

# *M. Sc. SYLLABUS*

## **BOTANY**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**(Revised, w.e.f. JUNE – 2016)**



**Re-Accredited Grade 'A' by NAAC  
(CGPA 3.05)**

**DEPARTMENT OF BIOSCIENCES  
SAURASHTRA UNIVERSITY  
RAJKOT – 360 005**

## DEPARTMENT OF BIOSCIENCES

The Department of Biosciences was established in 1969 by Late Prof. S.C. Pandeya as the founder Head of the Department. On the recommendations of the University Grants Commission, an integrated Post – Graduate Course in Biology was started as first of its kind in the Country. Later on, keeping Integrated Biology as the theme for the first year of the course, the academic programme was diversified into Plant Sciences, Animal Sciences and Microbiology, which were more recently renamed as M.Sc. in Botany, Zoology and Microbiology from the academic session 2007. From the academic session 2004-05, another M. Sc. Programme in Biotechnology was started. The Department initially started with its base in Environmental Sciences and in few years it took leadership in the field of ecology. Gradually, other areas of research, such as; Plant Physiology, Animal Physiology & Toxicology, Marine Biology & Coastal Ecology, Neurobiology, Ornithology, Wildlife Biology, Fisheries Biology, Insect Biology, Microbiology and Molecular Biology were also integrated into the thrust areas.

### THE FACULTY

At present, 11 faculty members (out of total 14 sanctioned positions) are conducting PG teaching and research in a wide array of research fields.

Name	Designation	Research Fields
<b>MICROBIOLOGY</b>		
Dr. S. P. Singh	Professor & Head	Microbiology, Extremophiles, Microbial enzymes, Protein Engineering, Metagenomics
Dr. R. K. Kothari	Professor	Microbiology, Virology
Dr. B. R. M. Vyas	Associate Professor	Microbiology, Degradation of Xenobiotics, Probiotics
Ms. J. H. Patel	Assistant Professor	Microbiology
Dr. S. D. Gohel	Assistant Professor	Microbiology, Extremophiles, Microbial enzymes
Dr. V.H. Raval	Assistant Professor (Contractual)	Microbiology, Extremophiles, Microbial enzymes
<b>BOTANY</b>		
Dr. Vrinda S. Thaker	Professor	Plant Physiology, Plant Biotechnology & Tissue Culture
Dr. Sumitra V. Chanda	Professor	Plant Physiology, Biochemistry & Herbal Technology
Dr. Nilesh S. Panchal	Professor	Plant Ecology, Desert Ecology, Environmental Science
Dr. Jigna Tank	Assistant Professor	Plant Physiology, Plant Molecular Biology
Dr. M.J.kaneria	Assistant Professor(Contractual)	Plant Physiology, Biochemistry & Herbal Technology
Dr. Kiran Chudasama	Assistant Professor(Contractual)	Plant Physiology, Plant Biotechnology
<b>ZOOLOGY</b>		
Dr. Rahul Kundu	Professor	Marine Biology & Coastal Ecology, Physiology & Toxicology
Dr. Varsha M. Trivedi	Assistant Professor	Arachnology, Insect Biology & Insect Pest Management, Avian Biology, Wildlife
Dr. Shweta Pathak	Assistant Professor(Contractual)	Marine Biology & Toxicology

## 1. THE COURSE

The M.Sc. Course in Botany is a full time curriculum, run for 2 years, spread over 4 semesters, with four theory Papers (three core and one interdisciplinary / multidisciplinary) and one combined practical in first two semesters. The last two semesters offer choice of courses to the students where two core courses and one elective (to be chosen from three available) courses will be taught. Any elective course will be taught only when prerequisite number of the student enrolls for that course. The minimum required number of student to run a course varies from course to course and to be decided by the Staff Council of the Department from time to time. A semester will be of about 100 working days. At the starting of Semester - III, students will be offered a Dissertation which is an original piece of research work and is part fulfilment for the degree, to be carried out by the student and submitted at the end of the fourth semester for evaluation. The elective courses and subject of dissertation should be decided by the student at the beginning of the 3rd Semester.

### 1.1 EDUCATIONAL STUDY TOUR

The Educational study tour (s) is *compulsory* and *part of the Curriculum to study different ecosystems, botanical, zoological and microbiological places of interest anywhere in the country.* Since the tour or tours are part of the curriculum, these can be conducted during any or all of the four semesters. The study tours can be undertaken anywhere within India to meet the academic demand. The students shall make Tour Reports and submit them during the IV Semester Examination for their evaluation. However, in special cases, alternative of the educational tour will be decided and assigned to the student concerned, by the Staff Council of the Department.

### 1.2 SEMINARS

Regular seminars will be organised on I and II Semesters and it is compulsory. Presentation on relevant topics, mostly from syllabus (oral and / or poster), is mandatory for the enrolled student. For each seminar, a student will be given marks, which will be added in the III Semester marksheet.

### 1.3 ATTENDANCE

Admitted students have to attend all the Lectures, Practicals and Seminars. A minimum prescribed attendance as per University rules is required to sanction a term grant. Students whose term is not granted will not be allowed to appear in the examination, and will have to join the same semester in the following year.

### 1.4. EXAMINATIONS

At the theory examinations, there shall be questions from the four units and all the questions are compulsory. Theory Examinations will be held at the end of each semester. However, Internal Examinations will be conducted by the Department during the ongoing Semester dates of which will be decided by the Staff Council. Students are required to apply in the prescribed application form for appearing in the Semester- end Theory Examination along with the necessary examination fees on the date to be notified by the University. The semester wise distribution of the courses and papers are given below.

## 2. SEMESTERWISE DISTRIBUTION OF MARKS:

### SEMESTER-I:

4 Papers (100 Marks each*)	: 400	
1 Combined Practical	: 200	<b>600</b>

### SEMESTER-II:

4 Papers (100 Marks each*)	: 400	
1 Combined Practical	: 200	<b>600</b>

### SEMESTER-III:

3 Papers (100 Marks each*)	: 300	
1 Combined Practical	: 150	<b>500</b>
Seminars	: 50	

### SEMESTER-IV:

3 Papers (100 Marks each*)	: 300	
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1 Combined Practical	: 150	<b>450</b>
Tour / Field Work	: 50	
M.Sc. Dissertation (Thesis:150& Viva 50)	: 200	<b>250</b>

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<b>Grand Total</b>	<b>:</b>	<b>2400</b>
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\* 70 Theory + 30 Internal

## 2.1. EVALUATION OF PAPERS

The theory papers will be having a weightage of 100 marks each. Out of 100 marks, 30 marks are in the form of Internal Examinations. The written Semester end examination for a paper will be of 70 marks from 4 units. The question paper will be of 70 Marks. The question papers will be of 5 questions. However, these are subjected to changes as per University rules prevailing at that time.

## 3.0 ADMISSION

Academic year of the University begins from June. The lectures and practicals of the third semester starts immediately. The same for the first semester usually commences immediately after admissions. The admission process is as per the criteria laid down by the University, through written admission test and personal interview.

### 3.1 Eligibility:

The candidate with B.Sc. degree in Botany with at least II class is eligible for admission to M.Sc. Botany course. Students, who have cleared B.Sc. with Botany as the second subject in S.Y. B.Sc. will also be considered for admission, provided the seats are available. A total of 20 seats are available in the Botany stream out of which 10 seats are on Self-Financed basis. Students will be admitted as per the reservation policy in effect from time to time, as directed by the University.

Candidates applying for admission should attach certified true copies of their B.Sc. examination mark sheets and passing certificate. In case of Saurashtra University's students, the candidates have to submit Transfer Certificate (TC) from the college last attended by them. Candidates coming from Universities other than Saurashtra University, have to submit Eligibility Certificate, immediately on obtaining admission, followed by submission of Transfer/ Migration Certificate.

*The M.Sc. courses run by this Department are full time studies and as such, a student admitted to the Department is not allowed to join any other courses or study, or take up any paid service.*

Limited number of seats in the University Hostel is available to the students admitted to the Department. Desirous students will have to apply in prescribed form available from the Rector of the Hostels. Some scholarships and free-ships are awarded to the students as per the University Rules.

Last date for receiving the application forms and the date and time of Admission Interview are shown in the application form. **THE CANDIDATE SHOULD BRING ALL ORIGINAL MARK SHEETS, CERTIFICATES ETC. AT THE TIME OF THE INTERVIEW.**

**3.2 Fee Schedules :** As per University rules as applicable from time to time in both Grant-in-Aid and Self-Finance Schemes

**3.3 Registration :** Students admitted to the first semester in each of the streams will have to get registration as post-graduate students of this University. No transfer will be given to any student once registered for a particular stream.

**M.SC. BOTANY SYLLABUS**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**  
 (Total 96 Credits)

Course Code	Course Name	Hours /Week	Credits
<b>SEMESTER - I</b>			
Bot - 101	Cell Biology (Core)	04	04
Bot - 102	Molecular Biology, Genetics & Evolution (Core)	04	04
Bot - 103	Biodiversity & Biosystematics (Core)	04	04
Bot- 104	Biostatistics and Bioinformatics** (Multi/ Inter disciplinary)	04	04
Bot- 105	Combined Practical Course	14	08
Bot- 106	Seminar Course – 1*	02	00
<b>TOTAL</b>			<b>24</b>
<b>SEMESTER - II</b>			
Bot - 207	Biochemistry (Core)	04	04
Bot - 208	Biotechnology & Immunology (Core)	04	04
Bot - 209	Environmental Science (Core)	04	04
Bot- 210	Analytical Techniques** (Multidisciplinary / Interdisciplinary)	04	04
Bot- 211	Combined Practical Course	14	08
Bot– 212	Seminar Course – 2*	02	00
<b>TOTAL</b>			<b>24</b>
<b>SEMESTER - III</b>			
Bot - 313	Plant Anatomy, Morphogenesis & Embryology (Core)	04	04
Bot - 314	Plant Ecology(Core)	04	04
<b>Elective Course** (any one of the following)</b>		04	04
Bot - 315	Plant Propagation Techniques (Elective)		
Bot - 316	Herbal Technology - I (Elective)		
Bot - 317	Diversity of Plant Life (Elective)		
Bot- 318	Combined Practical Course	08	04
Bot - 425	Dissertation / Project Course: Part-1*	09	00
Bot-106+212	Seminar Course (1 + 2)*	00	02
<b>TOTAL</b>			<b>18</b>
<b>SEMESTER - IV</b>			
Bot - 419	Plant Resource Utilization and Conservation(Core)	04	04
Bot - 420	Plant Physiology and Metabolism(Core)	04	04
<b>Elective Course** (any one of the following)</b>		04	04
Bot - 421	Plant Biotechnology and Genetic (Elective)		
Bot - 422	Herbal Technology - II (Elective)		
Bot - 423	Salinity, Desertification & Restoration Ecology (Elective)		
Bot - 424	Combined Practical Course	08	04
Bot - 425	Dissertation / Project Course*	09	12
Bot - 426	Educational Tour / Field Work Course*	00	02
<b>TOTAL</b>		<b>00</b>	<b>30</b>
<b>GRAND TOTAL</b>		<b>144</b>	<b>96</b>

\* (a) **Dissertation / Project** commences in III Semester but evaluated and Grade Points are to be added in 4<sup>th</sup> Semester. (b) **Educational Tours / Field Works** may be carried out in any Semester or all Semesters, but evaluated and Grade Points are to be added in the 4<sup>th</sup> Semester only. (c) **Seminar / Tutorial Courses** may be carried out in first two Semesters but evaluated and Grade Points are to be added in the 3<sup>rd</sup> Semester only.

**DISSERTATION / Project (Elective) Any one subject is to be chosen from the following** (Subjects offered may change from time to time depending on the availability of expertise): Plant Physiology, Immunology, Plant Tissue Culture, DNA Marker Technology, Plant Bioinformatics, Isolation and Purification of Plant Proteins, Herbal Technology, Salinity Studies in Plant, Desertification etc.

\*\* Elective and Multidisciplinary / Interdisciplinary Courses may or may not have practical and/or field work.

## DETAILED SYLLABUS

### M. Sc. BOTANY: SEMESTER - I

#### **BOT. 101: CELL BIOLOGY**

##### **Unit-1 : Cell Structure & Cell Cycle**

- 1.1 Cell Concept, Ultrastructure of Plasma Membrane, microbial and Plant Cell Wall.
- 1.2 Ultrastructure of Nucleus and Nucleolus. Pore Complex of Nuclear envelop.
- 1.3 Ultrastructure of Chromosome, Chromosomal Models, Special types of chromosomes.
- 1.4 Cell Cycle, G<sub>1</sub>/S Transition, Cyclines and cyclin dependent kinases. Regulation of CDK - cycline activity

##### **Unit-2 : Cellular Organization**

- 2.1 Mitochondria: Membrane Organization, Biogenesis and role in cellular energetics.
- 2.2 Chloroplasts: Ultrastructure, biogenesis, Photosynthetic units and reaction centres.
- 2.3 Ultrastructure and functions of Lysosome, Peroxisomes & Glyoxisomes.
- 2.4 GERL System and its functions. Vacuoles and their role in cell structure and function.

##### **Unit-3 : Cytoskeleton, Cellular Transport & Sorting**

- 3.1 Cytoskeleton: Ultrastructure and functions of Microtubules, microfillaments and associated proteins.
- 3.2 Cytoskeleton: Ultrastructure and functions of Actin, Myosin, IF and associated proteins.
- 3.3 Intracellular Junctions and their functions. Ca<sup>++</sup> dependent homophillic and non-homophillic cell-cell adhesion
- 3.4 Transport across cell membrane: diffusion, active transport and pumps, uniports, symports and antiports.

##### **Unit-4 : Cellular Communication, Apoptosis and Cancer**

- 4.1 Cell surface receptors and their mode of action. Phenomenon of exocytosis and endocytosis
- 4.2 Second messenger system, MDP kinase pathways
- 4.3 Apoptosis: Mechanism and significance
- 4.4 Cell biological approach of cancer, AIDS

#### **BOT. 102: MOLECULAR BIOLOGY, GENETICS & EVOLUTION**

##### **Unit-1. Population Genetics**

- 1.1 Principles of Mendalian genetics
- 1.2 Hardy-Weinberg genetic equilibrium, Natural selection
- 1.3 Genetics of Speciation
- 1.4 Origin of life: Coacervates, Miller's experiment, theories of organic evolution

##### **Unit-2. DNA as a hereditary material**

- 2.1 Structure of Nucleic acids, Structural differences in prokaryotic and eukaryotic DNA
- 2.2 DNA constancy and C-value paradox,
- 2.3 DNA replication and DNA methylation
- 2.4 Linkage and genetic (chromosome) mapping

##### **Unit-3. Gene structure and function (Prokaryotic and Eukaryotic)**

- 3.1 Loci, alleles, and Gene structure
- 3.2 Genetic code
- 3.3 Transcription
- 3.4 Translation

##### **Unit-4. Structural Changes in DNA material and Extra Chromosomal inheritance**

- 4.1 Molecular basis of spontaneous and induced mutations,
- 4.2 Chromosomal aberration
- 4.3 DNA damage and repair
- 4.4 Extra-chromosomal inheritance

#### **BOT. 103: BIODIVERSITY & BIOSYSTEMATICS**

##### **Unit – 1: Biodiversity**

- 1.1 Basic Concepts of Biodiversity: Genetic, species and ecological diversity.
- 1.2 Terrestrial, Marine Biodiversity, Eco-tourism and Biodiversity. Conservation and Sustainable use of

Biodiversity. Ecosystem monitoring and Rehabilitation.

- 1.3 Threats to Biological Diversity: Habitat Destruction, Invasive species, Disease, Over-exploitation, Pollution, Climate change and Biodiversity.
- 1.4 Structure and functions of the Convention on Biological Diversity (CBD), CBD mechanisms and working bodies. National Action Plan.

#### **Unit – 2: Microbial Taxonomy**

- 2.1 Principles of systematics and classification of microbes.
- 2.2 Introduction to akaryotes, virus, archea& bacteria, cyanobacteria and prokaryotes
- 2.3 Fungus like protists: Cellular slime moulds, plasmodial slime moulds. General features of Fungus
- 2.4 Classification of Zygomycetes, Ascomycetes, Basidiomycetes, Mycorrhizea

#### **Unit – 3: Plant Taxonomy**

- 3.1 Principles of systematics and classification of Plants.
- 3.2 General features and Classification of green protists like diatom, dinoflagellates, lichens and algae
- 3.3 Non-tracheophytes (Mosses) and Non-Seed Tracheophytes (Ferns and Fern allies).
- 3.4 Seed plants: Gymnosperm and Angiosperms

#### **Unit – 4: Animal Taxonomy**

- 4.1 Principles of systematics and classification of Animals.
- 4.2 Classification of Protista (Flagellates, Amoebas, Ciliates and Apicomplexans).
- 4.3 Major invertebrate phyla, Lower chordates
- 4.4 Vertebrates: Fish, Amphibia, Reptiles, Birds and Mammals

### **BOT. 104: BIOSTATISTICS AND BIOINFORMATICS**

#### **Unit – 1: Basics and concepts of Biostatistics**

- 1.1 Data, Tabulation, Classification, Frequency distribution and Graphics
- 1.2 Measure of Central Tendency – Mean, Mode & Median: Definition, Objectives, Merits, Demerits & Uses
- 1.3 Measure of Dispersion – Range, Variance, Standard deviation, Coefficient of Variation
- 1.4 Confidence limit and confidence interval

#### **Unit – 2: Statistical tests in Biology**

- 2.1 Student's t-test: Paired and Unpaired
- 2.2 Analysis of Variance
- 2.3 Regression and Correlation analysis
- 2.4 Chi-square test

#### **Unit – 3: Basics of Bioinformatics and Biological Database**

- 3.1 Introduction of Bioinformatics (Biological and IT links), Basic terminology
- 3.2 Application of bioinformatics in various fields: Medicine, Agriculture, Industries etc.
- 3.3 Types of biological database, File formats and Structure of database
- 3.4 Primary and Secondary database

#### **Unit – 4: Sequence alignment, Gene prediction and Basic concepts of Omics**

- 4.1 Sequence alignment: Nucleotide and Protein sequences, Pairwise and multiple sequence alignment, Phylogenetic relationship and importance of the study
- 4.2 Gene prediction: Gene structure in prokaryotic and eukaryotic systems, Prediction tools for the gene
- 4.3 Genomics: Definition and importance of the study
- 4.4 Other Omics (Transcriptomics, Proteomics and Metabolomics: Definition and importance of the study)

### **BOT. 105: COMBINED PRACTICAL COURSE**

#### **101. Cell Biology**

1. Preparation of paraffin blocks of animal tissue – Understanding the cytological and histological techniques
2. Section cutting, spreading and staining methods, Microscopy
3. Supra – vital Cytological staining of cellular organelles
4. Cellular metabolites: Permanent Cytological Staining
5. Nucleic Acids: Permanent Cytological Staining
6. Cytogenetics: Onion root tip squash preparation for mitosis
7. Dipteran salivary gland squash preparation for giant chromosome

8. Cytological Staining of Barr body
9. Cytogenetics: Stages of meiosis
10. Histological and Cytological Staining of Drumstick
11. Enzyme histochemistry & Cytochemistry
12. Observations on permanent cytological slides

### **102. Molecular Biology, Genetics & Evolution**

1. To confirm thalassemia by NESTROFT (Necked Eye Single Tube RBCs Osmotic Fragility Test)
2. To induce polyploidy in root of *Allium cepa* and observe cytological changes in cell
3. To study karyotype of human chromosome
4. Identification of normal male and female karyotype
5. Identification of Turner syndrome using Karyotype
6. Identification of Klinefelter syndrome using the karyotype
7. Identification of Down syndrome using the karyotype
8. Identification of Edwards syndrome using the karyotype
9. To perform linkage analysis and Map construction with example
10. To perform Pedigree analysis and Probabilities with example
11. Staining of Microbial Cells: Monochrome, Negative & Gram Staining
12. Bacterial Motility (Hanging Drop Method)
13. Bacteriological Media Composition & Preparation and Bacterial Cultivation Methods

### **103. Biodiversity & Biosystematics**

1. General features & classification of Invertebrates up to class or order
2. General features & classification of vertebrates up to class or order
3. General features and classification of diatoms, dinoflagellates, lichens and algae
4. General features and classification of non-tracheophytes and non-seed tracheophytes
5. General features and classification of Gymnosperms
6. General features and classification of angiosperms
7. Negative staining, Differential staining (Gram's staining)
8. Specialized staining: Capsule staining, Spirocheck staining, Metachromatic granule staining, Cell wall staining
9. Hanging drop techniques for motility

### **104. Biostatistics & Bioinformatics**

#### **Biostatistics:**

1. Frequency Distribution
2. Standard Deviation and Coefficient of Variation
3. Confidence limits for the population mean
4. Students 't' test
5. Analysis of Variance
6. Regression and Correlation
7. Chi Square Test

#### **Bioinformatics :**

8. Basic Terminologies in Bioinformatics
9. Biological databases
10. NCBI Search for Gene Sequences
11. UniProt Knowledgebase (UniProt KB) Search for Protein Sequences
12. RCSB PDB search for Protein 3D Structures
13. Pair wise Sequence Alignment using NCBI BLAST
14. Pair wise Sequence Alignment using Bio edit
15. Multiple Sequence alignment using CLC Protein Workbench
16. Multiple Sequence alignment using Clustal X
17. Analysis of 3 D structure of protein by Rasmol



## M.Sc. BOTANY : SEMESTER - II

### **BOT. 207: BIOCHEMISTRY**

#### **Unit – 1 : Carbohydrates, Lipids and Fatty Acid metabolism**

- 1.1 Monosaccharides and disaccharides: Types and properties
- 1.2 Polysaccharides: Homopolysaccharides and heteropolysaccharides
- 1.3 Classification and properties of simple and compound lipids
- 1.4 Function of lipids, Metabolism of fatty acids: Beta oxidation

#### **Unit – 2 : Protein Structure and Function**

- 2.1 Properties of amino acid, titration curves and function of proteins
- 2.2 Primary and Secondary structure of protein
- 2.3 Tertiary structure of protein, Ramchandran Plots
- 2.4 Quaternary structure of protein: globular and fibrous

#### **Unit – 3 : Enzymes: Basic Concepts and Kinetics**

- 3.1 An introduction to enzymes: Nomenclature and classification
- 3.2 Principles and mechanism of enzymes catalysis: single and multisubstrate, Coenzymes and cofactors
- 3.3 Kinetic properties of enzymes, Michaelis-Menten Model, Double reciprocal plot
- 3.4 Enzyme Inhibition: Competitive, Non- competitive, Uncompetitive and Mixed type

#### **Unit – 4 : Metabolism: Basic Concepts and Regulation**

- 4.1 Concept of Bioenergetics: laws of thermodynamic, Entropy and Enthalpy, Energy rich compounds and electron carriers
- 4.2 Glycolysis and Citric Acid Cycle
- 4.3 Other pathways of carbohydrate metabolism ED, Pentose Phosphate, Glyoxylate, Gluconeogenesis
- 4.4 Allosteric proteins, Feedback inhibition

### **BOT. 208: BIOTECHNOLOGY & IMMUNOLOGY**

#### **Unit – 1 : Biotechnology -1.**

- 1.1 Bioremediation: Principles and Methods,
- 1.2 Techniques of immobilization of enzymes & cells
- 1.3 Applications of Immobilized Enzymes & Cells
- 1.4 Principles and techniques of animal tissue culture

#### **Unit – 2 : Biotechnology -2**

- 2.1 Basics of genetic engineering
- 2.2 DNA isolation techniques
- 2.3 Restriction enzymes, Gene targeting
- 2.4 Vectors : plasmids, cosmids and phages, Host vector system, Screening of the recombinant clones

#### **Unit – 3 : Plant Tissue culture**

- 3.1 Principles and Techniques of Plant Tissue Culture
- 3.2 Basic Steps of Plant Tissue Culture
- 3.3 Selection of Plant Culture Media
- 3.4 Types of Plant Tissue Cultures

#### **Unit – 4 : Immunology**

- 5.1 Antigen Antibody: Structure of Ig, Ig Classes & Biological Activities, Factors Influencing Immunogenicity, Monoclonal Antibodies
- 5.2 Innate and Adaptive Immune System
- 5.3 Antigen-Antibody Interactions: ELISA Test, Agglutination, Precipitation, Immunofluorescence
- 5.4 Delayed and Immediate Hypersensitive Reactions, Autoimmunity

### **BOT. 209: ENVIRONMENTAL SCIENCE**

#### **Unit-1 Environment**

- 1.1 Definition, principles and Scope of Environmental science.
- 1.2 Earth, Man and Environment, Ecosystems, Pathways in Ecosystems, Physico-chemical and Biological

factors in the Environment, Geographical classification and zones.

- 1.3 Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere.
- 1.4 Scale of Meteorology, pressure, temperature, precipitation, humidity, radiation and wind.
- 1.5 Atmospheric stability, inversions and mixing heights, windroses

### **Unit-2 Ecosystem**

- 2.1 Definition, Principles and scope of ecology, Human ecology and human settlement,
- 2.2 **Ecosystems:** Structure and functions, abiotic and Biotic components, food chains, food web, ecological pyramids, population, community ecology and parasitism, prey-predator relationships
- 2.3 Biomes of the world
- 2.4 Overview of Sanctuaries, National park and Botanical garden

### **Unit-3 Pollution**

- 4.1 Air: Natural and anthropogenic sources of pollution, primary and secondary pollutants, Transport and diffusion of pollutants. Gas laws governing the behavior of pollutants in the atmosphere. Methods of monitoring and control of air pollution SO<sub>2</sub>, NO<sub>x</sub>, CO, SPM. Effects of pollutants on human beings, plants, animals, materials and on climate, Acid rain, Air Quality Standards
- 4.2 Water: Types, Sources and consequences of water pollution, physic-chemical and bacteriological sampling and analysis of water quality. Standards, sewage and waste water treatment and recycling. Water quality standard
- 4.3 Soil: Physico-chemical as bacteriological sampling as analysis of soil quality, Soil pollution control, Industrial waste effluents and heavy metals, their interactions with soil components. Degradation of different insecticides, fungicides and weedicides in soil. Soil organic and inorganic components
- 4.4 Global Environmental problems: Ozone depletion, global warming and climatic change, clean development mechanism.

### **Unit-4 Environmental Impact Assessment**

- 3.1 Introduction to environment impact analysis, Environmental impact statement and environmental management plan, Impact Assessment methodologies
- 3.2 Generalized approach to impact analysis
- 3.3 Procedure for reviewing environmental impact analysis and statement
- 3.4 Principles of Remote sensing and its applications of environmental sciences, Application of GIS in Environmental management

## **BOT. 210: ANALYTICAL TECHNIQUES**

### **Unit – 1 : Microscopy and Autoradiography**

- 1.1 Theories of Tissue fixation and staining techniques
- 1.2 Principles of Transmission and Scanning Electron microscopy
- 1.3 Principles of Phase Contrast and Fluorescence Microscopy
- 1.4 Principle and applications of Autoradiography

### **Unit – 2 : Spectroscopy**

- 2.1 Basic principles of Spectroscopy, UV, IR, Raman, ESR, ORD
- 2.2 CD and structure of proteins using NMR and ESR
- 2.3 Neutron and X-Ray diffraction for elucidation of 3D structure
- 2.4 Molecular modelling, Mass Spectrometry

### **Unit – 3 : Chromatographic techniques**

- 3.1 Basic Principle and types of Chromatography
- 3.2 Gas Chromatography, GC-MS, LC – MS / MS
- 3.3 Ion Exchange Chromatography, gel permeation, Affinity and reverse phase chromatography
- 3.4 HPLC and FPLC

### **Unit – 4 : Centrifugation and Electrophoretic Techniques**

- 1.1 Principle and applications of Centrifugation techniques
- 1.2 Basic principles of Electrophoresis, Agarose gel, native and SDS-PAGE
- 1.3 Isoelectric focusing, 2D-PAGE and their uses in protein research
- 1.4 Fractionation and Blotting Techniques

**BOT. – 211 : COMBINED PRACTICAL COURSE****207. Biochemistry: Suggested Laboratory Work**

1. To prepare a titration curve of a weak acid with a strong base
2. To prepare a titration curve and determine the pK and pI value of an amino acid
3. Qualitative analysis of Carbohydrates
4. To prepare a calibration curve of reducing sugars by DNSA
5. Extraction and estimation of reducing and non-reducing sugars by DNSA method.
6. To prepare a calibration curve of protein by Folin-Lowry method
7. Extraction and estimation of protein by Folin-Lowry method
8. To prepare a calibration curve of amino acid using Ninhydrin reaction method
9. Extraction and estimation of free amino acid content in germinating seeds by ninhydrin reaction method
10. To prepare a calibration curve for para nitrophenol
11. Estimation of enzyme acid phosphatase activity from given plant material
12. Determination of Vmax and Km
13. To separate amino acids by ascending paper chromatography
14. To determine acid value of fats and oils
15. To determine saponification value of fats and oils
16. Protein purification Table

**208. Biotechnology: Suggested Laboratory Work**

1. Isolation & Identification of Bacteria, Yeasts & Fungi
2. Biochemical Tests: Metabolic Activities of Enteric Bacteria: Sugar Fermentation, IMViC, H<sub>2</sub>S production, Phenylalanine Deaminase, Urea Hydrolysis, Nitrate Reduction, Amylase, Protease
3. Detection of Extracellular Alkaline Protease, amylase from Haloalkaliphilic Actinomycetes
4. Determination of Alkaline Protease from Haloalkaliphilic Actinomycetes using Anson-Hagihara's Method
5. Concept of Totipotency
6. Direct ELISA Technique
7. Indirect ELISA Technique
8. Antigen preparation
9. Preparation of plant tissue culture media
10. Callus culture from leaf material
11. To perform the Ouchterlony double diffusion.
12. To learn the technique of Immunoelectrophoresis
13. To learn the technique of radial immunodiffusion.
14. To learn the technique of agglutination.
15. To perform sandwich DOT ELISA test for antigen.
16. To perform Rocket Immunoelectrophoresis
17. To perform Western Blot Technique
18. To isolate genomic DNA from bacterial isolate

**209. Environmental Science: Suggested Laboratory Work**

1. To determine color of soil by physical observation and to determine water holding capacity
2. To determine field capacity of soil
3. To determine temperature soil by thermometer.
4. To determine soil-moisture by oven drying
5. To determine soil texture
6. To estimate the amount of organic carbon by Walkley and Black titration method
7. To estimate total nitrogen from given soil
8. To estimate the amount of Ca from given soil sample
9. To estimate the amount of Mg from given soil sample
10. To determine the amount of carbonate in the soil by rapid test
11. To determine the amount of nitrate by rapid test
12. To determine the base deficiency of soil by rapid test
13. To determine reductivity of soil by rapid test
14. To determine the amount of organic carbon by Walkley's and Black's titration method
15. To determine the amount of chloride by rapid test
16. To determine Calcium Carbonate in the Soil.
17. To determine phosphate content in the soil
18. To study the meteorological apparatus

19. To determine the alkalinity of given water sample.
20. To determine acidity of given water sample.
21. Dissolved oxygen (DO)
22. Biological oxygen demand (BOD)
23. Chemical oxygen demand (COD)
24. Bacteriological analysis by MNP
25. Color, turbidity, odour and pH, TS, TDS and TSS
26. Chloride estimation
27. Sulfate estimation
28. Ca-Mg Hardness/ Estimation of total hardness of water by EDTA method.
29. Phosphorus Phosphate estimation(ascorbic acid method)
30. Estimation of Nitrite-Nitrogen of given water sample

**210. Analytical Technique: Suggested Laboratory Work**

1. Demonstration of a state-of-the-art compound microscope with Brightfield, Phase-Contrast, Fluorescence and Darkfield operational details.
2. Demonstration of computer controlled brightfield microscopy
3. Demonstration of Image capturing and Image analysis by Image Analysis software
4. Determination of various image analysis parameters (cell or tissue length, width, diameter etc.) by using both microscopy and image capturing and analyses.
5. Demonstration of Stereo zoom dissecting microscope
6. Determination of various image analysis parameters (Tissue or Organism length, width, diameter etc.) by using both microscopy and image capturing and analyses.
7. Localization of anthocyanin in plant tissue
8. Localization of phenols in plant tissue
9. Localization of Tannins in plant tissue
10. Localization of alkaloids in plant tissue
11. Localization of lignins in plant tissue
12. Localization of starch in plant tissue
13. Localization of flavanoids in plant tissue
14. Determination of molecular mass of Protein by size exclusion chromatography (Theoretical)
15. PCR amplification of gene
16. DNA sequencing of the amplified gene
17. Electrophoresis of PCR product

## **M.Sc. BOTANY – SEMESTER- III**

### **BOT. 313: PLANT ANATOMY, MORPHOGENESIS AND EMBRYOLOGY (CORE)**

#### **Unit- 1 Anatomy**

- 1.1 Meristematic and permanent tissues of plants
- 1.2 Shoot and root apex organization
- 1.3 Special and secretory tissues of plants
- 1.4 Types of tissue systems
- 1.5 Anatomical features of dicotyledonous and monocotyledonous plants
- 1.6 Secondary and anomalous growth in plants

#### **Unit -2 Morphogenesis**

- 2.1 Evolution of morphogenetic pattern
- 2.2 Organogenesis of root, stem and leaf,
- 2.3 Organogenesis of bud, flower and inflorescence
- 2.4 Morphogenesis: light, temperature and precipitation affecting on morphogenesis

#### **Unit- 3 Embryology**

- 3.1 Micro and Mega sporangium
- 3.2 Female and Male gametophyte
- 3.3 Fertilization
- 3.4 Endosperm Types
- 3.5 Embryogenesis and types of embryo

#### **Unit- 4 Applied Embryology**

- 4.1 Apomix
- 4.2 Polyembryony
- 4.3 Embryology in relation to taxonomy
- 4.4 Experimental Embryology

#### **SUGGESTED READING:**

1. Plant Cell Morphogenesis - Zarsky, Viktor, Cvrckova, Fatima; Plant Morphogenesis - Edmund Ware Sinnott
2. Plant Organogenesis - De Smet
3. Vascular Morphogenesis – Ribatti and Domenico
4. Morphogenesis - Jonathan Bard
5. The Embryology of Angiosperms – SS Bhojwani and SP Bhatnagar
6. Plant Anatomy – A Fann
7. Plant Anatomy – BP Pandey
8. A textbook of Plant Anatomy – P Saxena & SM Das
9. Plant Anatomy: Applied Approach – DF Cutler, T Botha & DW Stevenson
10. Plant Anatomy – JD Mauseth
11. An Introduction to Plant Structure and Development – CB Beck
12. Plant Anatomy and Embryology – SN Pandey & A Chadha
13. Plant Anatomy – R Crang & A Vssilyev

### **BOT. 314: PLANT ECOLOGY (CORE)**

#### **Unit- 1. Structure of Plant Communities**

- 1.1 Concept of community and continuum
- 1.2 Community analysis analytical character
- 1.3 Community analysis synthetic characters
- 1.4 Physiognomic characters, growth forms and sampling methods

#### **Unit -2. Community Metabolism and Dynamics**

- 2.1 Primary production, productivity and methods of measurement
- 2.2 Energy dynamics (energy flow pathways)
- 2.3 Litter production and decomposition
- 2.4 Community change (ecological succession)

**Unit -3. Population dynamics and Autecology**

- 3.1 Population growth, carrying capacity and population regulation
- 3.2 Species interaction: competition, allelopathy
- 3.3 Concept of ecological niche
- 3.4 Ecotype formation and classification
- 3.5 Plant indicators

**Unit- 4. Soil and Desert**

- 4.1 Soil structure
- 4.2 Soil processes, nitrogen mineralization
- 4.3 Desertification: causes and control
- 4.4 Fire: effect on grasslands and forests

**SUGGESTED READING**

1. Fundamentals of Ecology: Odum E. P.
2. Fundamentals of Ecology: Agarwal S. K
3. Concept of Ecology: Kormondy E. J.
4. Ecology and Environment : P.D. Sharma
5. Quantitative and dynamic ecology: Kershaw K. A.
6. Plant Ecology : Michael L
7. Encyclopaedia of Soil Science : Rattan lal
8. Fundamentals of soil science : Millar, Charles Ernest
9. Soil: introduction : Michael and Donald
10. Environmental soil science: Kim H. Tan
11. Ecology: Krebs C. J.

**BOT. 315: PLANT PROPAGATION TECHNIQUES (ELECTIVE)****Unit :1 Introduction to Plant Propagation**

- 1.1 Techniques of plant propagation
- 1.2 The development of nurseries and plant propagation organization
- 1.3 Genetic control in propagation (sexual and asexual propagation)
- 1.4 Environmental factors regulating plant propagation

**Unit:2 Vegetative propagation**

- 2.1 Clones preparation in vegetative propagation
- 2.2 Propagation by cutting
- 2.3 Propagation by grafting
- 2.4 Techniques of budding
- 2.5 Layering and its natural modification

**Unit:3 Methods of Micropropagation – I**

- 3.1 Basic of plant tissue culture
- 3.2 Selection criteria for explants
- 3.3 Callus induction and sub culturing
- 3.4 Protoplast isolation, culture and selection of hybrids

**Unit:4 Methods of Micropropagation – II**

- 4.1 Anther culture and production of haploids
- 4.2 Organ culture and organogenesis, Somaclonal variation
- 4.3 Preparation of artificial seeds
- 4.4 Production of secondary metabolites

**SUGGESTED READING:**

1. Plant Propagation - M K. Sadhu
2. Molecular Biotechnology Principles and Practices - Channarayappa
3. Biochemistry and Molecular Biology of Plants - Bob B, Wilhelm G and Russell J

**BOT. 316: Herbal Technology I (Elective)****Unit 1. Medicinal plants: An Introduction**

- 1.1 Importance of medicinal plants
- 1.2 Cultivation of medicinal plants
- 1.3 Propagation of medicinal plants
- 1.4 Conservation strategies of medicinal plants

**Unit 2. Traditional utility of medicinal plants**

- 2.2 Traditional and alternative systems of medicine
- 2.3 Major medicinal plants of India
- 2.4 Major medicinal plants of the World
- 2.5 Indigenous traditional drugs

**Unit 3. Phytoconstituents and their extraction techniques**

- 3.1 Pre extraction operation for crude drugs
- 3.2 Effect of solvents on extraction
- 3.3 Procedure for extraction of herbal drugs
- 3.4 Extraction procedure of alkaloids, tannins, saponins, phenols, flavonoids

**Unit 4. Quality Control techniques**

- 4.1 Adulteration and deterioration
- 4.2 Factors affecting herbal drugs quality
- 4.3 Identification by morphological evaluation
- 4.4 Development of standardization parameters

**SUGGESTED READING:**

1. A Handbook of Medicinal Herbs - Dhananjay J. Deshpande
2. A Handbook of Medicinal Plants - N D Prajapati, S. S. Purohit, A K. Sharma
3. An Introduction to Herbal Medicine in Ethnobotany - Rahat Ali,
4. Ayurvedic Medicinal Plants of India, Vol. 1-2 (Set) - Bhutya, R.K.
5. Handbook of Ayurvedic Medicinal Plants: Herbal Reference Library - L. D. Kapoor
6. Importance Of Medicinal Plants - Noor Ahmed Khan, Syed Aftab Iqbal
7. Indian Medicinal Plants - 8 Volumes (2nd Edition) - K. R. Kirtikar and B. D. Basu
8. Indian medicinal plants forgotten healers guide to ayurvedic herbal medicine – Prakash Paranjpe
9. Indian Medicinal Plants: An Illustrated Dictionary - Khare, C.P.
10. Medicinal Plant : Cultivation : A Scientific Approach - S.S. Purohit and S.P. Vyas
11. Medicinal Plants Cultivation and their Uses - H. Panda
12. Medicinal Plants of India: An Encyclopaedia - Ravindra Sharma
13. Medicinal Plants of the World - Ivan A Ross
14. Quality Standards of Indian Medicinal Plants : Vol. 10 - NeerajTandon and Parul Sharma
15. The Ayurvedic Plants - P. H. Kulkarni, Shahida Ansari
16. The Encyclopedia of Medicinal Plants - Andrew Chevallier
17. Practical Pharmacognosy – CK Kokate
18. Practical Pharmacognosy – KR Khandelwal
19. Herbal drug technology – SS Agrawal & M Paridhavi
20. Herbal technology recent trends and progress – M Danian

**BOT. 317: DIVERSITY OF PLANT LIFE (Elective)****Unit -1: Bryophyta**

- 1.1 General characters, economic importance and classification of bryophyta
- 1.2 Morphological patterns and variation in leaf, stem and reproductive organ of bryophyta
- 1.3 Anatomical patterns and variation in leaf, stem and reproductive organ of bryophyta
- 1.4 Reproduction and Life-cycles of bryophyta
- 1.5 Evolutionary trends amongst the different groups and their affinities

**Unit -2: Pteridophyta**

- 2.1 General characters, economic importance and classification of pteridophyta
- 2.2 Morphological patterns and variation in leaf, stem, root and reproductive organ of pteridophyta
- 2.3 Anatomical patterns and variation in leaf, stem, root and reproductive organ of pteridophyta

- 2.4 Reproduction and life cycles of pteridophyta
- 2.5 Evolutionary trends amongst the different groups and their affinities
- 2.6 Stele of pteridophyta

### Unit -3: Gymnosperms

- 3.1 General characters, economic importance and classification of gymnosperms
- 3.2 Morphological patterns and variation in leaf, stem and reproductive organ of gymnosperms
- 3.3 Anatomical patterns and variation in leaf, stem and reproductive organ of gymnosperms
- 3.4 Reproduction and Life-cycles of gymnosperms
- 3.5 Evolutionary trends among the different groups

### Unit -4: Angiosperms

- 4.1 Classification of family as per Bentham & Hooker classification
- 4.2 Merits and demerits of Bentham & Hooker classification
- 4.3 Detailed study: Families of Polypetalae, Gamopetalae and Apetalae
- 4.4 Detailed study: Families of monocotyledons

### SUGGESTED READING:

1. College Botany by Das, Datta and Gangulley
2. Bryophytes by Puri P.
3. Bryophyta by N. S. Parihar
4. The morphology of Pteridophyta by Sporne K.K.
5. Pteridophyta by N. S. Parihar
6. Cryptogamic Botany by Smith
7. Angiosperms by R. N. Sutaria
8. Bombay flora by Hook
9. Gymnosperms by Bhatnagar S. P. and Moitra
10. Numerical taxonomy by Cole A. J.
11. Principles of angiosperms taxonomy
12. Plant Biosystematics by Grant W. F.
13. Diversity and classification of flowering plants

### BOT. 318: COMBINED PRACTICAL

#### 313. SUGGESTED LABORATORY WORK

1. To study anatomical features of *Tridax procumbens* stem
2. To study secondary growth in *Bougainvillea spectabilis*
3. To study anatomical features of *Cleome viscosa* stem
4. To study anatomical features of *Clitoria ternatea* stem
5. To study anatomical features of *Gymnosporium montana* leaf
6. To dissect out embryo from seed of *Lycopersicon esculentum*
7. To dissect out embryo from seed of *Cyamopsis tetaralioides*
8. To dissect out embryo from seed of *Cucumis sativus*

#### 314. SUGGESTED LABORATORY WORK

1. To determine the requisite size of the quadrats by species area curve method in given grassland
2. To determine the minimum number of quadrats for studying of grassland.
3. To determine the density and abundance of plant species in a grazing by quadrat method
4. To determine the frequency of plant species in a grazing land by quadrat method.
5. Differentiation of ecotype in *Chatharanthus roseus* by a scatter diagram method.
6. To determine vegetative cover of plant species in grazing land by line transect method.
7. To determine Important value Index (IVI) of plant species in a grazing land

#### 315. SUGGESTED LABORATORY WORK

1. To prepare the Murashige & Skoog media for callus culture of different plants.
2. To inoculate explants into media for callus development.
3. To prepare the Murashige & Skoog media for multiple shoot development in various range and inoculation of shoot explants from different plants
4. To study the lyophilization technique for plant materials.
5. Principle & basic information of HPLC.



6. To study the components of HPLC.
7. To study system maintenance in HPLC.
8. To understand software applications in HPLC.
9. To study phenols compounds in *Phoenix dactylifera* plant using HPLC.
10. To calculate Molarity and Normality of solutions and compare with software.

### 316. SUGGESTED LABORATORY WORK

1. Study of proximate parameters: loss on drying, total ash, acid insoluble ash and water Soluble ash
2. Determination of different solvent soluble extractive value.
3. Macroscopic, microscopic and powder study of leaf of *Vincarosea* L.
4. Macroscopic, microscopic and powder study of leaf of *Adhatodavasica* L.
5. Demonstration of various apparatus used in herbal technology
6. To study different types of crystals of calcium oxalate from different plants
7. Identification and uses of 10 Indian medicinal plants
8. Qualitative phytochemical analysis
9. Identification and uses of some indigenous traditional drugs
10. Various Extraction methods
  - a) Decoction
  - b) Cold percolation method – Individual
  - c) Cold percolation method – successive
  - d) Soxhlet extraction method

### 317. SUGGESTED LABORATORY WORK

#### Unit -1: Bryophyta

1. Morphological study of thallose / foliose of different groups of bryophyta
2. Anatomical study of thallose / foliose of different groups of bryophyta
3. Morphological study of sporophyte of different groups of bryophyta
4. Anatomical study of sporophyte of different groups of bryophyta

#### Unit -2: Pteridophyta

5. Morphological study of leaf / stem / root of different groups of pteridophyta
6. Anatomical study of leaf / stem / root of different groups of pteridophyta
7. Morphological study of reproductive organ of different groups of pteridophyta
8. Anatomical study of reproductive organ of different groups of pteridophyta

#### Unit -3: Gymnosperms

9. Morphological study of leaf / stem / root of different groups of gymnosperms
10. Anatomical study of leaf / stem / root of different groups of gymnosperms
11. Morphological study of reproductive organ of different groups of gymnosperms
12. Anatomical study of reproductive organ of different groups of gymnosperms

#### Unit -4: Angiosperms

13. Study plants of polypetalae group
14. Study plants of gamopatalae group
15. Study plants of apetalae group
16. Study plants of monocotyledons group

## **M.SC. BOTANY – SEMESTER - IV**

### **BOT. 419: PLANT RESOURCE UTILIZATION AND CONSERVATION (CORE)**

#### **Unit 1 Agricultural Products of India**

- 1.1 History, origin and distribution of crop plants
- 1.2 Major staple crops: rice, wheat, maize
- 1.3 Minor staple crops: millets, ragi, rye, barley
- 1.4 Major pulses: oil seeds, fibre crops

#### **Unit 2 Forest and Forestry**

- 2.1 Classification of Indian Forests
- 2.2 Afforestation, Forms and growth of forest trees
- 2.3 Silviculture, Silviculture systems,
- 2.4 Forest Menustration and Protection
- 2.5 Major and minor forest products of India

#### **Unit 3 Grassland and Fodder Resources**

- 3.1 Major grassland area of India and its classification
- 3.2 Importance of fodder grasses, forbs and legumes
- 3.3 Grassland management

#### **Unit 4 Intellectual Property Right**

- 4.1 Overview of Intellectual Property Plant variety protection
- 4.2 Farmer's and Breeder's rights
- 4.3 Biodiversity act
- 4.4 Protection of traditional knowledge

#### **SUGGESTED READING:**

1. Economic Botany - SampatNehra
2. Economic Botany - B. P. Pandey
3. Economic Botany: A Profile - AkhilBaruah
4. Economic Botany of Crop Plants - AVSS Sambamurty and NS Subrahmanyam
5. A textbook of Modern Economic Botany - AVSS Sambamurty and NS Subrahmanyam
6. Textbook of Economic Botany - V. Verma
7. Encyclopaedia of Forest Sciences - Evans, Youngguist and Burley
8. Forestry: Principles and Applications - AJ Raj, SB Lal
9. Forestry - Gyan Deep Singh
10. Indian Forestry - K. Manikandan, S. Prabhu
11. Tree and Forest Measurement - P.W. West
12. Forest and Forestry - K.P. Sagreya

### **BOT. 420: PLANT PHYSIOLOGY AND METABOLISM (CORE)**

#### **Unit -1: Growth and Development**

- 1.1 Plant growth processes
- 1.2 Physiology of flowering :vernalization and photoperiodism
- 1.3Seed viability and germination
- 1.4 Seed and bud dormancy
- 1.5 Senescence and Abscission

#### **Unit -2: Mineral Nutrition**

- 2.1 Essential elements and their role in plant growth and development
- 2.2 Translocation phenomena in plants
- 2.3 Assimilation of inorganic nutrients
- 2.4 Plant - Water relations
- 2.5 Transpiration and stomatal movement

**Unit-3: Photochemistry and Photosynthesis**

- 3.1 Photosynthetic pigments and light harvest complexes
- 3.2 Photo oxidation of water
- 3.3 Mechanisms of electron and proton transport
- 3.4 Carbon assimilation the Calvin cycle, photorespiration and its significance
- 3.5 The C4 cycle, the CAM pathway, physiological and ecological considerations

**Unit-4: Plant growth regulators**

- 4.1 Physiological effects and mechanism of action of auxins, gibberellins and cytokinins
- 4.2 Physiological role of abscisic acid and ethylene,
- 4.3 Minor group of phytohormones: brassinosteroids, polyamines, jasmonic acid, salicylic acid and their role in plant growth and development.
- 4.4 Methods of hormones estimation: bioassay and immunoassay
- 4.5 Hormone receptors and Signal transduction

**SUGGESTED READING**

1. *Plant Physiology: Davlin Robert*
2. *Plant physiology : Salisbury and Ross*
3. *Plant Physiology: Taiz and Zeiger*
4. *Biochemistry and Physiology of Plant Hormones : Moore*
5. *Modern plant Physiology : R.K. Sinha*
6. *Introduction to Plant Physiology : Hopkins*
7. *Plant Physiology: Mukharjee and Ghosh*
8. *Physiology of Plant Growth and Development : Wilkins*
9. *Hormones, Signals And Target Cells In Plant Development : Daphne And Michael*
10. *Plant hormone signaling : Peter and Stephen*
11. *Introductory Plant Physiology : Noggle and Fritz*

**BOT. 421: PLANT BIOTECHNOLOGY AND GENETIC ENGINEERING (ELECTIVE)****Unit -1: Genetic Engineering**

- 1.1 Basic techniques in genetic engineering
- 1.2 Plant based vectors and its properties
- 1.3 Methods for screening of GMO plants
- 1.4 Other techniques of gene cloning in plants

**Unit-2: DNA Marker Techniques**

- 2.1 Non-PCR based technique (Restriction fragment length polymorphism)
- 2.2 PCR based technique
- 2.3 Amplified fragment length polymorphism and its significance
- 2.4 Inter simple sequence repeat marker and its significance

**Unit -3: Protein Isolation Techniques**

- 3.1 Isolation of proteins from plant parts
- 3.2 Protein fractionation techniques – salt and solvent based technique
- 3.3 Electrophoresis and protein marker technology in agriculture
- 3.4 IEF and Protein finger printing in crop species

**Unit -4: Immunological Techniques**

- 4.1 Immunological techniques in identification of plant metabolites
- 4.2 Biological control of pest
- 4.3 Plantibody
- 4.4 Fluorescence techniques for markers

**SUGGESTED READING**

1. *Molecular Biotechnology Principles and Practices - Channarayappa*
2. *Biochemistry and Molecular Biology of Plants - Bob B, Wilhelm G and Russell J*
3. *Genetic Engineering - Smita R and Neelam P*
4. *Bioinformatics Principles and Applications - Zhumur G and Bibekanand M*

**BOT. 422: Herbal Technology II (Elective)****Unit 1. Analysis of Phytoconstituents**

- 1.1 Classification and sources of crude drugs
- 1.2 Identification and extraction of medicinal plants
- 1.3 Secondary metabolites and their importance
- 1.4 Biosynthetic schemes of some important phytoconstituents

**Unit 2. *In vitro* Screening methods used for herbal drugs**

- 2.1 Antimicrobial screening of herbal drugs
- 2.2 Screening for anticancer activity
- 2.3 Screening for antioxidant activity
- 2.4 Screening for antiurolythetic activity

**Unit 3. *In vivo* Screening methods used for herbal drugs**

- 3.1 Screening for anti-inflammation and analgesic activity
- 3.2 Screening for antiulcer activity
- 3.3 Screening for antidiuretic activity
- 3.4 Screening for liver related disorders

**Unit 4. Drugs from natural origin**

- 4.1 Anticancer drugs
- 4.2 Antidiabetic drugs
- 4.3 Antihepatotoxic drugs
- 4.4 Antiulcer and anti-inflammatory drugs

**SUGGESTED READING:**

1. Bioactive Phytochemicals - V. K. Gupta
2. Handbook of Phytopharmacology - Amritpal Singh Saroya
3. Medicinal Plants Phytochemistry, Pharmacology and Therapeutics (2 vols) - V. K. Gupta, G.D. Singh, Surjeet Singh and A. Kaul
4. Medicinal Plants: Biodiversity and Drugs - M. K. Rai, G A. Cordell, J L. Martinez, M Marinoff, L Rastrelli
5. Modern Phytomedicine – Ahmad Iqbal , AqilFarrukh, Owais Mohammad
6. The Constituents of Medicinal Plants - Andrew Pengelly
7. Herbal medicine: bimolecular & clinical aspects - FF Benzie & SW Galor
8. Quality Control of Herbal Drugs – PK Mukherjee

**BOT. 423: WATER, SOIL AND DESERTIFICATION****Unit-1 Water**

- 1.1 Physical condition of water in soil and energy concept
- 1.2 Movement of water in soil
- 1.3 Field capacity, evaporation and evapotranspiration
- 1.4 Energy relation in uptake of water by plants

**Unit-2 Soil – Plant relationships in water availability**

- 2.1 Upward movement of water in soil and roots
- 2.2 Optimum depth of free water
- 2.3 Root extension
- 2.4 Water supply and plant behavior
- 2.5 Photosynthesis in relation to transpiration and soil fertility

**Unit-3 Soil salinity**

- 3.1 Soluble salts
- 3.2 Classification of salt affected soils
- 3.3 Excess sodium; physical and nutritional effect

### 3.4 Soil - plant relationship in reference to salinity

#### Unit-4 Desertification

- 4.1 Desertification; cause and control
- 4.2 Plants for conservation of soil and water in arid ecosystem
- 4.3 Ecodevelopment of arid land in India
- 4.4 Restoration of ecosystem

#### SUGGESTED READING

1. Water relations of plants by Paul J. Kramer
2. Plants for arid lands by G. E. Wickens, J. R. Goodin & D. V. Field
3. Plants and environment by R. F. Daubenmire
4. The ABC of Soil by Jacob S. Joffe
5. Restoration ecology by William R. Jordan, Michael E. Gilpin and John D. Aber
6. Restoration ecology and sustainable development by Krystyna M. Urbanska, Nigel R. Webb and Peter J. Edwards
7. Ecology by Charles J. Krebs
8. Desertification control by Singh and Kar
9. Fundamental of Ecology by Odum E. P.
10. Fundamentals of soil science by Miller and Charles Ernest

#### BOT. 424: COMBINED PRACTICALS

##### 419. SUGGESTED LAB WORK

1. To study the major and minor crops.
2. To study the major oil seeds.
3. To study the major fibers crops.
4. To study the major forest products.
5. To measure the height of tree by Abney hand level
6. IPR terminology

##### 420. SUGGESTED LAB WORK

1. Extraction and estimation of chlorophyll by Arnon's method
2. To measure osmotic potential from plant cell by incipient plasmolysis in broad range
3. To measure osmotic potential from plant cell by incipient plasmolysis in narrow range
4. To measure the rate of transpiration by cobalt chloride method
5. To calculate various growth indices from the given primary data of the plant
6. To study given specimens
7. To measure leaf area by linear measurement
8. To study effect of dormancy breaking pretreatment in seeds
9. To study seed germination by Top paper method
10. To study seed germination by between paper method
11. To study seed germination by sand method
12. To study seed germination by agar method
13. To test the viability of seeds by Tetrazolium test.

##### 421. SUGGESTED LAB WORK

1. Isolation of DNA from different plant samples
2. Preparing and Running Standard Agarose DNA Gel
3. To study the amplification of DNA using PCR.
4. Preparing and Running Standard Agarose PCR amplification test Gels
5. To perform DNA sequencing and determine the DNA sequence by ABI3130 genetic analyzer.
6. Isolation of protein from the seeding.
7. To estimate the amount of protein in the given sample by Lowry's method.
8. Write the references by given journal pattern.

##### 422. SUGGESTED LAB WORK

1. Separation of chloroplastic pigments by solvent extraction method

2. Separation of chloroplastic pigments by ascending paper chromatography
3. Isolation of Lawsone from leaves of *Lawsoniainermis*L.
4. Separation of Lawsone by thin layer chromatography
5. Isolation of Curcumin from rhizomes of *Curcuma longa* L.
6. Separation of Curcumin by thin layer chromatography
7. Isolation of caffeine from tea leaves
8. Separation of caffeine by thin layer chromatography
9. Isolation of piperine from black pepper
10. Separation of piperine by thin layer chromatography
11. To determine total phenol content from the given plant material.
12. To prepare a calibration curve of gallic acid for total phenol content
13. To determine total flavonoid content from the given plant material.
14. To prepare a calibration curve of quercetin for total flavonoid content
15. To determine alkaloid content in the given plant sample
16. To determine antimicrobial susceptibility test by agar well diffusion method

#### **423. SUGGESTED LAB WORK**

**Perform following experiment to determine or estimate**

1. Soil texture of given soil sample
2. Soil aggregate of given soil sample
3. Soil bulk density of given soil sample
4. Soil porosity of given soil sample
5. Soil particle density of given soil sample
6. Field capacity and water holding capacity of given soil sample
7. pH of soil and water of given sample
8. E.C. of soil and water of given sample
9. Organic carbon, organic matter and nitrogen of given soil sample
10. Phosphorus of given soil sample
11. Calcium of given soil sample
12. Potassium of given soil sample
13. Sodium of given soil sample
14. Lithium of given soil sample