

SAVITRIBAI PHULE UNIVERSITY OF PUNE

T. Y. B. Sc. Botany Revised Syllabus

Theory Courses New Syllabus to be implemented from June 2015				
Paper	Course	Semester III	Course	Semester IV
I	BO. 331	Cryptogamic Botany	BO.341	Plant Physiology and Biochemistry
II	BO. 332	Cell and Molecular Biology	BO.342	Plant Ecology and Biodiversity
III	BO. 333	Genetics and Evolution	BO.343	Plant Pathology
IV	BO. 334	Spermatophyta and Palaeobotany	BO.344	Medicinal and Economic Botany
V	BO. 335	Horticulture and Floriculture	BO.345	Plant Biotechnology
VI	BO. 336	Computational Botany	BO.346	Plant Breeding and Seed Technology

Practical Based on theory Courses

Practical No	Course	Practicals Based on
Practical I	BO.347	BO.331: Cryptogamic Botany BO. 332: Cell and Molecular Biology BO.341: Plant Physiology & Biochemistry BO.345: Plant Biotechnology
Practical II	BO.348	BO.333: Genetics and Evolution BO.334: Spermatophyta and Palaeobotany BO.342: Plant Ecology and Biodiversity BO.346: Plant Breeding and Seed technology
Practical III	BO.349	BO.335: Horticulture and Floriculture BO.336: Computational Botany BO.343: Plant Pathology BO.344: Medicinal and Economic Botany

**Equivalence of the T.Y.B.Sc. Botany Revised Syllabus
Semester III**

Theory Courses New Syllabus to be implemented from June 2015				
Paper	Course	Semester III (New Syllabus)	Course	Semester III (Old Syllabus)
I	BO. 331	Cryptogamic Botany	BO. 331	Algae, Fungi and Bryophytes
II	BO. 332	Cell and Molecular Biology	BO. 332	Molecular Biology
III	BO. 333	Genetics and Evolution	BO. 333	Angiosperms and Evolution
IV	BO. 334	Spermatophyta and Palaeobotany	BO. 334	Genetics and Plant Breeding
V	BO. 335	Horticulture and Floriculture	BO. 335	Biometry and Computer Applications
VI	BO. 336	Computational Botany	BO. 336	Cell Biology and Seed Technology

Semester IV

Theory Courses New Syllabus to be implemented from June 2015				
Paper	Course	Semester IV (New Syllabus)	Course	Semester IV (Old Syllabus)
I	BO.341	Plant Physiology and Biochemistry	BO.341	Plant Physiology and Biochemistry
II	BO.342	Plant Ecology and Biodiversity	BO.342	Plant Pathology
III	BO.343	Plant Pathology	BO.343	Pteridophytes, Gymnosperms and Palaeobotany
IV	BO.344	Medicinal and Economic Botany	BO.344	Plant Biotechnology
V	BO.345	Plant Biotechnology	BO.345	Botanical Techniques
VI	BO.346	Plant Breeding and Seed Technology	BO.346	Pharmacognosy

Proposed Syllabus from 2015-2016 in Botany
T. Y. B. Sc. Semester III
Paper- I: BO : 331 Cryptogamic Botany
(Algae, Fungi, Bryophytes and Pteridophytes)

1. Introduction: Cryptogams- meaning. Types- Lower Cryptogams and Higher Cryptogams, brief review with examples. **02L.**

Algae: **(11L)**

2. Algae: General characters, economic importance and Classification (Chapman and Chapman, 1973) up to classes. **03L.**

3. Study of life cycle of algae with reference to taxonomic position, occurrence, thallus structure, and reproduction of *Nostoc*, *Chara*, *Sargassum* and *Batrachospermum*.

08 L.

Fungi:

(11L)

4. Fungi: General characters, economic importance and Classification. (Alexopoulos, 1979) up to classes. **03L.**

5. Study of life cycle of fungi with reference to taxonomic position, thallus structure, and reproduction of *Rhizopus*, *Saccharomyces*, *Puccinia* and *Cercospora*. **08**

L.

Bryophytes: **(12L)**

6. Bryophytes: General characters, economic importance and Classification. (G.M. Smith, 1955) up to classes. **03L.**

7. Study of life cycle of Bryophytes with reference to taxonomic position, thallus structure (Morphology and anatomy), reproduction and sporophyte structure of *Marchantia*, *Anthoceros* and *Polytrichum*.

09 L.

Pteridophytes: **(12L)**

8. Pteridophytes: General characters and economic importance and Classification. (K.R. Sporne, 1975) up to classes. **03L**

9. Study of life cycle of Pteridophytes with reference to taxonomic position, Morphology, anatomy, reproduction, gametophytes and sporophyte of *Psilotum*, *Selaginella* and *Marsilea*.

09 L.

(Development of sex organs and sporophyte is not expected.)

Reference Books :

1. Vashistha B. R. et al., Botany for degree students-Algae
2. Das, Datta and Gangulee-College Botany Vol I
3. Sharma, O.P. -Algae
4. Vashishta B.R. et al., Botany for degree students- Fungi
5. Sharma, P.D.-The Fungi
6. Sharma, O.P.-Fungi
7. Chopra G.L. and Yadav D.L. A Text book of Bryophytes.

8. **Parihar, N.S.** An introduction to Embryophyta: Bryophyte-I
9. **Puri Prem.** Bryophytes, Atmaram and Sons. Delhi.
10. **Vashishta B.R.** Botany for degree students Bryophytes- Vol-III
11. **Parihar N.S.** 1991. Bryophyta. Central Book Depot, Allahabad.
12. **Puri P.** 1980. Bryophytes. Atma Ram and Sons, Delhi.
13. **Alexopoulos C.J , Mims C.W. and Blacwel M.I** 1996. Introductory Mycology. John Wiley and Sons Inc.
14. **Kumar H.D.** 1988. Introductory Phycology. Affiliated East-West Press Ltd., New Delhi.
15. **Sporne K.R.** 1991. The Morphology of Pteridophytes. B.I Publishing Pvt. Ltd. Bombay.

Practicals - 06

(Finalize the practicals after discussion in workshop).

1. Study of **Algae** with respect to systematic position thallus structure and reproduction of *Nostoc*, *Chara*, *Sargassum* and *Batrachospermum*.
2. Study of **Fungi** respect to systematic position thallus structure and reproduction of *Rhizopus*, *Saccharomyces* and *Puccinia*.
3. Study of **Bryophytes** with respect to systematic position thallus structure and reproduction of *Marchantia*, *Anthoceros* and *Polytrichum*.
4. Study of **Pteridophytes** with respect to systematic position, sporophyte - morphology and anatomy, reproductive structures of *Psilotum*, *Selaginella* and *Marsilea*.
5. Excursion tour.

Paper II: BO.332: CELL AND MOLECULAR BIOLOGY

Chapter 1 Cell Biology: An Introduction

2L

1. Definition and brief history
2. Units of measurement of cell
3. Prokaryotic and Eukaryotic Cell
4. Cell biology and other Biological Sciences

Chapter 2 Cytoplasmic Matrix

2L

1. Physical nature of cytoplasmic matrix
2. Chemical organisation- organic and inorganic compounds of cytoplasmic matrix

Chapter 3 Plant Cell- Cytoplasmic Constituents

15L

Morphology, Ultrastructure, Chemical composition, Functions of Cell wall, Plasma membrane, Endoplasmic Reticulum, Golgi apparatus, Lysosomes, Microbodies, Mitochondria, Plastids, Vacuoles, Ribosomes

Chapter 4 Plant Cell- Nucleus and Chromosomes

5L

Nucleus- Morphology, Ultrastructure, Nucleoplasm, Nucleolus, Functions

Chromosome- Number, Morphology, Structure, Karyotype and ideogram, Chemical composition, Euchromatin and Heterochromatin, Giant chromosomes

Chapter 5 Molecular Biology

1L

Definition, History, Scope and Importance, Central Dogma of Molecular Biology

Chapter 6 Nature of Genetic Material

5L

Characteristics of genetic material, Physical and Biological evidences to prove DNA as genetic material, Chargoff's Law, Franklin and Wilkion's Work, Watson and Cricks Model of DNA, Forms of DNA- A, B and Z, C-Value Paradox, RNA as genetic material-TMV

Chapter 7 DNA Replication

3L

Introduction and types, Messelson and Stahl's Experiment, Molecular mechanism of DNA replication

Chapter 8 DNA Damage and Repair

2L

Introduction, Causes and types, DNA repair system- Photoreactivation, Dark excision repair,

Chapter 9 Gene Organization

3L

Promoter-structure and function in prokaryotes and eukaryotes, Terminators, Units

of Gene, Enhancers, Split genes, jumping genes

Chapter 10 Transcription

3L

Structure and role of m-RNA, r-RNA, t-RNA, Transcription apparatus, Mechanism of Transcription in Prokaryotes,

Chapter 11 Genetic Code and Translation

4L

Genetic Code- Definition, Concept, Work of Nirenburg and Khorana, Properties of Genetic code, Translation- Definition, Mechanism of translation- Initiation, Elongation and Termination

Chapter 12 Gene Action and Regulation

3L

Relation of Gene and Enzymes- One gene one enzyme hypothesis, regulation of metabolism, Inducible and Repressible enzymes, Gene regulation- in prokaryotes (Lac Operon Model) and eukaryotes (Britten and Davidson's Model)

Practicals:

1. Cytological techniques-preparation of Fixatives, preparation of stains (Aceto-carmine and Aceto-orcein).
2. Study of various stages of mitosis and meiosis
3. Study of Chromosomes Morphology (from colchicines pretreated Onion root tip cells)
4. Maceration technique for study of plant tissues
5. Study of polytene chromosome from Chironomus larvae
6. Plant Genomic DNA extraction from Cauliflower
7. Estimation of Plant DNA by DPA Method
8. Extraction and estimation of RNA by Orcinol Method

References:

1. Cell and Molecular Biology , S. C. Rastogi
2. Cytology, T. S. Verma and V. K. Agarwal

3. Cell Biology, C. B. Pawar
4. Cell and Molecular Biology, P. K. Gupta
5. Fundamentals of Molecular Biology, Veer Bala Rastogi
6. Fundamentals of Molecular Biology, G. K. Pal and Ghaskadabi
7. Cell Biology, Molecular Biology, Genetic, Evolution and Ecology, Verma and Agarwal
8. Cell and Molecular Biology, Robertis and DeRobertis
9. Molecular Cell Biology, 4th Edition, Lodish S. Baltimore
10. Molecular Biology of Gene, Watson J. D.
11. Biochemistry and Molecular Biology of Plants, Buchanan B. B.
12. Molecular and Cell Biology, Wolfe S.L.

Paper III: BO: 333: Genetics and Evolution

- 1. Genetics- Introduction** **1L**
 Definition, Concept of heredity and variations, Branches and Applications of Genetics
- 2. Mendelism** **4L**
 Genetical terminology, Selection of experimental material , Monohybrid cross, Law of dominance, Incomplete dominance, Law of segregation/law of purity of gametes, Dihybrid cross, Law of independent assortment, Back cross and Test cross
- 3. Interactions of genes** **6L**
 Non-epistatic genetic interactions- complementary genes (9:7), Duplicate Genes (15:1), Epistatic genetic interactions- Masking genes (12:3:1), Supplementary genes (Recessive epistasis) (9:3:4), Inhibitory genes(13:3), Lethal genes (2:1)-Concept, Inheritance of coat colour in mice, Inheritance of sickle cell anemia
- 4. Multiple alleles** **2L**
 Definition, Concept, Characters of multiple alleles, Examples of multiple alleles – inheritance of blood group in human, self-incompatibility in **Nicotiana** and eye colour in **Drosophila**
- 5. Linkage and Crossing over** **4L**

Linkage- Definition and Types, Crossing over: Definition and Types, Construction of a linkage map by two point test cross and three point test cross

6. Quantitative and Cytoplasmic Inheritance

4L

Concept of quantitative inheritance, Difference between qualitative and quantitative traits, Inheritance of quantitative trait in Maize (Cob length), Cytoplasmic inheritance – Definition and concept, Chloroplast- Variegation in Four O'clock plants, Mitochondria- Petite mutants in yeast

7. Sex linked inheritance

5L

Concept of Sex chromosomes and autosomes, Inheritance of X- linked genes - eye colour in **Drosophila**, Inheritance of colour blindness in humans, Inheritance of Y- linked genes - Holandric genes in humans, Sex influenced genes – baldness in humans Sex-limited genes - feathering in domestic fowl

8. Euploidy and Aneuploidy

5L

Numerical changes in chromosomes- Euploidy and Aneuploidy, Euploidy- Monoploidy, Origin and production, morphology and uses. Polyploidy -Concept and Characteristics of polyploids, Autopolyploidy- Origin and production, effects of autopolyploidy, uses. Allopolyploidy- Concept, synthesized allopolyploidy (wheat and cotton) Evolutionary significance of polyploidy –Aneuploidy, Monosomy and nullisomy- origin and cytology, Trisomy in **Datura** and humans

9. Chromosomal Abberations

5L

Types of structural changes in chromosomes, Deletion: types, cytology and genetic effects, Duplication: types and cytology, position effect and bar eye phenotype in **Drosophila**, Inversion: types and their cytology, Translocation: types, translocation complexes, Variation in chromosome morphology: Isochromosomes, ring chromosomes and Robertsonian translocation

10. Evolution – Introduction and Theories of Evolution

4L

The concept of organic evolution, Theories of Evolution, Pre-Darwinian period- Theory of Inheritance of acquired characters (Lamarck's), Darwinism- Theory of Natural Selection, Post-Darwinian period- Modern synthetic theory

11. Evidences of Evolution **3L**

Direct evidences and conclusions from fossil records, Indirect evidences, Evidences from Genetics, Evidences from bio-geographical relations

12. Population Genetics and Evolution **5L**

Concept of Mendelian population, Gene pool and its models, Hardy-Weinberg law of gene frequencies, Factors affecting allelic frequency, Genetic polymorphism

Practicals based on Genetics

1. Study of structural heterozygotes (multiple translocations) in **Rhoeo** 1P
2. Induction of tetraploidy in onion root cells and preparation of squash for observation of tetraploid cells 1P
3. Preparation of salivary gland chromosomes in **Chironomous** larvae 1P
4. Estimation of frequency of PTC taste sensitivity, earlobe and rolling tongue in known population 1P
5. Genetic problems on gene mapping using three point test cross data 1P

Paper IV: BO.334: SPERMATOPHYTA AND PALAEOBOTANY)

GYMNOSPERMS: (12L)

1. Introduction, general characters, economic importance and classification according to Chamberlain (1934). **(2L)**
2. Study of life cycle of *Pinus* and *Gnetum* with reference to distribution, morphology, anatomy, reproduction, gametophyte, sporophyte, seed structure and alternation of generations. **(10 L)**
(Developmental stages of sex organs are not expected)

ANGIOSPERMS (24L)

1) Origin of angiosperms: **(3 L)**

Origin with reference to time, place and ancestry-

- 1) Pteridosperms theory 2) Bennettitalean theory 3) Gnetalean theory

2. Classification

Review of artificial, natural and phylogenetic systems (general account), **(4 L)**

Hutchinson systems with reference to outline and assumptions, merits and limitations, Advanced Phylogenetic Group system-III (APG-III).

3) Study of following families according to Bentham and Hooker's System: (14 L)

With reference to systematic position, distinguishing characters, economic importance, general floral formula, floral diagram of following families: Magnoliaceae, Capparidaceae, Rhamnaceae, Leguminosae (Fabaceae), Asteraceae, Acanthaceae, Apocynaceae, Lamiaceae, Nyctaginaceae, Orchidaceae and Cannaceae

4) Plant identification **(3 L)**

Latin diagnosis and recent trends, use of flora, Practicing indented and bracketed keys, Preparation of artificial keys, Plant authentication.

PALAEOBOTANY : (12 L)

1. Geological time scale, Form genera concept. (1L)
2. **Fossil**- Definition, process of fossil formation, types of fossils.-Impression, Compression, Petrification, Pith cast and Coal ball. (3L)
3. **Study of following fossil groups.** (08 L)
 - a) **Psilopsida**- Salient features of order Psilophytales, external and internal morphology of *Rhynia*.
 - b) **Lycopsidea**- Salient features of order Lepidodendrales, external and internal morphology of *Lepidodendron*,
 - c) **Sphenopsida**- Salient features of Calamitales, external and internal morphology of *Calamites*
 - d) **Pteridosperms**- External and internal morphology of *Lyginopteris oldhamia*.
 - e) **Pentoxylae**- Salient feature, external and internal morphology of stem [*Pentoxylon*], Leaf [*Nipaniophyllum*].

References:-

1. **Sporne K.R.** 1991. The Morphology of Pteridophytes. B.I Publishing Pvt. Ltd. Bombay.
2. **Stewart W.N. and Rathwell G.W.** 1993. Paleobotany and the Evolution of plants. Cambridge University Press.
3. **Bhatnagar S.P and Moitra Alok** 1996. Gymnosperms. New Age International Pvt. Ltd. Publishers, New Delhi, 470 pp.
4. **Biswas C and Johari B.M** 2004. The Gymnosperms Narosa Publishing House, New Delhi. 497 pp.
5. **Sporne K.R** 1965. The Morphology of Gymnosperms London, pp. 216.
6. **Bierhorst D.W.** 1971. Morphology of Vascular Plants. New York and London.
7. **Chamberlain C.J** 1934. Gymnosperms-Structure and Evolution, Chicago.
8. **Coulter J.M. and Chamberlain C.J.** 1917. Morphology of Gymnosperms, Chicago.
9. **Foster A.S and Gifford E.M** 1959. Comparative Morphology of Vascular Plants. San Francisco.
10. **Maheshwari P. and Vasil, Vimla** 1961. Gnetum, Delhi.
11. **Blatter E and W.S Millard.** 1929. Some Beautiful Indian Trees J.Bom. Nat Hist Soc. 33:624-635.
12. **Bor N.L** 1943. Manual of Indian Forest Botany. London.
13. **Vashishta P.C., A.R. Sinha, Anil Kumar.** 2006. Gymnosperms. S.Chand.
14. **Vashishta P.C.** 2006. Pteridophytes. S. Chand.
15. **Parihar N.S.** 1996. Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
16. **Arnold C.R.-**An Introduction to Palaeobotany
17. **E.H.N.Andrews-**Studies in Palaeobotany (Botany for Degree Students Vol.-V)
18. **Shukla A.C. and Mishra S.P.-** Essentials of Palaeobotany.

19. **Stewart W.N. and Rathwell G.W.** 1993. Paleobotany and the Evolution of plants. Cambridge University Press.
20. **Cronquist, A.** 1968. The Evolution and Classification of Flowering Plants. Thomas Nel and Sons, Ltd. London.
21. **Davis P. H. and V. H. Heywood** 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd London.
22. **Heywood V.H** 1967. Plant Taxonomy, London.
23. **Lawrence, G.H.M** 1951. Taxonomy of Vascular Plants.
24. **Lawrence G. H. M** 1955. An Introduction to Plant Taxonomy
25. **Rendle A.B.** 1925. The Classification of flowering plants. 2 Vols. London.
26. **Santapau H.** 1953. The Flora of Khandala on the Western Ghats of India.
27. **Singh V. and D.K Jain,** 1981 Taxonomy of Angiosperms. Rastogi Publication, Meerut.
28. **Swingle D.B.** 1946. A Text book of Systematic Botany. Mc Graw Hill Book Co. New York.
29. **Takhtajan A.** 1969. Flowering Plants; Origin and Disposal.
30. **Pande B.P** 1997. Taxonomy of Angiosperms. S.Chand.
31. **Gurucharan Singh 2005-** Plant systematics
32. **Naik V.N. -** Taxonomy of Angiosperms.
33. **Yadav S.R. and Sardesai M.R.-** Flora of Kolhapur District.
34. **Bhagat R.B., Shimpale V.B. and Deshmukh R.B.** Flora of Baramati
35. **Shivrajan V.V. -**Introduction to Principles plant taxonomy
36. **V. V. Sivarajan, N. K. P. Robson** 1991. Introduction to the Principles of Plant Taxonomy IInd Edi.
37. **Theodore Cooke (1903)-** The flora of The Presidency of Bombay Vol. I, II, III
38. **Chopra G.L.-** Angiosperms
39. **Datta S.C.-** A Hand Book of Systematic Botany
40. **Priti Shukla and Shital Mishra-** An introduction to Taxonomy of angiosperms.
41. **Sharma O.P.** Plant Taxonomy Tata McGraw-Hill Education
42. **Singh, N.P. and S.Karthikeyn** (2000) B.S.I. Calcutta. Flora of Maharashtra State, Dicotyledons. Vol. I and II
43. **Sharma B.D., Karthikeyan. S. and N P. Singh** (1996) B.S.I., Calcutta Flora of Maharashtra State, Monocotyledons -
44. *Botanical Journal of the Linnean Society*, 2009, 161, 105–121.
45. <http://www.mobot.org/MOBOT/research/APweb/>

Practical based Gymnosperm Paper IV: BO.334 (1P)

1. Study of *Pinus* with the help of permanent slides and plant material.
 - i) External morphology, ii) T. S. of stem(Temporary double stained preparation), iii) T. S. of needle(Temporary double stained preparation), iv) Morphology of male cone – T. S. & L. S. Permanent slide, mounting of pollen grains.
 - v) Morphology of female cone – T. S. & L. S. Permanent slide, vi) Mounting of pollen grains.
 - vii) V. S. of mature ovule(Permanent slide)
2. Study of *Gnetum* with the help of permanent slides and plant material.
 - i) External morphology, ii) T. S. of stem

- iii) T. S. of leaf (permanent slide), iv) Morphology of male cone
- vi) Morphology of female cone
- vii) V. S. of mature ovule
- 3. Study of at least any eight families as per theory course (3P)
- 4. Identification of plants with the help of regional/local/suitable flora. (1 P)
- 5. Preparation of an artificial key based on multiple characters/ androecium/gynoecium/ vegetative characters (at least two keys) (1P)
- 6. Study of the following with the help of slides and/ or specimens.
 - i) Impression ii) Compression iii) Petrification iv) Coal ball v) *Rhynia*
 - vii) *Lyginopteris* viii) *Pentoxylon* ix) *Nipaniophyllum* x) *Lepidodendron*

Paper –IV BO.335: HORTICULTURE AND FLORICULTURE

Chapter 1 Horticulture- Introduction 4L

Definition, branches, scope and economic importance of horticultural crops, export and import potential of horticultural crops, Horticultural zones of India and Maharashtra, Global and national scenario of horticulture

Chapter 2 Horticultural Plants 4L

Nutritive value of fruits and vegetables, Classification of horticultural crops, Classification of Vegetables, Fruits, Ornamental plants, Spices and Flowers

Chapter 3 Horticulture- Methods of Plant Propagation 6L

- A. Sexual propagation- importance, seed viability and treatments
- B. Artificial Vegetative Propagation – Importance, Methods- cutting. Layering, grafting and budding.
- C. Physiological and Anatomical basis of rooting
- D. Role of growth regulators in horticulture

Chapter 4 Special Practices in Horticulture 6L

Training and Pruning- objectives, types, systems of trainings
 Fruit crops- Special practices like Bahar treatment, Girdling, Notching, Ringing, Bending, Vegetable crops special practices- Earthing up, Staking, Blanching

Chapter 5 Fruits and Vegetables Production Technology 8L

Introduction, soil and climate requirements, commercial varieties, special practices- harvesting and post harvest management, plant protection methods of following

Fruits- Banana, Mango, Vegetables- Tomato, peas, Beans

Chapter 6 Ornamental Horticulture **5L**

Introduction, Origin and History of Gardens, Famous Indian Gardens, Gardening styles- English garden, Italian Garden, Mughal Garden, Japanese garden, Landscape gardening

Chapter 7 Floriculture **8L**

Introduction, Concept, Definition, Scope and Importance of floriculture, Important floriculture crops and methods of cultivation for cultivation of Aster, Gladiolus, Orchids, Tagetus

Chapter 8 Flower Industry **7L**

A- **Dry Flowers** - Introduction, Indian market of dry flowers, Selection of material, Techniques of drying- Air drying, sun drying, press drying, dessicants, oven and microwave drying methods. Preservation methods, bleaching, dyeing and painting, storage , care of dried flowers, etc.

B- **Cut Flowers** – Introduction, Species and cultivars of Orchids, **Anthuriums** and **Heliconias**, Harvesting - Techniques, mode of harvesting, post harvest handling- conditioning , precooling, pulsing and impregnation, grading, bunching, wrapping packing and cold storage of cut flowers, Indian market of Cut flowers

Practicals

1. Phenology of any two of each: fruit, vegetables and flowering crops
 2. Study of garden tools and implements- Sprayer, Duster, Pruning knife, Sprinkler, Micro-irrigation system,
 3. Study of garden containers and filling of pots and pits and plantation any one plants of each fruit, vegetable and flowering crops
 4. Study of cutting, layering, budding and grafting
 5. Study of technique of training and pruning
 6. Methods of harvesting of cut flowers and their preservation methods
 7. Methods of making dry flowers
- **Visit to any one Nursery unit, Commercial Orchards, fruit market, floriculture Industry and submission of report in Practical Examination**

Reference Books-

1. Horticulture: V. L Sheela, MJP Publications

2. Plant Propagation, Principles and Practices: Hartmann and Koster's
3. Principles of Horticulture and Fruit Growing by Y. N Kunte, M.P Kawathalkar and K.S Yawalkar (Agri- Horticultural Publication House, Nagpur)
4. Arora J. S *Introductory Ornamental Horticulture* Kalyani Publications
5. Bose T. K & Yadav L. P *Commercial Flowers* Naya Prokash
6. Singh B. D *Plant Breeding* Kalyani Publications
7. Chadha K. L & Pareek O. P *Advances in Horticulture* Vol. IV Malhotra Publications
8. Sudheer K. P and Indira V *Post Harvest Technology of Horticultural Crops* New Delhi Publications
9. Adams C. R. Principles of Horticulture, 4th Edt. Elsevier Publication, 2004

PAPER V: BO 336 - COMPUTATIONAL BOTANY

13. Introduction to Biostatistics 3L

- a. Definition
- b. Statistical terms : Population, sample, primary and secondary data, qualitative and quantitative data, parameter and statistics, attributes, variables, discrete and continuous variables, statistical error, linear and non-linear functions of statistics, frequency, and its distribution
- c. Scope, applications and uses of biostatistics

14. Sample and sampling 4L

- a. Definition
- b. Sampling unit, sample and population
- c. Types of sampling
 - i. Random sampling – with replicates, without replicates, systematic sampling, stratified sampling
 - ii. Non-random sampling- Purpose, quota sampling
- d. Need of randomness
- e. Achieving randomness
 - i. Lottery methods
 - ii. Use of random number table
- f. Merits and limitations of sampling

15. Collection and representation of data 5L

- a. Classification of data
 - i. Meaning and need of classification
 - ii. Objectives of classification

- iii. Classification according to class interval
- iv. Overlapping and non-overlapping frequency table
- b. Methods of representation of statistical data
 - i. Essential features of tabular presentation
 - ii. Advantages of tabular presentation
 - iii. Graphic representation of data and its advantages
 - iv. Types of graphic representation
 - 1. Histogram
 - 2. Frequency polygon
 - 3. Frequency curve
 - 4. Scatter or dot diagram
 - v. Merits and limitations of graphic representation
 - vi. Diagrammatic representation of data
 - 1. Line diagram
 - 2. Bar diagram
 - 3. Pie diagram

16. Measures of central tendency of grouped and ungrouped data **4L**

- a. Simple arithmetic mean, its merits and limitations
- b. Averages of position: Median and mode, their merits and limitations

17. Measures of dispersion **4L**

- a. Meaning of dispersion
 - i. Range: Computation in individual, discrete and continuous series, coefficient of range, merits and limitations
 - ii. Mean deviation and standard deviation: computation for grouped and ungrouped data, merits and limitation
 - iii. Variance: Definition, coefficient of variance

18. Correlation and regression **4L**

- a. Definition and types of correlation
- b. Coefficient of correlation and its properties
- c. Methods of studying correlation: Scatter diagram and Karl Pearson's coefficient of correlation
- d. Coefficient of determination (r^2)
- e. Regression analysis
 - i. Definition and types of regression
 - ii. Linear regression

19. Probability and types of theoretical probability distribution **4L**

- a. Concept of probability
- b. Binomial distribution
- c. Poisson distribution
- d. Normal distribution
 - i. Normal distribution curve
 - ii. Relationship between normal curve area and standard deviation
 - iii. Properties of normal distribution curve

20. Tests of significance of mean 4L

- a. Introduction
- b. Statistic and its standard error
- c. Meaning of statistical hypothesis, level of significance, null hypothesis and alternative hypothesis
- d. Student's 't' test: unpaired and paired test
- e. χ^2 test as a test of goodness of fit and its significance

21. Computation of seed testing and plant growth indices 10L

- a. Seed germination and early seedling growth.
 - i. Germination percentage
 - ii. Mean germination time (MGT)
 - iii. Germination index (GI)
 - iv. Germination speed (GS)
 - v. Vigor index (VI)
- b. Seed germination and early seedling growth under stress
 - i. Promptness index (PI)
 - ii. Germination stress tolerance index (GSI),
 - iii. Plant height stress tolerance index (PHSI)
 - iv. Root length stress tolerance index (RLSI)
 - v. Dry matter stress tolerance index (DMSI)
- c. Plant growth indices
 - i. Absolute Growth Rate (AGR)
 - ii. Crop Growth Rate (CGR)
 - iii. Relative Growth Rate (RGR)
 - iv. Leaf Area Index (LAI)

10. Analysis of data on vegetation studies 6L

- a. Data obtained from quadrates and transects methods
 - i. Frequency
 - ii. Percent frequency
 - iii. Relative frequency

- iv. Density
 - v. Relative density
 - vi. Abundance
 - vii. Dominance
- b. Computation of crop/vegetation biomass using satellite data
- i. Simple Ratio (SR) or Ratio Vegetation Index (RVI)
 - ii. Difference Vegetation Index (DVI),
 - iii. Normalised Difference Vegetation index (NDVI) or greenness index

NOTE – For Biostatistics, emphasis be given on methodology and numerical problem solving rather than derivations and proofs.

Practicals

1. Computation of mean, mode, median, variance and standard deviation from the given data 1P
2. Representation of data by various graphical methods 1P
3. Statistical problem solving based on Student's 't' test and χ^2 test 2P
4. Statistical problem solving based on data for correlation and regression 2P
5. Germination of various seed lots and analysis of data with various seed germination indices 1P
6. Analysis of vegetation data obtained from list count quadrat method for frequency, density, abundance, relative dominance and importance value index. 1P
7. Analysis of satellite data collected on biomass for RVI, DVI, NDVI, TNDVI, and PVI. 1P

OR

Projects (Equivalent to 6 practicals)

1. Study effect of agrochemicals/ mutagens/ plant extracts/ fertilizers/etc/ on seed germination and early seedling growth, analyze data statistically. **OR**
2. Study varietal variation to abiotic stress based on seed germination and early seedling growth analyze data statistically. **OR**
3. Study vegetation by list count quadrat / line/belt transect method and analyze data statistically. **OR**
4. Collect satellite data on vegetation/biomass and compute RVI, DVI, NDVI, TNDVI, and PVI.

References:

1. Introduction to biostatistics, Pranab Kumar Banerjee.
2. Fundamentals of biostatistics, Khan and Khanum
3. Methods in Biostatistics for medical students and research workers, B K Mahajan

4. ABC of Research Methodology and Applied Biostatistics, M N Parikh and Nithya Gogtay
5. Biostatistics in brief, K Viswesara Rao
6. Introduction to Biometry, S G Purohit, V D Ranade and A V Dusane
7. Biostatistics-Basic Concepts and Methodology for the Health Sciences, Wayne W Daniel
8. Basic statistics, B L Agarwal
9. Biostatistics – Principle and Practice, B Antonisamy, Soloman Chrostopher and P Prasanna Samuel
10. Introduction to biostatistics and research methods, PSS Sundar Rao and J Richards
11. Drought stress in peanut, Lambert Publication , Laware And Shinde

SEMESTER IV

Paper I: BO. 341: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Plant Physiology

- 1) **Photosynthesis:** Structure of a chloroplast, photosynthetic pigments and their role, Photosystems, Light reaction, electron transport chain, Cyclic and Non-cyclic photophosphorylation, Path of carbon in photosynthesis - Calvin cycle, HSK pathway: Salient features of C4 plants, metabolic pathway, CAM pathway, Photo-respiration, Significance of photosynthesis. **(10)**
- 2) **Respiration:** Structure of a mitochondrion, Respiratory substrates, Types of respiration, Mechanism of aerobic respiration – Glycolysis, TCA cycle. Electron transport system, Chemi-osmotic hypothesis of ATP synthesis, Balance sheet of ATP generation in respiration. Significance of respiration. **(7)**
- 3) **Translocation of organic solutes:** Definition, Path of translocation, Evidences for phloem transport, Mechanism of translocation – Pressure flow theory, Diffusion, Source to sink relationship, Phloem loading and unloading. **(4)**
- 4) **Stress Physiology :** Concept of abiotic , biotic and xenobiotic stresses. Types of stresses – Salinity, drought. Effect of stresses on the plant growth. **(3)**

Biochemistry

- 1) **Carbohydrates:** Definition and classification Properties and functions of carbohydrates. Synthesis and breakdown of starch. (4)
- 2) **Amino acids and proteins:** Definition, synthesis and properties of amino acids. Role of amino acids. Classification of proteins on the basis of structure, properties and functions of proteins. (5)
- 3) **Lipids:** Definition , classification, properties and functions of lipids. Synthesis of lipids, β -oxidation. (4)
- 4) **Enzymology:** Definition and nature of enzymes, active site, Classification (IUB) and properties of enzymes, Co-enzymes. Mechanism of enzyme action- Lock and key hypothesis, Induced fit theory. Factors affecting enzyme activity – pH, temperature, substrate concentration, enzyme concentration. Enzyme inhibitors – Competitive, uncompetitive, non-competitive. (6)
- 5) **Secondary Metabolites:** Definition, Types, Metabolic pool and biosynthesis of secondary metabolites through – malonic, mevalonic and shikimic acid pathways. Role of secondary metabolites. (5)

References: -

S. N. Pandey and B. K. Sinha (2014). Plant Physiology, Vikas Publishing House Pvt. Ltd., India.

Buchanan B.B, Gruissem W. and Jones R.L (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists Maryland, USA.

Salisbury F.B and Ross C.W (1992). Plant physiology (Fourth Edition) Wadsworth Publishing Company, California,USA.

William G. Hopkins (1995) Introduction to Plant Physiology, Published by – John Wiley and Sons, Inc.

Lincoln Taiz and Eduardo Zeiger (2003). Plant Physiology (3rd edition), Published by – Panima Publishing Corporation

R. G. S. Bidwell (revised edn.)-Plant Physiology

Verma S.K. and Verma Mohit (2007). A.T.B of Plant Physiology, Biochemistry

and Biotechnology, S.Chand Publications.

Leninger A.C (1987). Principles of Biochemistry, CBS Publishers and Distributors (Indian Reprint)

Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) 1997. Plant Metabolism (Second Edition) Longman, Essex, England.

Galstone A.W. 1989. Life processes in Plants. Scientific American Library, Springer Verlag, New York, USA..

Moore T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer – Verlag, New York, USA.

Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee 1999. Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi

Taiz L. and Zeiger E. 1998. Plant Physiology (Second Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA.

Verma S.K. and Mohit Verma 2007. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S.Chand Publications.

Practicals based on Paper I: BO. 341: Plant Physiology and Biochemistry:-

1. Estimation of chlorophyll-a and chlorophyll-b by spectrometric or colorimetric method.
2. Separation of photosynthetic pigments by TLC/Paper chromatography.
3. To determine diurnal fluctuation in TAN values of CAM plants.
4. Estimation of soluble proteins by Lowery *et. al.* method.
5. Separation of amino acids by paper chromatography.
6. Demonstration of
 - a. Ringing experiment for path of solute translocation.
 - b. Hill reaction

- c. Qualitative tests for alkaloids, tannins, glycosides, starch, lipids and proteins.
- d. Enzyme activity: catalase

Paper II: BO.342: PLANT ECOLOGY AND BIODIVERSITY

Plant Ecology (24L)

1. Ecology (8L)

Introduction, Interrelationship between the living world and the environment, components and dynamism of Ecosystem, homeostasis.

Impact of human activities on environment – Causes, Prevention and control of – Air, water and Soil Pollution

Brief account of environmental toxicology – Eutrophication, bioaccumulation and biomagnifications

2. Environmental Crisis (3L)

Desertification, Ozone depletion and Global warming

3. Environmental Impact Assessment (3L)

Process, objectives of EIA, Hierarchy in EIA, Historical Review of EIA, Concepts related to EIA, Basic data collection for EIA

4. Environmental Audit (3L)

Meaning, need, Audit Protocol, Processing, Certification, personnel environmental Audit.

5. Ecology and Economics (3L)

Man and Biosphere concept.

Relation between ecology and economics

6. Remote Sensing (4L)

Definition, basic principles,

Process of data acquisition and interpretation,

Global positioning System

Application of Remote Sensing in ecology.

Biodiversity (24L)

Introduction to Biodiversity (02 L)

Introduction, Concept, Aims and objectives,
Scope and values of Biodiversity.

Characterization of Biodiversity: (05 L)

Introduction, need for characterization, various disciplines of Biodiversity- Genetics, Species and Ecosystem. Concept of endemism and phylogeography.

Biodiversity Loss: (03 L)

Loss of Species and Genetic Diversity: Introduction, Factors causing loss of species and genetic diversity, Founder Effects, Genetic Drift, Inbreeding Depression, IUCN Categories (RET plants)

Inventorying and Monitoring of Biodiversity: 03 L)

Introduction, Necessity, planning and approaches to inventorying and monitoring, capacity building.

Conservation of Biodiversity: (11L)

Current Practices in Conservation,

In-situ Conservation: International efforts and Indian initiatives; protected areas in India, Concept of Biosphere Reserves and National Parks.

Ex-situ Conservation: Germplasm Collections, Botanical Gardens, Seed Banks, Gene Banks, Pollen Banks, DNA Banks, Wetlands, mangroves and coral reefs. Enlist national agencies playing role in conservation (BSI, NBPGR, ICAR, CSIR, DBT),

Social Approach to Biodiversity Conservation: Sacred Groves, Sthalavrikshas, Chipko Movement, Role of Universities and other Educational Institutions in Biodiversity Conservation

References:

1. **M. Anji Reddy** Textbook of Remote sensing and GIS (Third edition, 2006) by BS Publication, Hyderabad

2. **George Joseph** Fundamentals of remote sensing (Second edition, 2005) by Universities press (India) Private Ltd., Hyderabad.
3. **John R. Jensen** Remote sensing of the environment (2000), Dorling Kindersley India Pvt. Ltd,
4. Current sciences special issue remote sensing for national development Volume 61 numbers 3 and 4 August 1991
5. **Larry W. Canter**," Environment Impact Assessment", McGraw-Hill Book Company, New York
6. **G.J. Rau and C.D. Weeten**, "Environmental Impact Analysis Hand book, McGraw Hill, 1980.
7. **E.P. Odum. 1996.** Fundamentals of Ecology. Natraj Publishing, Dehradun.
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15. **Smith L.R. and Mith T.M. 1998.** Elements of Ecology. (4th edition). An imprint of Addison Wesley, Longman ink., California.
1. **K.V. Krishnamurthy** (2003). An Advanced Textbook on Biodiversity- Principles and Practice, Oxford and IBH Publ. New Delhi
2. **Michael J. Jeffries** (2005). Biodiversity and Conservation, Routledge, London
3. **Shailaja Ravindranath and Sudha Premnath** (1997). Biomass Studies – Field Methods for Monitoring Biomass Oxford and IBH, New Delhi.
4. **William J. Sutherland**(1997). Ecological Census Techniques – A Handbook Cambridge Uni. Press.
5. **Magurran Anne** (1988). Ecological Diversity and Its Measurement Chapman and Hall India
6. **Michael P.** (1984). Ecological Methods for field and Laboratory investigations TMH Co. ltd. Bombay.
7. **Uma Shaanker, R. Ganeshiah, KN. and Bawa KS** (2001), (Eds). Forest Genetic Resources: Status, Threats and Conservation Strategies Oxford and IBH, New Delhi
8. **Heywood and Watson** (1995), Edt. Global Biodiversity Assessment UNEP, Cambridge University Press.

9. **Global Biodiversity: Status of the Worlds Living Resources** (1992); WCMC; Chapman and Hall, London
10. **David Hill, Matthew Fasham, Graham Tucker, Michael Shewry and Philip Shaw** (2004) Edt. Handbook of Biodiversity Methods – Survey, Evaluation and Monitoring; Cambridge
11. **Handbook of the Convention on Biological Diversity** (2001), Secretariat of the Convention on Biological Diversity. Earthscan publ., London
12. **Avise J.C.** (1994), Molecular Markers, Natural History and Evolution; Chapman and Hall, London
13. **Barbier E.B., Burgess J.C. and Folke C.** (1994). Paradise Lost? The Ecological Economics of Biodiversity; Earthscan, London
14. **Hajra P.K. and V. Mudgal** (1997) Edt. Plant Diversity Hotspots in India – An Overview, BSI
15. **John E. Weaver and F.E. Clement** (1938). Plant Ecology McGraw-Hill.
16. **Orians G.H., Brown G.M., Kunin W.E. and Swierbinski J.E.** (1990). Preservation and Valuation of Biological Resources Univ. Washington Press
17. **Bowles M.L. and Whelan C.J** (1996) edt. Restoration of Endangered Species - Cambridge Univ. Press.
18. **T.V. Ramchandra, R. kiran, N. Ahalya** (2002). Status, Conservation and Management of Wetlands, Allied Publ. New Delhi.
19. **Gadgil M. and Guha R** (1992). This Fissured Land: An Ecological History of India Oxford University Press, New Delhi
20. **Ashish Kothari** (1997) Understanding Biodiversity- Life, sustainability and Equity; Orient Longman

Practicals-Plant Ecology

1. Study of polluted water body with ref. to BOD.
2. Study of physicochemical properties of water body by using Sacchi disc, pH meter and electric conductivity meter.
3. Acquisition of ecological data of particular locality by using GPS/ altimeter/geographic maps etc
4. Study of suitable ecosystem by line/belt transect method/ nested quadrat method.
5. Visit to near by locality to study biodiversity and submission of report

Practicals-Biodiversity

1. Study and application of diversity indices to suitable ecosystem/ area.
2. To measure the latitude, longitude and altitude by using GPS

3. Visit to near by conservation institutes/sacred groove and report writing.

PAPER III BO.343:: PLANT PATHOLOGY

1 Fundamentals of plant pathology

5 L

Introduction, Important terminology- Incitants, Host, Parasite, Pathogen, Inoculum, Penetration, Infection, Incubation, Disease, Disease development, Symptoms, Sign, Endophyte, Predisposition, Suscept, Resistance, Epidemic, Etiology. Economic importance of plant diseases, History of plant pathology, Introduction to Indian Agricultural Research Institute (IARI), International Crop Research Institute for Semi Arid Tropics (ICRISAT), Contribution of Anton DeBary and Prof. B.B. Mundkur.

2 Disease Development

6 L

Concept of disease cycle, Inoculation, Prepenetration, Penetration, Infection, Dissemination. Epidemics- Forms, Decline,, Exponential model. Disease forecasting, Measurement of plant disease and yield loss.

3 Defence Mechanisms

3 L

Concept and Definition, Types- Preexisting- Structural and chemical, Induced- Structural and Biochemical

4 Methods of Studying Plant Diseases

5 L

Macroscopic study, Microscopic study, Koch"s postulates. Culture technique, Media Types and Preparation, Pure culture methods- streak plate, Pour plate, spread plate, Serial dilution.

5 Fungal Plant Diseases

5

L

Introduction to fungi as plant pathogens. Study of Diseases- Club root of Crucifers, Downy mildew of Grapes, Head smut of Jowar, Leaf spot of Turmeric, Tikka disease of Groundnut with reference to causal organism, symptoms and signs, disease cycle and control measures.

6 Bacterial Plant Diseases

3

L

Introduction to bacteria as plant pathogens, Study of Diseases- Citrus Canker, Black arm of Cotton with reference to causal organism, symptoms and signs, control measures.

7 Mycoplasma Plant Diseases

3

L

Introduction to Mycoplasma as plant pathogens, Study of Diseases- Grassy shoot disease of sugarcane, Little leaf of brinjal with reference to symptoms and signs, control measures.

8 Nematodal Plant Diseases

2

L

Introduction to Nematodes as plant pathogens. Study of Diseases- Root knot disease of vegetables, Ear cockle of Wheat with reference to causal organism, symptoms and signs, control measures.

9 Viral Plant Diseases

3

L

Introduction to Viruses as plant pathogens. Study of Diseases- Tobacco Mosaic Disease, Bunchy top of Banana with reference to causal organism, symptoms and signs, control measures.

10 Non Parasitic Diseases

4

L

The impact and abiotic causes- Temperature, Soil moisture and relative humidity, Poor oxygen, Poor light, Air pollutants, mineral deficiencies. Herbicide injury, Study of Tip burn of Paddy, Mango necrosis, Black Heart of Potato, Khaira disease of rice.

11 Principles of Plant Disease Control

5

L

General account, Quarantine, Eradication, cultural control practices, Biological control, Curative measures, Chemical control, Use of Effective Microorganism Solution (EMS), Microbial Pesticides, IPM

12 Molecular Diagnostics and Transgenic in Crop Protection

4 L

Introduction, Classical approaches, Use of antibodies, Pathogen derived resistance against bacterial and fungal diseases, Expression of vaccines in plants.

Practicals

1. Preparation of any one culture media for isolation of plant pathogens.
2. Study of Koch's Postulates
3. Culture technique - Streak plate methods, Pour plate methods, Spread plate and Serial dilution method for preparation of pure culture.

4. Study of any two of each fungal, bacterial and mycoplasma diseases.
5. Study of any two viral and non-parasitic diseases of plants.
6. Study of any two of each fungicides and microbial pesticides
 - Visit to any Agricultural Research Institute and Plant Pathology Laboratory and submission of report

References:

1. Fungi and Plant Diseases by B. B. Mundkur
2. Plant Pathology, R. S. Mehrotra
3. Principles of Plant Pathology, R. S. Singh
4. Plant Pathology, P. D. Sharma
5. Plant Disease, R. S. Singh
6. Plant Pathology, Mandal and Dasgupta
7. Plant Pathology, G. N. Agrios
8. Agricultural Microbiology, Rangaswamy and Bhagyaraj
9. Fundamentals of Plant Pathology by Ravi Chandra
10. Methods of Microbial and Plant Biotechnology, L. N. Nair
11. Molecular Plant Pathology, 2003. Dickinson, Bios Scientific Publication, London, New York

Paper IV: BO.344: MEDICINAL AND ECONOMIC BOTANY

Medicinal Botany (36L)

1. Introduction to Pharmacognosy

(3L)

1.1. Origin, history, definition and scope of Pharmacognosy,

1.2. Methods of classification and their significance in the study of drugs of natural origin (alphabetical, biological, chemical, taxonomical, chemotaxonomical and pharmacological)

2. Ayurvedic Pharmacy

(8L)

2.1 Introduction

2.2 Tridosha concept, Humoral, Indigenous Systems of medicine (Ayurveda, Siddha, Unani, Tibi, Chinese etc.)

2.3 Ayurvedic principles- Ras. Guna, Vipaka, Virya, Prabhava,

2.4 Ayurvedic formulations –Asava, Arishta, Kvatha, Churna, Ksharas, Leha, Vatika, Taila, Bhasma,

3. Analytical Medicinal botany (6L)

3.1 Drug adulteration

3.2 Methods of extraction (percolation, maceration, Soxhlet extraction etc.) of different classes of phytochemicals from crude drugs.

3.3 Methods of drug evaluation- Morphological, Microscopic, Chemical and Physical methods.

4. Cultivation, collection and processing of herbal drugs from Mentha and Eucalyptus. (3L)

4.1 Cultivation- Methods, Factors affecting cultivation

4.2 Collection and Processing- Collection, harvesting, drying, garbling, packing, storage of crude drugs.

5. Study of medicinally important drugs (6L)

Study of drugs w.r.t. occurrence, distribution cultivation, microscopic characters, constituents and uses of the following.

Root Rhizome drugs :- *Glycyrrhiza*,

Stem drugs: - *Ephedra*,

Leaf drugs: - *Adhatod*,

Flower drugs: - Clove,

Fruit drugs: - Amla,

Unorganized drugs :- Shilajit and *Acacia* gum,

Contraceptive drugs: - *Dioscorea*.

6. Applied Medicinal Botany (8L)

6.1 Study of drugs with respect to Biological source, Geographical distribution, common varieties, macro and microscopic characters, chemical constituents and therapeutic uses, adulterants of the following plants/drugs *Strychnos nux vomica*-Seeds, *Tinospora cordifolia*-Stem

6.2 Concept of active principle, and major metabolic Pathway (Carbohydrates and Proteins) leading to the Production of therapeutically active Chemical Constituents

6.3 Concept, definition and introduction to Biopharmaceutics, Pharmacodynamics and clinical Pharmacokinetics with applications

7. Ethnobotany : Definition, principles, scope and ethnic societies in India. (2L)

Economic Botany (12L)

1. Introduction to economic botany and its scope (2L)

2. Important Botanical resources- meaning and Mention of only botanical resources any five for non-wood forest products (NWFPs) such as (4L)

2.1 Paper making and 2.2 Gums

3. Origin, evolution, source & uses of Rice, *Curcma longa*, Safflower, Sugarcane, *Butea monosperma*/*Samanea saman*/ *Sclleichera oleosa* and Rose. (6L)

References:-

1. A Pharmacognosy and Pharmacobiotechnology. New Age international (P)Limited, Publishers (formerly wileyEastern Limited)
2. **Bruncton J.:** Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited.

3. **Harborne, J. B.** (1973): Phytochemical Methods: A guide to Modern Techniques of plant Analysis. Chapman and Hall, London
4. **Khandelwal K. R.**(2008): Practical Pharmacognosy Techniques and Experiments; NiraliPrakashan, Pune.
1. **Kokate C.K. (2014)**Practical Pharmacognosy, Vallabhprakashan, New Delhi, 5th edition
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3. **Trease G.E. and Evans. W.C.** Pharmacognosy ELBS Twelfth Edition
4. **Tyler V.E Brady L. R and Robbers J.E. (1976).**Pharmacognosy Lea and Febiger. Philadelphia.8th edition KM Varghese and Co.Mumbai,
5. **Vaidya S.S. and Dole.V.A.** Bhaishyajalpana, AnmolPrakashan, pune
6. **Wallis,T.E. (2003)**Test books of pharmacognosy CBS publishers and distributors New Delhi (Latest Edition)
7. **T. E. Wallis, J. & A. Churchill** Ltd., London, 1960. Textbook of Pharmacognosy
8. **Anonymous** The Ayurvedic Pharmacopoeia of India Volume-I and IV, Govt. of India, Ministry of Health and Family Welfare, Department of Ayush Page 41.
9. **P.L. Kochhar(1987)** Tropical Crops: A Textbook of Economic Botany (Macmillan international college edition)
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12. **N.D. Prajapati (2010)**A Handbook of Medicinal Plants: A Complete Source Book
13. **Himadri Panda(2002)** The Complete Technology Book On Natural Products (Forest Based)
14. **Pharmacognosy and Phytochemistry -- Vinod Rangari.**

Practicals based Paper VI: BO.346: Medicinal and Economic Botany

1. Study of any six drug plants from theory syllabus (Macroscopic and Microscopic). (2P)
2. Demonstration of Plant extraction methods -Cold and Soxhlet extraction and TLC of any one drug studied in theory. (1P)
3. Study and preparation of ayurvedic formulations - Asav, Arishtha, Churna (1P)
4. Qualitative analysis of Alkaloid, Glycoside and Tannin (1P)
5. Study of stomatal index and vein islet number using suitable plant material using micrometer and camera Lucida. (1P)
6. Survey of local flora with respect their medicinal and economic importance and submission of 10 dry specimens.

Paper V: BO. 345 PLANT BIOTECHNOLOGY

1. Introduction to Biotechnology

5L

Introduction and History of plant Biotechnology

Pioneering work and significant achievements in Indian plant Biotechnology

Global Impact and Current excitements of plant Biotechnology - Plant Health care and plant protection.

2. Plant Tissue Culture

15L

Brief History, Importance of plant tissue culture

Types of culture, basic technique of plant tissue culture, Concept, technique and applications of callus culture, cell suspension culture, protoplast culture, somatic hybridization and cybrids, Haploid production, Micropropagation, embryo culture-and embryo rescue

3. Germplasm and Cryopreservation

4L

In situ and **Ex situ** conservation, techniques of cryopreservation, cold storage, low pressure and low oxygen storage, applications

4. Transgenic Plants as Bioreactors

6L

Metabolic engineering of starch, cyclodextrins, fructans, Bioplastics, Genetically engineered plants as protein factories, Production of therapeutic proteins from plants.

5. Biotechnology of Biological Nitrogen Fixation

6L

Non symbiotic Nitrogen Fixation-Diazotrophs and their ecology, special features,

Mechanism of N₂ Fixation

Nitrogenase and Hydrogenase

Symbiotic N₂ Fixation- establishment of symbiosis,

Factors affecting and mechanism of symbiotic N₂ Fixation

Genetics of Diazotrophs- Nod genes, Nif gene

Biofertilizers- algal, fungal, phosphate solubilising and organic fertilizers

6. Biotechnology and Society

4L

Biotechnology- Benefits, GM foods and its safety, patenting of biotechnological inventions, Biotechnology and developing countries, Recombinant foods and religious beliefs, recombinant therapeutic product for human health care, Intellectual property rights

7. Bioinformatics

4L

Introduction, Database and its classification, NCBI, Data retrieval tools, INTREZ, OMIN, BLAST, FASTA, Applications of Bioinformatics

8. Genomics and Proteomics

4L

Genomics- methods, types and applications, Proteomics- Concept, types and importance

Practicals

1. Preparation of MS Medium
 2. Callus Induction using maize embryo
 3. Study of application of biofertilizers- Algal, Fungal, Bacterial, Phosphate Solubilizers and Organic Fertilizers
 4. Estimation of Nitrate Reductase enzyme from Legume nodules
 5. Study of Transgenic plants- Bt Cotton, Bt Brinjal, Bt Tomato, Golden Rice
- Visit to NCBI and Report preparation

Reference Books:

1. R. C. Dube (2008)- A Text Book of Biotechnology, S. Chand

2. P.K. Gupta-Elements of Biotechnology
3. Satyanarayana-Biotechnology
4. Kalyan Kumar De-Plant tissue culture
5. Pal J.K. and Ghaskadabi S.S. (2008) Fundamentals of Molecular Biology.
6. Verma and Agrawal- Molecular Biology
7. Devi P.2008-Principle and Methods of plant Molecular Biology, Biochemistry and Genetics Agrobios, Jodhpur, India.
8. Glick B.R. and Tompson J.E. 1993 Methods in Plant Molecular Biology and Biotechnology CRC Press Boca Raton, Florida.
9. Hall R.D. (Ed.) 1999 Plant cell culture Protocol human press Inc., New Jersey, USA
- 10.Kumar H.D. 2002 A Text Book of Biotechnology 2nd Edn. Affiliated Easyt-West Press Private Ltd New Delhi.
- 11.Ramawat K.G. 2003 Plant Biotechnology, S. Chand & Co. Ltd . Ramnagar New Delhi. 110055
- 12.Trivedi P.C.2000 Plant Biotechnology, Panima Publishing Carpation, New Delhi.
- 13.Rajdan- Plant tissue culture.

Paper VI: BO346: PLANT BREEDING AND SEED TECHNOLOGY

PLANT BREEDING (24 L)

1. Introduction, scope and importance (2 L)

2. Conventional techniques, methods and practices of breeding (10 L)

(a) Plant introduction and acclimatization

- i. Concept, objectives
- ii. Types of plant introduction
- iii. Advantage, limitations/ Disadvantages and achievements.

(b) Selection methods

- i. Concept,
- ii. Types of selections –mass selection, pure line selection and clonal selection.
- iii. Advantage and disadvantages/limitations, achievements.

(c) Hybridization

- i. Definition and Concept,
- ii. Difficulties in crop hybridization and precaution to be taken during hybridization
- iii. General procedure of hybridization
- iv. Parent selection in a breeding program
- v. Criteria for selecting parents

Breeding Methodology

- i. Pedigree method
- ii. Bulk method
- iii. Single-seed descent method
- iv. Backcross method, Achievements

(d) Heterosis and hybrid vigour

- i. Concept
- ii. Causes of heterosis- dominance hypothesis
- iii. Applications

3. Alternative breeding techniques

(08 L)

(a) Mutation breeding

Introduction and concept

Types of Mutation

induced mutagenesis

mutagens used -Chemical and physical mutagens

methods of working

Gamma gardens, concept and design

Applications

(b) Importance of Polyploidy and aneuploidy in crop improvement

Properties of polyploids,

Methods of obtaining polyploids

Methods used in obtaining haploids

Production of triploids in plant breeding

Applications and achievements

4. Breeding for stress tolerance

(4L)

Mechanisms and genetic bases of resistance/tolerance to biotic and abiotic stresses in plants,

Breeding for resistance/tolerance.

Molecular Approaches
Characteristics evaluated for drought tolerance
Characteristics evaluated for insect/pest tolerance
Achievements

SEED TECHNOLOGY (24L)

1. Introduction: (2 L)

Definition of seed,
Stages of Seed Production,
Classes of Seed (nucleus seed, breeders seed, foundation seed, certified seed and truthful seed),
Role of seed technology.

2. Seed certification: (2 L)

General procedure of seed certification,
field inspection,
observation during inspection,
field count,
Duties of seed inspector.

3. Seed processing:

Concept (2 L)
Principle and techniques of processing of seeds

4. Seed sampling, storage and packaging (6 L)

Seed sampling,
Types of seed samples,
Sampling equipments.
Factor affecting seed storage and need of seed storage,
Methods of protection and control,
Air conditioning and dehumidification,
Sanitation and fumigation of seed stores.
Seed sorting and bagging, bag weighing, bag closing, type of bag closer,
Labelling and maintaining lot identify, lot numbers, seed pellets,
Handling and stacking,
Maintenance of seed processing record.

5. Physical purity analysis (3L)

Definition of purity components
Procedure
ODV test
Reporting and results.

6. Seed Testing

A. Moisture Testing

(3L)

By air oven method
Moisture meters.

B. Germination testing

(3L)

Definition and objectives,
General principles and requirements,
Procedure and methods (Paper, Sand and Soil)
Seedling evaluation.

7. Seed Marketing:

(3L)

Marketing- Basic concepts, supply & demand, price equilibrium, seed transportation, storage, cost & returns, cost processing, packing and marketing, Organization for seed marketing, seed markets in India, structure & working.

Practicals based on Plant Breeding and Seed technology

1. Demonstration of Hybridization Techniques.
2. Effect of chemical mutagens on seed germination and seedling growth.
3. Demonstration of chlorophyll mutation in M2 generation.
(Photographs)
4. Polyploidy induction in *Allium cepa* by colchicine.
5. Seed moisture testing by hot air oven method.
6. Demonstration of seed sampling equipments with the help of photographs.
7. Visit to seed processing unit / Seed marketing organization.

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