

# GUJARAT UNIVERSITY

## *BOTANY SYLLABUS*

### *M.Sc. II*

#### **BOTANY DEPARTMENT Effective from July 2004**

1. There will be Three Papers (Three Hour Duration) and Three Practicals (Five hour Duration) of One Hundred Marks and Fifty Marks respectively at Annual Examination.
2. The Botanical Excursion is highly essential for studying vegetation in its natural state. There shall be at least one Botanical excursion out side Gujarat State for each year. Tour report and submission of specimen will be given due weightage.
3. Candidate shall be required at the time of practical examination at the end of each year ;
  - The laboratory Journal and diary of field work (Tour report) duly signed by the teachers concerned from time to time.

#### **M.Sc. Part II - Work load as per UGC Norms**

Each Paper	Total Hours	
Paper IV, V and VI	90 hours	270 hours
Practicals	200 hours	600 hours
Seminars [Department & Class]	30 hours	90 hours
	320 hours	960 hours

**PAPER 4: GENETICS, BIOMETRICS, PLANT BREEDING, BIOTECHNOLOGY AND GENETIC ENGINEERING.**

**PAPER 5: PLANT RESOURCE, UTILIZATION AND ETHNOBOTANY, PLANT ECOLOGY, REMOTE SENSING AND PLANT GEOGRAPHY .**

**PAPER 6 : ADVANCED PLANT PHYSIOLOGY**

**PAPER 6 : SPECIAL ENVIRONMENTAL BIOLOGY**

**PAPER 4: GENETICS, BIOMETRICS, PLANT BREEDING, BIOTECHNOLOGY AND GENETIC ENGINEERING**

## **GENETICS 2 - UNITS:**

### **Genetics of prokaryotes and eukaryotic organelles:**

Mapping the bacteriophage genome; phage phenotypes; genetic recombination in phage; genetic transformation, conjugation and transduction in bacteria; genetics of mitochondria and chloroplasts; cytoplasmic male sterility.

### **Gene structure and expression :**

Genetic fine structure; cis-trans test; fine structure analysis of eukaryotes; introns and their significance; RNA splicing; regulation of gene expression in prokaryotes and eukaryotes.

### **Genetic recombination and genetic mapping :**

Recombination; independent assortment and crossing over; molecular mechanism of recombination; role of RecA and RecBCD enzymes; site-specific recombination, chromosome mapping, linkage groups, genetic markers, construction molecular maps, correlation of genetic and physical maps; somatic cell genetics - an alternative to gene mapping.

### **Mutations :**

Spontaneous and induced mutations; physical and chemical mutagens; molecular basis of gene mutations; transposable elements in prokaryotes and eukaryotes; mutations induced by transposons; site-directed mutagenesis; DNA damage and repair mechanisms; inherited human diseases and defects in DNA repair; initiation of cancer at cellular level; protooncogenes and oncogenes.

### **Cytogenetics of aneuploids and structural heterozygotes :**

Effect of aneuploidy on phenotype in plants; transmission of trisomics and their use in chromosome mapping of diploid and polyploid species; breeding behaviour and genetics of structural heterozygotes; complex translocation heterozygotes; translocation tester sets; Robertsonian translocations; B-A translocations.

## **BIOMETRICS - 0.5 UNIT:**

Mean; mode; median; standard deviation and error; Chi-square; regression; correlation; ANOVA.

## **PLANT BREEDING - 0.5 UNIT :**

**Methods of plant improvement :**

Pure line and mass selection; hybridization in self and cross pollinated crops; introduction and acclimatization; hybrid vigour. Mutations and polyploidy as methods of plant improvement.

## **PLANT BIOTECHNOLOGY AND GENETIC ENGINEERING - 2**

### **UNITS:**

#### **Biotechnology :**

Basic concepts, principles and scope.

#### **Plant cell and tissue culture:**

General introduction, history, scope, concept of cellular differentiation, totipotency.

#### **Organogenesis and adventive embryogenesis:**

Fundamental aspects of morphogenesis: somatic embryogenesis and androgenesis, mechanisms, techniques and utility.

#### **Somatic hybridization:**

Protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, achievements and limitations of protoplast research.

#### **Applications of plant tissue culture:**

Clonal propagation, artificial seed, production of hybrids and somaclones, production of secondary metabolites / natural products, cryopreservation and germplasm storage.

#### **Recombinant DNA technology :**

Gene cloning principles and techniques, construction of genomic / c DNA libraries, choice of vectors, DNA synthesis and sequencing, polymerase chain reaction, DNA fingerprinting.

### **Paper IV : Laboratory Exercises**

#### **1 : - Genetics and Plant Breeding :**

1. Induction of polyploidy using colchicine: different methods of the application of colchicine
2. Isolation of chlorophyll mutants following irradiation and treatment with chemical mutagens.
3. Estimation of nuclear DNA content through microdensitometry.
4. Problems based on the genetical problems as per the syllabus.

#### **2 : - Biometric Exercises :**

1. Representation of Data by graphics and histograms, Central tendencies ( Mode and Median).
2. Chi-square, Standard Deviation and Error.
3. Regression and Coefficient of Correlations.
4. Analysis of variance.

### **3 : - Biotechnology and Genetic Engineering :**

1. Isolation of protoplasts from different plant tissues and testing their viability.
2. Demonstration of protoplast fusion employing PEG.
3. Organogenesis and somatic embryogenesis using appropriate explants and preparation of artificial seed.
4. Demonstration of androgenesis in *Datura*.

# PAPER V : PLANT RESOURCE, UTILIZATION AND ETHNOBOTANY, PLANT ECOLOGY, REMOTE SENSING AND PLANT GEOGRAPHY

## PLANT RESOURCE AND UTILIZATION - 1.5 UNITS

- **Origins of agriculture:**
  1. World centres of primary diversity of domesticated plants;
  2. The Indo-Burmese centre; plant introductions and secondary centres.
- **Origin, evolution, botany, cultivation and uses of**
  - (i) Food, forage and fodder crops
  - (ii) Fibre crops
  - (iii) Medicinal and Aromatic plants
  - (iv) Vegetable oil-yielding crops.
- **Important fire-wood and timber-yielding plants of India.**
- **Non-wood forest products (NWFPs):**
  1. Bamboos
  2. Raw materials for paper - making.
  3. Gums and Resins.
  4. Dyes.

## ETHNOBOTANY - 0.5 UNITS

- **Methods of research in Ethnobotany**
- **Interdisciplinary approaches in Botany**
- **The Folklore of Gujarat - major tribal groups and their distribution in different parts of Gujarat.**
- **Uses of plants and plant products by the ethnic groups for various purposes in Gujarat (As per list).**

### Plant List :

- |                                |                                 |                                 |
|--------------------------------|---------------------------------|---------------------------------|
| 1.): <i>Achyranthes aspera</i> | 2.): <i>Aloe vera</i>           | 3.): <i>Asperagus racemosus</i> |
| 4.): <i>Azadirachta indica</i> | 5.) <i>Boerhavia diffusa</i>    | 6.): <i>Butea monosperma</i>    |
| 7.): <i>Calotropis procera</i> | 8.): <i>Emblīca officinalis</i> | 9.): <i>Ipomoea aquatica</i>    |
| 10.): <i>Terminalia arjuna</i> | 11.): <i>Withania somnifera</i> |                                 |

## PLANT ECOLOGY - 2 UNITS

1. **EDAPHIC FACTOR:** Soil origin, factors affecting soil formation, soil texture, soil composition, soil classification, soil profile, Types of Indian soil, soil erosion and soil conservation.
2. **VEGETATION ORGANIZATION:** Composition structure, origin and development of community, Analytical and synthetic characters of plant community and classification of community and ecological niche.
3. **VEGETATION DEVELOPMENT:** Process of ecological succession, models of succession and changes in ecosystems during succession.
4. **ECOSYSTEM ORGANIZATION:** Structure and function of ecosystem, Energy dynamics, Biogeochemical cycles of C, N, P, S and Ca, Ecosystem modelling.
5. **BIOLOGICAL DIVERSITY:** Concepts and levels; role of biodiversity in ecosystem functions and stability; speciation and extinction; IUCN categories of threat; distribution and global patterns; terrestrial biodiversity hot spots; inventory.
6. **AIR, WATER AND SOIL POLLUTION:** Kinds; sources; quality parameters; effects on plants and ecosystems.
7. **CLIMATE CHANGE:** Greenhouse gases( $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ , CFCs; sources, trends and role); ozone layer and ozone hole, consequences of climate change( $\text{CO}_2$  fertilization, global warming, sea level rise, UV radiation).
8. **ECOSYSTEM STABILITY:** Concept (resistance and resilience); ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion; environmental impact assessment; ecosystem restoration.
9. **ECOLOGICAL MANAGEMENT:** sustainable development, sustainability indicators.

## REMOTE SENSING 0.5 UNIT

**REMOTE SENSING:** Principle, techniques and applications of Remote sensing in India, limitation of remote sensing and future trend of Remote sensing. Few case study of selected systems in India - Gujarat.

## PLANT GEOGRAPHY - 0.5 UNIT

**PLANT GEOGRAPHY:** Major plant communities of the world, Phytogeographical regions of the world, Climate of India, Vegetation of India.

## Paper V : Laboratory Exercises - Plant resource, utilization and Ethnobotany

The practical course is divided into three units;(1) Laboratory Work; (2) Field survey and (3) Scientific visits.

### Laboratory work

1. **Food crops:** Wheat, Rice, Maize, Chickpea, Potato and Sweet Potato. Morphology and microchemical tests for stores food materials.
2. **Forage / fodder crops:** Study of important crops of locality Sorghum, Bajra, Guar (*Cyamopsis tetragonoloba*).
3. **Plant fibres:**
  - Textile fibres: Cotton, Jute, Linum and Sunn hemp.
  - Cordage fibers: coirMorphology and microscopic study of whole fibres using appropriate staining procedures.
4. **Medicinal plants:** *Adhatoda vasica*, *Plantago ovata*, *Rauvolfia serpentina*, *Withania somnifera*, *Aloe barbadense* and *Mentha arvensis*. Study of plants morphology.
5. **Vegetable oils:** Mustard, Groundnut, Soybean, Coconut, Sunflower, Castor and Cotton. Morphology, microscopic structure of the oil-yielding tissues, tests for oil and iodine number.
6. **Gums, resins and dyes:** Study of Acacia Gum, Guar Gum (*Cymopsis tetragonoloba*), Shahanjana Gum (*Moringa oleifera*) and Dyes (*Turmeric*, *Bixa orellana*, *Indigo*, *Butea monosperma*, *Lawsonia inermis*).
7. Study of ethnic plant samples used by tribals as per list.

### Plant List :

- |                                |                                 |                                 |
|--------------------------------|---------------------------------|---------------------------------|
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| 7.): <i>Calotropis procera</i> | 8.): <i>Emblica officinalis</i> | 9.): <i>Ipomoea aquatica</i>    |
| 10.): <i>Terminalia arjuna</i> | 11.): <i>Withania somnifera</i> |                                 |

### Scientific Visits:

The students should be taken to one of the following:

1. A protected area( biosphere reserve, national park, or a sanctuary)

2. A wet land
3. A mangrove
4. National Bureau of Plant Genetic Resources, New Delhi or one of its field stations,
5. Head quarters of the Botanical Survey of India or one of its regional circles
6. A CSIR Laboratory doing research on plants and their utilization.
7. An ICAR research institute or a field station dealing with one major crop or crops.
8. A recognized botanical garden or a museum (such as those at the forest research institute, Dehra Dun; National Botanical Research Institute, Lucknow, Tropical Botanical Garden and Research Institute, Trivandrum, which has rich collection of plant.

\* The students are expected to prepare and submit a brief illustrated narrative of the field survey and the scientific visits during their final practical examination.

## Laboratory Exercises - Plant Ecology

1. To determine minimum size and number of quadrates for study on vegetation.
2. To study the vegetation using line transects / belt transect / chart quadrate method.
3. To estimate IVI of the species using quadrate method.
4. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
5. To determine the water holding capacity of soils collected from different locations.
6. To determine percent organic carbon and organic matter in the soils of cropland, grassland and forest.
7. To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples by azide modification of Winkler's method.
8. To estimate Alkalinity ( $\text{CO}_3^{2-}$ ,  $\text{HCO}_3^{-1}$ ) from soil samples.
9. To estimate Hardness ( $\text{Ca}^{+2}$ ,  $\text{Mg}^{+2}$ ) from soil samples.
10. To estimate Salinity ( $\text{Cl}^{-}$ ) from soil samples.



# **PAPER VI : ADVANCED PLANT PHYSIOLOGY**

## **Crop Physiology 1 - Unit:**

- Germination and seedling emergence.
- Vegetative growth.
- Flowering and fruit growth.
- Some aspects of overall growth and its modifications as influenced by environmental factors.
- Methods of growth analysis and growth correlations.

## **Hormones 1 - Unit:**

- Biosynthesis, Translocation, Bioassay, Physiological functions and Mechanism of naturally occurring plant growth hormones.
- General account of Brassinoids, Jasmonic acid, Polyamines and Phenols.
- Synthetic PGRs and their uses.

## **Stress Physiology 1 - Unit:**

- Light stress: Visible light stress - injury and resistance, Ionizing radiation stress - injury and resistance, UV light stress - injury and resistance.
- Temperature stress: Chilling stress - injury and resistance, Freezing stress - injury and resistance, Heat stress - injury and resistance.

## **Plant Tissue Culture 1 - Unit:**

- Laboratory organization, Media preparation and sterilization techniques.
- Types of culture and Micropropagation.
- Cell suspension and secondary metabolites.
- In-vitro production of haploids, Protoplast fusion and somaclonal variations.
- Germplasm storage and cryopreservation.

## **Horticulture 1 - Unit:**

- Seed germination - methods, factors and effect of PGRs.
- General aspects of Vegetative (Asexual) Propagation: Importance, Clone-changes with age, Chimeras.
- Propagation by Cuttings: Anatomical aspects, Physiological aspects and factors, Techniques and Advantages.
- Propagation by Grafting and Budding: Advantages, Anatomical aspects, Graft incompatibility, Physiological Aspects, Techniques of Grafting and Budding.

- Propagation by Layering: Anatomical and Physiological aspects, factors and types.
- Propagation by Specialized stems and roots: Bulbs, Corms, Tubers, Tuberous roots, Rhizomes and Pseudobulbs.
- General account of Important Horticultural plants: Growing practices, Propagation, Flowering, Packaging, Post-harvest Methods and Preservation.
- Green House: Types, Construction and advantages.

## Laboratory Exercises - Advanced Plant Physiology

1. Methods of Growth Analysis.
2. Seed viability, seed vigour study and seed leachate study.
3. Seed germination under different Light, Temperature and Hormone treatments.
4. Determination of IAA / IAA oxidase activity
5. Bioassays of Hormones.
6. Biochemical methods using different PGRs and Plant hormones.
7. Seed soaking and foliar spray with different PGRs.
8. Determination of Amylase, Invertase, Peroxidase from Control and Stressed seeds.
9. Estimation of Sugar, Protein, Aminoacid from Control and Stressed seeds.
10. Dessication and seedling survival of different seeds.
11. Seed germination studies using different osmotica.
12. Preparation of Media.
13. Transfer of different explants.
14. Micropropagation experiment.
15. Cell suspension with reference to secondary metabolites.
16. Study of scarification and stratification for seed germination.
17. Study of different types of Chimeras and their propagation.
18. Demonstration of the effect of auxin on rooting of cuttings.
19. Study of the rooting of different types of cuttings.
20. Study of root initials /primordia ( anatomically) in selected cuttings.
21. Study of the technique of Grafting and Budding.
22. Study of the technique of Layering.

23. Study of Bulbs / Corms / Rhizomes as propagating materials.
24. Study of Important Horticultural plants
25. Study of Post-harvest Shelf life of cut flowers / fruits.

## **PAPER-VI SPECIAL ENVIRONMENTAL BIOLOGY- 5 UNITS.**

- Ecosystem Pattern.
- Ecotoxicology.
- Production ecology and energy resources.
- Remote sensing in detail.
- Applications of environmental Biology.

DETAILS TO BE WORKED OUT BY RESPECTIVE CENTRE.

### **SUGGESTED READINGS:**

1. Plant Propagation: Principles and Practices, second edition, by Hudson T. Hartmann and Dale E. Kester. 1968. Prentice-Hall, Inc., Englewood Cliffs, N.J.
2. Advances in Plant Physiology, vol. 10, by D.K. Arora and Seema Gupta, 1996. Anmol Publications Pvt Ltd.
3. Manual of cultivated plants by L.H. Bailey 1958. The Macmillan Company, New York.
4. Commercial Floriculture, by S. Prasad and U. Kumar, 1998. Agrobotanica.
5. Commercial flower Production, by Utpal Banerjee, 2001, Mangal Deep Publications, Jaipur.
6. Some beautiful Indian Trees, second edition, by E. Blatter and Walter S. Millard, 1997, Oxford University Press.
7. Some beautiful Indian Climbers and Shrubs, second edition, by N.L. Bor and M.B. Raizada, Oxford University Press.
8. Floriculture in India, by G.S. Randhawa and A. Mukhopdhyay, 1998, Allied Publishers Limited.
9. Plant Physiology : Fundamentals and Applications, second edition, by Arvind Kumar and S.S. Purohit, 2001, Agrobios.
10. Economic Botany by A.V.S.S. Samba Murty and N.S. Subramanyam, Wiley Eastern Ltd.
11. A Manual of Ethnobotany. 2<sup>nd</sup> Edition. by S.K. Jain. Scientific Publishers. Jodhpur.

12. Ethnobiology, by Rajiv K. Sinha and Shweta Sinha, Surbhi Publication, Jaipur.
13. Responses of Plants to environmental stresses, Levitt, J. (1980) Academic Press.
14. Nilsson, E.T. and Orcutt D.M. (1996) The Physiology of Plants under Stress. John Wiley & Sons. Inc New York.

## **GUJARAT UNIVERSITY**

### **PRACTICAL EXAMINATION IN BOTANY**

**M.Sc. PART - II**

**PRACTICAL : IV (BASED ON PAPER - IV)**

**TIME : 5 Hours**

**Maximum Marks : 50**

**[Genetics, Biometrics, Plant Breeding, Biotechnology & Genetic Engineering]**



- Q.1 Solve the following Genetical Problems. (10)
- Q.2 Using a suitable Statistical method solve the following problems (10)
- Q.3 Transfer the given explant onto the medium. (10)
- Q.4 Comment upon the following: (10)
- A. Plant Breeding 5 marks
- B. Plant Biotechnology 5 marks
- Q.5 Viva Voce and Journal. (10)

**GUJARAT UNIVERSITY**  
**PRACTICAL EXAMINATION IN BOTANY**  
**M.Sc. PART - II**  
**PRACTICAL : V (BASED ON PAPER - V)**

TIME : 5 Hours

Maximum Marks : 50

**[Plant Resource, Utilization and Ethnobotany, Ecology, Remote Sensing and Plant Geography]**

- =====
- Q.1 Give the common name, botanical name, family and economic importance of specimens A and B. (08)
- Q.2 Perform any two chemical tests of specimen C. (04)

Q.3 Study the Vegetation using Line Transect / Belt Transect / Chart  
Quadrat / I V I. (10)

Q.4 Estimate alkaloids / hardness / salinity / organic carbon / DO from  
the given sample. (10)

Q.5 Comment upon specimens: (08)  
D : Ethnobotany  
E : Remote Sensing

Q.6 Viva Voce, Submission and Journal. (10)

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**PRACTICAL EXAMINATION IN BOTANY**  
**M.Sc. PART - II**

**PRACTICAL : VI (BASED ON PAPER - VI)**

TIME : 5 Hours

Maximum Marks : 50

**[Special paper - Advanced Plant Physiology]**

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- Q.1 Work out RGR, NAR and LWR of the given data. (06)
- Q.2 Estimate IAA from given Plant Material. (06)
- Q.3 Estimate \_\_\_\_\_ from control and stressed samples. (08)
- Q.4 Transfer the given Explant onto the given medium. (06)
- Q.5 Perform the given Horticultural Experiments as per given slip. (06)
- Q.6 Comment upon the following: (08)  
A.  
B.
- Q.7 Viva Voce and Journal. (10)

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**PRACTICAL EXAMINATION IN BOTANY**  
**M.Sc. PART - II**  
**PRACTICAL : VI (BASED ON PAPER - VI)**

TIME :5 Hours

Maximum Marks: 50

[Special Paper - Environmental Biology]

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- Q.1 Chart out \_\_\_\_\_ in the map of India /  
Chart out \_\_\_\_\_ in the map of World. (06)
- Q.2 Determination of Alkalinity / Hardness and Salinity of given samples. (08)
- Q.3 Determination of DO / Free CO<sub>2</sub> / TDS, DS and EC of given samples. (08)
- Q.4 Determination of buffering capacity / Organic Carbon of the given water sample. (08)
- Q.5 Perform the Experiments as per given slip. (08)
- Q.6 Identification - Anderson Diagram. (02)
- Q.7 Viva Voce and Journal. (10)