townsend, C.R. 1996. Ecology. Blackwell Science, Cambridge, U.S.A.
3. Chapman, J.L. and Reiss, M.J. 1988. Ecology: Principles and Applications. Cambridge University Press, Cambridge, U.K.
4. Heywood, V.H. and Watson, R.T.1995. Global Biodiversity Assessment. Cambridge University Press.
5. Kershaw, K.A. Quantitative and Dynamic Ecology. Oxford and IBH. Kormondy, E.J. 1996. Concepts of Ecology. Prentice-Hall of India Pvt. Ltd., New Delhi.
6. Odum, E.P. 1983. Basic Ecology. Saunders, Philadelphia
7. Smith, R.L. 1996. Ecology and Field Biology. Harper Collins, New York.

CB-9 Plant Biochemistry and Plant Molecular Biology [5 Credits]

1. Basics of biochemistry, Structure and properties of water; pH and buffers.
   Carbohydrates:Nomenclature and classification; Monosaccaharides, Disaccharides, Oligosaccharides polysaccharides.
   Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacyl glycerols structure, functions and properties; Phosphoglycerides.
2. **Proteins:** Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quarternary; Protein denaturation and biological roles of proteins.
   Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of DNA; Types of RNA; Structure of tRNA. Enzyme structure and classification, mechanism of action,Michaelis-Menten equation, and factors affecting enzyme activity.
3. Nucleic acids: Carriers of genetic information, Types of DNA, Types of genetic material, The Nucleosome Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin. Mechanism of Transcription:Translation, transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing
4. Gene expression, Regulation of gene expression: Lac operon and Tryptophan operon. The replication of DNA, Chemistry of DNA synthesis, semi-conservative and semi-discontinuous replication, RNA priming, replication of linear ds-DNA, replication of the 5'end of linear chromosome, Enzymes involved in DNA replication. Adaptor hypothesis and discovery of mRNA template, Principles of transcriptional regulation. Ribozymes; RNA editing and mRNA transport.

Recommended Books

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning.
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill, Livingstone.
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman.
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
5. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
6. Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.

CB-10 Stress Physiology [5 Credits]

1. General aspect of stress physiology of plants, types of stress; Biotic and Abiotic Stress, physical or chemical alteration, Stress Tolerant, Stress Factors; Drought or water stress, Salt stress, Temperature stress, Light stress, Mechanism of Tolerance, Effect of Cold Temperature on Plants

2. Physiology and biology of oxidative stress in plants, differences in salt and ion stress, Chilling injuries, freezing injuries, nutrient stress, deficiency syndromes, Heavy metal, salinity stress

3. Environmental factors; Water stress; Salinity stress, High light stress; Temperature stress; Hypersensitive reaction; Pathogenesis- related (PR) proteins; Systemic acquired resistance; Mediation of insect and disease resistance by jasmonates.Reactive oxygen species–Production and scavenging mechanisms.

4. Stress sensing mechanisms in plants Calcium modulation, Phospholipid signaling, Developmental and physiological mechanisms that protect plants against environmental stress. Adaptation in plants; Changes in root: shoot ratio; Aerenchyna development; Osmotic adjustment; Compatible solute production.

Recommended Books

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Shanker, A. K., and Venkateswarlu, B. 2011. Abiotic stress inplants – mechanismsand adaptations, InTech, Janeza Trdine 9, 51000 Rijeka, Croatia
4. Gupta, T.K and Palma, J. M. 2022. Plant Growth and Stress Physiology, Springer Cham, Springer Nature Switzerland AG 2021

LC-2 Lab Course Based on Core Botany (CB-8, CB-9 & CB-10) [5 Credits]

1. To determine the minimum size of the quadrat by species area curve method and minimum number of quadrats to be laid down in the field under study.
2. To determine the frequency, density and abundance of each species present in community.
3. To calculate relative frequency and relative density of each species in a given area.
4. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
5. Study of plant cell structure with the help of epidermal peel mount of Onion/Rhoeo/Crinum.
6. Measurement of cell size by the technique of micrometry.
7. Study of DNA replication mechanisms through photographs.
8. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.
9. Photographs establishing nucleic acid as genetic material.
10. Quantitative estimation of peroxidase activity in the seedlings in the absence and presence of salt stress.
11. Superoxide activity in seedlings in the absence and presence of salt stress.Quantitative estimation and zymographic analysis of glutathione reductase.

Major Elective Course Basket (EB-2)

EB 02a: Natural Resource Management [2 Credits]

1. Natural resources: Definition and types. Sustainable utilization: Concept, approaches (economic, ecological and sociocultural). Land: Utilization (agricultural, horticultural, silvicultural); Soil degradation and management.Water: Fresh water (rivers, lakes, groundwater, water harvesting technology, rain water storage and utilization.

2. Biological Resources: Biodiversity-definition and types; Significance; Threats; Management strategies; Bioprospecting; IPR; CBD; National Biodiversity Action Plan). Forests: Definition, Cover and its significance (with special reference to India); Major and minor forest products; Depletion; Management.

3. Energy: Renewable and non-renewable sources of energy-solar, wind, tidal, geothermal and bioenergy resources. Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint.

4. Resource Accounting; Waste management. National and international efforts in resource management and conservation.

Recommended Books:

1. B. W. Pandey. 2005. Natural Resource Management. Mittal Publication, New Delhi
2. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House,New Delhi.
3. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
4. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

EB 02b: Recombinant DNA Technology [2 Credits]

1. Introduction, history and importance of gene cloning and polymerase chain reaction. Scope of rDNA technology in various sectors, Vehicles: Plasmid and Bacteriophage; Purification of DNA: Total DNA purification from plant tissues and Agrobacterium. Plasmid DNA isolation (Alkaline lysis method). Enzymes used in the manipulation of purified DNA (Restriction endonuclease, Ligase, Polynucleotide kinase, DNA polymerase, reverse transcriptase, alkaline phosphatase and Terminal nucleotidyl transferase).
2. Cloning vectors like plasmids, M13 bacteriophage and λ bacteriophage. Rationale for the design of vectors for the over expression of recombinant proteins in plants and cell lines. Selection of suitable promoter sequences, ribosome binding sites, transcription terminator sequences, fusion protein tags, purification tags, protease cleavage sites and introducing restriction enzyme sites (for easy cloning and confirmation), sequences confirming high plasmid copy number and inducible expression system (IPTG). Expression vectors for recombinant protein production in plants, yeast cells, bacteria and cell lines.
3. Basic idea of gene cloning: methods and procedure involved in the isolation of full-length coding sequence of target genes. Cloning of PCR products, cDNA fragments, Promoters and adapter sequences in plasmids.
4. Introduction of recombinant DNA into various types of host cells. DNA sequencing methods: Sanger-Coulson method & Maxam-Gilbert method. Automated sequencing (Illumina sequencing and Nanopore sequencing). PCR & its application. DNA finger printing (RFLP & RAPD and REP-PCR). Bioinformatics – BLAST, nucleotide and protein sequence analysis.

Recommended Books:

1. Old. R. W., Primrose, S.B., & Twyman, R.M., (2001), Principles of Gene manipulation: An introduction to Genetic Engineering, Oxford and Blackwell scientific Publication.
2. Green. M. R., and Sambrook. J, 2012, Molecular cloning – A laboratory manual, Cold Spring Harbore Laboratory Press.
3. Nicholl, Desmond S T, 2023, An Introduction to Genetic Engineering, 4th revised edition, Cambridge University Press.
4. Brown. T. A, 2023, Genomes, 5th Edition, CRC Press.
5. Bernard R Glick, Jack J. Pasternak and Cheryl L. Patten, 2003, Molecular Biotechnology, Principles and Applications of Recombinant DNA.
6. Recombinant DNA by J. D. Watson, 2003, W.H. Freeman Publishers, New York.
7. Robertson D, Scott S, Miller D, 1997, Manipulation and expression of recombinant DNA: Lab Manual, Academic Press.

LCE-2 Lab Course Elective Based on EB 02a/ EB 02b

<u>EB 02a [2 Credits]</u>

1. Estimation of solid waste generated by a domestic system (biodegradable and non-biodegradable) and its impact on land degradation.
2. Collections of data on the forest cover of a specific area.
3. Measurement of dominance of woody species by the DBH (diameter at breast height) method.
4. Calculation and analysis of ecological footprint.
5. Ecological modelling.

EB 02b [2 Credits]

1. Demonstration of Restriction mapping via NEB cutter and snap gene software.
2. Demonstration of total DNA from Plant tissues by CTAB method.
3. Demonstration of Plasmid DNA from Bacteria via Alkaline lysis method.

4. Demonstration of Agarose gel Electrophoresis
5. Demonstration of Poly-achrilamide gel electrophoresis and molecular weight analysis of various protein bands.
6. Demonstration of Restriction digestion of plant genomic DNA/Plasmid DNA and analysis of molecular weights of various DNA fragments.

Minor Elective Course Basket (EBM-2) [4 Credits]

EBM-2 Aquatic Botany

1. Aquatic ecosystems: Definition, features, types, and functions of aquatic ecosystems- marine ecosystems (ocean, coastal) and freshwater ecosystems (lotic, lentic, and wetlands)
2. Phytoplanktons of freshwater and marine systems and their ecological significance
3. Benthic algae of pond, riverine, temperate water streams and marine systems
4. Seaweeds: Biodiversity of Seaweeds along the coast of India, Economic importance
5. Vascular plants: Freshwater aquatic plants, seagrasses and mangroves
6. Biotechnological importance of aquatic plants

Suggested Readings:

1. Edmondson, W.T. (1976). Freshwater Biology 2nd Ed. John Wiley (Ed.) and Sons, Inc.
2. Bames R.S.K. (1999). Introduction to Marine Ecology, Blackwell Science.
3. Hutchinson, G.E. (1976). A Treatise on limnology. Vol I & II John Wiley & Sons
4. Jeffery S. Levinton (2000). Marine Ecology, Biodiversity and Function. Oxford