NORTH MAHARASHTRA UNIVERSITY,

JALGAON

(NAAC Re-Accredited)

FACULTY OF SCIENCE

SYLLABUS FOR

T.Y.B.Sc.

IN BOTANY

To Be Implemented From

Academic Year 2014-15

NORTH MAHARASHTRA UNIVERSITY, JALGAON
CLASS-T.Y.B.Sc.
SUBJECT- BOTANY
PROPOSED OUT LINE OF SYLLABUS W.E.F. JUNE-2014

SEMESTER-I

BOT. 351 Paper I	**:**	**Diversity of Lower Cryptogams**
BOT. 352 Paper II	**:**	**Taxonomy of Angiosperms**
BOT. 353 Paper III	**:**	**Genetics and Molecular Biology**
BOT. 354 Paper IV	**:**	**Advanced Plant Physiology**
BOT. 355 Paper V	**:**	**Plant Ecology and Phytogeography**
BOT. 356 Paper VI	**:**	**OPTIONAL (Only One)**
BOT. 356.1	**:**	**Plant Biotechnology**
BOT. 356.2	**:**	**Gardening**
BOT.356.3	**:**	**Seed Technology**
BOT.356.4	**:**	**Ethnobotany**

SEMESTER-II

BOT. 361 Paper I	**:**	**Diversity of HigherCryptogams**
BOT. 362 Paper II	**:**	**Gymnosperms & Paleobotany**
BOT. 363 Paper III	**:**	**Plant Breeding**
BOT. 364 Paper IV	**:**	**Plant Biochemistry**
BOT. 365 Paper V	**:**	**Embryology & Palynology**
BOT. 366 Paper VI	**:**	**OPTIONAL (Only One)**
BOT. 366.1	**:**	**Botanical Techniques**
BOT. 366.2	**:**	**Pharmacognosy**
BOT. 366.3	**:**	**Plant Pathology**
BOT. 366.4	**:**	**Horticulture**

(Note: In case of optional papers, only respective number of papers should be selected for both semesters)

PRACTICAL COURSES

BOT. 301 Practical Paper I :	**(Based on Paper I & III)** **i.e. BOT-351, BOT-361, BOT-353, BOT-363.**
BOT. 302 Practical Paper II	**: (Based on Paper II & IV)** **i.e. BOT-352, BOT-362, BOT-354, BOT-364.**
BOT. 303 Practical Paper III :	**(Based on Paper V & VI)** **i.e. BOT-355, and BOT-356.1, BOT-356.2,BOT 356.3,BOT.356.4, and BOT-365, BOT-366.1, BOT-366.2, BOT-366.3and BOT.366.4**

BOT. 351 PAPER- I
DIVERSITY OF LOWER CRYPTOGAMS [60 Periods]
Semester-I

AIMS AND OBJECTIVES:

1. To study salient features of cryptogamic plants.
2. To make students aware of the status of cryptogams as a group in plant kingdom.
3. To study the life cycles of selected genera.
4. To study economic importance of cryptogamic plants.

ALGAE (30 Periods)

Chapter 1. Introduction To Algae: **05**

1.1 Definition and aspects of diversity of Algae and its importance.
1.2 General characters of algae.
1.3 Classification of algae up to classes with reasons as per G. M. Smith (1955) giving at least two examples from each class.
1.4 Life cycle patterns: Haplontic, Diplontic and Diplohaplontic.
1.5 Alternation of generations.
1.6 Similarities and differences related to fungi.
1.7 Prokaryotic and Eukaryoticcells of Algae.
1.8 Contribution of Indian Phycologists:
i) Prof. M. O. P. Iyengar
ii) Ella Gonzalves

Chapter 2. Range of ThallusStructure in Algae: **03**

2.1 Unicellular thallus
2.2 Colonial thallus
2.3 Filamentous thallus
2.4 Siphonaceous thallus
2.5 Pseudoparenchymatous
a) Uni-axial thallus
b) Multi-axial thallus
2.6 Parenchymatous thallus

Chapter 3.Origin and Evolution of Sex in Algae **04**

3.1 Definition and methods of reproduction in Algae.
3.2 Origin of sex i.e. origin of gametes
3.3 Evidences for zoosporic origin of gametes.
3.4 Evolution of sex.

Chapter 4. Life Cycle of *Chara* with respect to: **05**

4.1. Systematic position with reasons.
4.2. Occurrence
4.3. Structure of thallus

4.4. Reproduction
a) Vegetative reproduction
b) Sexual reproduction
4.5. Structure and development of sex organs
a) Nucule
b) Globule
4.6. Fertilization and germination of zygote.

Chapter 5. Life Cycle of *Ectocarpus* with respect to: **04**

5.1 Systematic position with reasons
5.2 Occurrence
5.3 Structure of thallus
5.4 Reproduction.
a) Asexual reproduction
b) Sexual reproduction in *Ectocarpussiliculosus.*

Chapter 6. Life Cycle of *Batrachospermum* with respect to: **05**

6.1. Systematic position with reasons
6.2. Occurrence
6.3. Structure of thallus
6.4. Reproduction
a) Asexual reproduction
b) Sexual reproduction
6.5. Structure of sex organs
6.6. Fertilization
6.7. Post-fertilization changes
6.8. Germination of oospores

Chapter 7. Economic importance of Algae: **04**

7.1. Role of algae in relation to:
a) Agriculture
b) Food
c) Fodder
d) Industry: Agar, Alginates and Carragenins
e) Sewage disposal: by oxidation method
f) Origin of Petroleum and gas.
g) Medicines
7.2. Recent trends in algal biotechnology in relation to Single Cell Protein (SCP)

FUNGI (30 Periods)

Chapter 8.An introduction to the Fungi. **04**

8.1. General characters of fungi.
8.2. Classification of fungi up to classes giving reasons as per Ainsworth (1973).
8.3. Contribution of following Mycologists.
i) Prof. E. J. Buttler
ii) Prof. C. V. Subramanian.

Chapter 9. Study of Myxomycotina with respect to: **03**

9.1. Thallus structure
9.2. Types of plasmodia
9.3. Nutrition
9.4. Reproduction
  a) Vegetative and Asexual
  b) Sexual
9.5. Schematic representation of life cycle of *Stemonitis*.

Chapter 10. Life Cycle of *Albugo* with respect to: **04**

10.1 Systematic position with reasons
10.2 Habit and Habitat
10.3 Structure of mycelium.
10.4 Reproduction
  a) Asexual
  b) Sexual
10.5 Schematic representation of life cycle of *Albugo*

Chapter11. Life Cycle of *Penicillium* with respect to: **05**

11.1 Systematic position with reasons.
11.2 Habit and Habitat
11.3 Structure of mycelium
11.4 Reproduction
  a) Asexual
  b) Sexual
11.5 Schematic representation of life cycle of *Penicillium*
11.6 Economic importance of *Penicillium.*

Chapter 12. Life Cycle of *Pucciniagraminis-tritici* with respect to: **06**

12.1. Systematic position with reasons.
12.2 Five spore stages: Spermatia, Aeciospores, Urediospores, Teleutospores andBasidiospores
12.3. Schematic representation of life cycle of *Pucciniagraminis-tritici*
12.4. Control and forecasting measures
12.5. Wheat rust problem in India.

Chapter 13. Study of Deuteromycotina with respect to: **03**

13.1. Salient features
13.2. Reproduction and fruiting bodies

Chapter 14. Study of Lichens: **02**

14.1. General characters,
14.2. Types
14.3. Importance.

Chapter 15. Economic Importance of Fungi: **03**

15.1. Role of fungi in relation to:
15.2 Medicine
15.3 Food and fodder.
15.4 Soil fertility

15.5 Plant pathology
15.6 Mycoses
15.7 Biodeterioration
15.8 Fermentation Industry

REFERENCE BOOKS:

ALGAE:

1. Bold, H.C. and M.J.M.Wynne (1978) Introduction to the Algae - Structure and Reproduction. Prentice Hall of India Pvt. Ltd New Delhi.
2. Chapman, V.J. and D.J. Chapman (1979) The Algae, English Language Book Soc& Mac Millons, London, England.
3. Ganguli, H.C. and A.K. Kar (2001) College Botany Vol.II, Books and Allied Press Ltd. Kolkata, India
4. Kuma, H.D. (1988) Introductory Phycology. Affiliated East-West Press Ltd., New Delhi, India
5. Kumar, H.D. and H.N.Singh (1976) A Text Book of Algae. Affiliated EastWest Press Ltd., New Delhi, India
6. Lee, R. E. (1989) Phycology Cambridge University Press, Cambridge. U.K.
7. Morris, I. (1968) An Introduction to the Algae. Hutchinson and Com. London. England.
8. Pandey, B.P. (1994) A Text Book of Botany - Algae. S.Chand and Com. Ltd., New Delhi, India.
9. Pandey, B. P. College Botany Vol-I, S. Chand and Company Ltd. Ramnagar, New Delhi, India
10. Pandey, S.N. Trivedi, PS. and S P.Misra (1995) A Text Book of Algae, Vikas Pub. House Pvt. Ltd. New Delhi, India.
11. Prescott, G.W. (1969) The Algae : A Review. Thomas Nelson and Press, London, U.K.
12. Round, F.E. (1965) The Biology of the Algae. Edward Arnold Pub, London, U.K.
13. Sharma, O.P. Text book of Algae. Toto McGraw Hill publishing company Ltd. New Delhi, India
14. Vashishta, B.R., Sinha, A.K. and V. P. Singh (2010) Botany for degree student : Algae, S. Chand and Company Ltd. Ramnagar, New Delhi, India

FUNGI :

1. Ahmadjian, V. and M.E. Hale (1973) The Lichens, Academic-Press, New York, U.S.A.
2. Alexopoulos, C.J. and C.W. Mims (1979) Introductory Mycology, John Wiley, New York, U.S.A.
3. Alexopoulos, C.J, Mims, C.W. and M.Blackwell (1996) Introductory Mycology (4th Ed.) John Wiley and Sons Inc. New York, U.S.A.
4. Dube, H.C. (1990) .An Introduction to Fungi Vikas Pub. House Ltd. New Delhi, India.

5. Hale, M.E. (1983) The Biology of Lichens, Edward Arnold Publ. New Delhi, India.

6. Joshi, K .R. (1995) Opprtunistic Mycoses. Scientific Publishers, Jodhpur, India.

7. Mehrotra, R.S. and C.R Aneja (1990) AnIntroduction to Mycology. Wiley Eastern Ltd., New Delhi, India.

8. Pandey, B.P. (1994) A Text Book of Botany-Fungi. S. Chand and Co, Ltd. New Delhi, India

9. Sharma, P. D. (1998) The Fungi. Rastogi Pub. Meerut India

10. Sharma, O. P. (1990) Text Book of Fungi. Tata McGraw-Hill Pub Co. Ltd New Delhi. India

11. Vashista, B. R.(2008) Botany for degree students : Fungi, Chand and Comp Ltd., New Delhi. India.

12. Vaidya, J. G. (1995) Biology of the Fungi Satyajeet Prakashan, Pune, India.

13. Webster, J. (1980) Introduction to Fungi Cambridge University Press, Cambridge

----------XXXX----------

BOT.352:PAPER-II
TAXONOMY OF ANGIOSPERMS[60 Periods]
Semester-I

AIMS and OBJECTIVES:

1. To study origin of Angiosperms with respect to Age and Probable ancestors.
2. To study Pre-Darwinian and Post- Darwinian systems of Classification.
3. To study various Angiospermic Families emphasizing their morphology, Biology, Phylogeny and interrelationship.
4. To study functions and Botanical features of Botanical gardens.
5. To know role of Anatomy, Embryology and Palynology in Taxonomy.

Chapter1.SystemsofPlantClassification 10

1.1 ConceptofPre-Darwinian
- i) System based on habit
- ii) Sexual system
- iii) System based on forms -relationship

1.2 Post-Darwiniansystems
- i) Theory of evolution
- ii) School of thoughts
- a) Rannelian School: Hutchinson'ssystem. (Outline merits and demerits)
- b) Englerian School: Engler and Prantl's system(Outline merits and demerits)

1.3 Comparisonbetween Engler&Prantl'sandHutchinson'ssystem

Chapter2.StudyofAngiospermicFamilies 30

2.1 (SensuBenthamandHooker'ssystemofclassification)
Studyof followingfamilies w.r.t geographicaldistribution, vegetative andfloralcharacters,distinguishingfeatures,floralformula,andeconomicimportance.

1. Annonaceae
2. Crucifereae [Brassicaceae]
3. Tiliaceae
4. Rutaceae
5. Caesalpinaceae
6. Mimoceae
7. Myrtaceae
8. Cucurbitaceae
9. Compositeae[Aseraceae]
10. Sapotaceae
11. Asclepiadaceae
12. Convolvulaceae
13. Acanthaceae

14. Labiate (Lamiaceae)
15. Nyctaginaceae
16. Casuarianaceae
17. Orchidaceae
18. Amaryllidaceae
19. Scitaminae: Musaceae
20. Graminae (Poaceae)

2.2. Points of Biological and Morphological interest**.**

1) Asclepiadaceae
2) Convolvulaceae
3) Casuarinaceae
4) Orchidaceae

Chapter3.Origin of Angiosperms: 08

3.1 Time , Place and origin of angiosperms

3.2 Probable ancestors of angiosperms

a) Pteridospermales
b) Bennettitales
c) Gnetales

Chapter4.BotanicalGardens: 05

4.l. DefinitionandfunctionsofBotanicalgardens

4.2. Botanicalfeaturesofthefollowing:

a)NationalBotanicalgarden–Lucknow.
b)IndianBotanicalgarden– Kolkata.
c)RoyalBotanicalgarden- Kew(England)

Chapter5.Herbarium: 05

5. l. Definitionandfunctions

5.2. Herbarium techniques

Chapter6ModernTrendsinTaxonomy: 05

6.1 Roleoffollowing:

a) Cytology(number and morphology of chromosomes)
b) Anatomy (stomata, trichomes andxylem elements)
c) Palynology (number and types of aperture , exine stratification)

REFERENCE BOOKS:

1. Heywood,V.H.andMoore,D. M.(Eds.)(1984)CurrentConceptsinPlantTaxonomy, Academic Press, London, U.K.
2. Jeffrey, C.E. (1982) An Introductionto Plant Taxonomy, Cambridge University Press, Cambridge,London,U.K.
3. Lawrence,G.H.M.(1951) Taxonomyof Vascular Plants.McMillan,NewYork,U.S.A.
4. Naik,V.N.(1985)TaxonomyofAngiosperms.TataMcGraw-HillPubl.Co.Ltd.,NewDelhi, India.
5. Sharma, O.P. (1993) Plant Taxonomy, .Tata McGtaw Hill. Publ.Co.Ltd. New Delhi, India.

6. Singh, V. (1993) Taxonomyof Angiosperms Rastogi Publication, Meerut(U.P.)India.

7. Singh,V.,Pande,P.C.andD.K.Jain(1994).AText*Book*ofBotany:Angiosperms.Rastogi Publications, Meerut(U.P.), India.

8. Singh,M.P.,Nayar,M.P.andR.P.Roy(1994).TextBookofForestTaxonomy,AnmolPubl.P. (Ltd.) New Delhi, India.

9. Subramanayam, N.S. (1997) Modern Plant Taxonomy, Vikas Publ. House, New Delhi, India.

10. Sivarajan,V.V.(1984) IntroductiontoPrinciplesofPlantTaxonomy.Oxford&I.B.H. Publishing co. New Delhi, India.

----------XXXX----------

BOT. 353: PAPER- III
GENETICS AND MOLECULAR BIOLOGY [60 Periods]
Semester-I

AIMS and OBJECTIVES:

1. To introduce the students with "Science of Heredity".
2. To study the role of genes in evolution of species.
3. To study linkage, segregation and mutation of genes during evolution.
4. To study the scope and importance of molecular biology.
5. To study the biochemical nature of nucleic acids, their role in living systems, experimental evidences to prove DNA as a genetic material.
6. To understand the process of synthesis of proteinsand role of genetic code inpolypeptide formation.
7. To study the concept of gene, its classical nature, comparison with modern approach.
8. To understand organization of nucleic acids in prokaryotes and eukaryotes.

GENETICS(30 Periods)

Chapter 1. Mendelian Genetics: **07**

- 1.1 Historical background.
- 1.2 Mendel's work -Monohybrid and Dihybrid Ratio
- 1.3 Mendel's Laws:
  - a) Law of dominance
  - b) Law of segregation.
  - c) Law of independent assortment.
- 1.4 Deviation from Mendel's laws (Neo-Mendelism):
  - a) Duplicate dominant gene (15:1)
  - b) Duplicate gene with cumulative effect(9:6:1 ratio)
  - c) Epistasis (13:3 ratio).

Chapter 2. Multiple Alleles: **03**

- 2.1 Concept, characters and examples.
- 2.2 Multiple alleles in blood groups in human being.
- 2.3 Sterility genes in *Nicotiana.*

Chapter 3. Linkage and Crossing over: **06**

- 3.1 Concept and history of linkage
- 3.2 Detection of linkage from F_2 data
- 3.3 Process of crossing over
- 3.4 Types of crossing over :single, double and multiple
- 3.5 Chromosome mapping by three point test cross

Chapter 4. Population Genetics: **06**

- 4.1 Hardy-Weinberg's law of genetic equilibrium.
- 4.2 Factors affecting the equilibrium in population.
  - i) Migration
  - ii) Mutation
  - iii) Selection
  - iii) Genetic drift

Chapter 5. Chromosomal aberrations and mutations: **08**

5.1 Structural changes in chromosomes – Addition, deletion, duplication,inversion andtranslocation

5.2 Numerical changes in chromosomes – Euploidy, Aneuploidy.

5.3 Gene mutations- concept, mutagens- U.V., I. R. and chemical.

MOLECULAR BIOLOGY (30 Periods)

Chapter 6.Introduction to molecular biology. **05**

6.1. Historical background.

6.2. Scope and importance.

6.3 Concept of Cell cycleand types of cell division

Chapter 7. Nucleic Acids: **10**

7.1. Evidences for DNA as a genetic material - Griffith's and Avery'sexperiments (Transformation).

7.2. Molecular Model of DNA (Watson and Crick's Model)

7.3. Forms of DNA : A-DNA, B-DNA and Z-DNA

7.4. Types of DNA replication-: Conservative, Dispersive andSemi conservative

7.4 Meselson and Stahl's experiment.

7.5. Mechanism of DNA replication: Initiation of replication, replication fork, RNA- primer, Semi-discontinuous replication, Okazaki fragment, enzyme involved in replication.

7.6 Types of RNA: r-RNA, m-RNA, t-RNA, clover leaf model.

Chapter 8. Genetic Code and Protein Synthesis: **07**

8.1. Concept of genetic code.

8.2. Properties of genetic code.

8.3. Components involved in protein synthesis.

8.4. Central dogma of molecular biology.

8.5. Mechanism of protein synthesis.

a) Transcription

b) Translation

Chapter 9. Modern Concept of Gene: **04**

9.1 Introduction

9.2 Exon, intron, splicing of transcripts

9.3 Concept of citron, recon, muton and replicon

9.4 Current concept of gene and pseudo-gene.

Chapter 10. Gene Regulation in Prokaryotes: **04**

10.1 Operon concept.

10.2 Inducible operon – Lac operon.

10.3 Repressible operon- Tryptophan operon.

REFFERENCE BOOKS:

GENETICS AND MOLECULAR BIOLOGY

1. Dnyansagar, V.R (1996) Cytogenetics (TMH India), New Delhi, India.

2. Gardner, Simmons and Snustad. (2006) Principles of Genetics.8th edition.JohnWiley& Sons.- India,

3. Gupta, P.K. (1989) Cytology, Genetics and Evolution 5th Ed Rastogi Publ. New Delhi, India.

4. Gupta, P.K. (1995) Cytogenetics, Rastogi Publications Meerut, India.

5. Gupta, P. K. (1998) Genetics, Plant, Breeding and Evolution. RastogiPublications, Meerut, India.

6. Gupta. P. K. (2005). Genetics, Rastogi Publications, Meerut, India.

7. Gupta, P.K. (1999) A Text Book of Cell and Molecular Biology, RastogiPublication, Meerut. India

8. Kumar, H. D. (1988) Biology and Biotechnology, Vikas Publishing house.

9. Powar, C.B. (1999). Genetics Vol.I and II.Himalaya Publications, Mumbai, India.

10. Strickberger, M.W Genetics, 3rd edition. Macmillan Publishing Co. New York, US A

11. Sambamurty,A. V.S.S (2005) Genetics, 2nd edition. Narosa Publishers New Delhi India.

12. Sambamurty, A. V. S. S. (2008) Molecular biology, Alpha Science Intl. Ltd. New Delhi.

13. Sunder Rajan, S. (2004)Cytogenetics. Anmol PublicationsPvt. Ltd. Delhi India.

14. Sarin, C. (1995). Genetics TMH India, New Delhi, India.

16. Sharma,V. N., A. Tandon. Concepts in molecular biology, 2004.New Age international.

17. Strickberger, M.W Genetics, 3rd edition. Macmillan Publishing Co. New York, US A.

20. Verma, P. S., V. K. Agrawal. (2008) Cell Biology, Genetics, Molecular biology, Evolution and Ecology.3rd edition S. Chand & co.New Delhi, India.

---------XXXX--------

BOT. 354 PAPER-IV
ADVANCED PLANT PHYSIOLOGY [60 Periods]
Semester-I

AIMS and OBJECTIVES

1) To learn and understand about mineral nutrition in plants.
2) To study the growth and developmental processes in plants.
3) To learn about movement in plants.
4) To study fat metabolism under primary metabolism of plants.

Chapter 1. Mineral Nutrition and Absorption of Minerals: 12

1.1 General role of mineral elements in plants, Micro and Macroelements:

1.2 Specific functions and deficiency symptoms of following elements:Nitrogen, Sulphur, Phosphorous, Potassium, Magnesium, Iron, Boron.

1.3 Brief understanding of organic and inorganic fertilizers, hydroponics.

Chapter 2. Plant Growth and Development: 13

2.1. Introduction, Definitions of growth, Development and Differentiation.

2.2. Introduction and roles of following phytohormones.

a) Auxins
b) Gibberellins
c) Cytokinins
d) Ethylene
e) Abscisic Acid.

2.3. Factors affecting growth.

Chapter 3. Physiology of Flowering: 10

3.1 Photoperiodism: Discovery, Classification of Plants:- Short Day, Long Day and Day Neutral Plants. Photoperiodic Induction, Inductive cycles, role of phytochrome in photoperiodism

3.2 Vernalization: Discovery, Perception of temperature, Mechanism of Vernalization, hormonal replacement of Vernalization

Chapter 4. Fat Metabolism : 08

4.1. Introduction
4.2. Synthesis of fatty acids
4.3 α and β-oxidation
4.4. Relevance of fat metabolism in germination.

Chapter 5. Nitrogen Metabolism: 10

5.1 Introduction

5.2 Ammonification, nitrification, nitrate assimilations and Denitrification

5.3 Types of Nitrogen fixation:

a) Physical nitrogen fixation
b) Biological Nitrogen Fixation: i) Symbiotic and ii) Non-symbiotic Nitrogen fixation

5.4 Nif, nod and Hub genes
5.5 Mechanism of symbiotic nitrogen fixation
5.6 Effect of environmental factors on Nitrogen fixation: a) Temperature, b) water stress, c) Water logging, d) Salinity
5.7 Importance of nitrogen fixation in agriculture

Chapter-6. Photorespiration: 07

6.1 Introduction
6.2 Metabolism of Photorespiration
6.3 The photorespiratory cycle.
6.4 Significance of Photorespiration
6.5 Differences between dark respiration and photorespiration

REFFERENCE BOOKS

1. Daniel, M. (1991) Methods in Plant Chemistry and Economic Botany. Kaiyani Publishers, Ludhiana, India.
2. Daniel, M. and S.D. Sabnis (1990) A Phytochemical Approach to Economic Botany. Kaiyani Publishers, Ludhiana, India
3. Devlin, R.M. and Witham, F.H. (1986), Plant Physiology (Fourth edition), CBS Publishers and Distributers, Delhi, 110032.
4. Grewal, R.C. (2010) Plant physiology, Campus Book International, New Delhi, India.
5. Haiborne, T.C. (1981) Phytochemical Methods : A Guide To Modem Techniques of Plant Analysis. Chapman and Hall, London, U.K.
6. Hopkins, W.G (1985) Introduction to Plant Physiology; John Wiley and Sons. Incl. New York, U.S.A.
7. Jain, V.K. (1997) Fundamentals of Plant Physiology. Atrnaram & Sons, New Delhi India
8. Lincoln, Taiz and EduardonZeiger (2010) Plant Physiology Sinauer Associates,Inc.
9. Mukherjee, S and A.K. Ghose (1996). Plant Physiology, Vikas Publishing House, New Delhi, India.
10. Mukharji, S. and Ghosh, A.K. (2012), Plant Physiology, New Central Book Agency (P) Ltd. Kolkata, 700009.
11. Pandey, S.K and B.L.Sinba (.994) Plant Physiology, Vikas Publishing House, New Delhi, India.
12. Sarabhai, B.P. (1995), Elements of Plant Physiology, Amol Publications, New Delhi, India.
13. Verma, V. (1984) Introduction to Plant Physiology. Emkey Publications, New Delhi, India.

----------XXXX----------

BOT:-355 :PAPER-V.
PLANT ECOLOGY AND PHYTOGEOGRAPHY [60 Periods]
Semester-I

AIM AND BJECTIVES:

1: To know scope and importance of the discipline.
2: To study the ecological techniques.
3: To know about plant communities.
4: To know about conservation of natural resources, Energy and Pollution.
5: To study botanical regions of India.
6: To study vegetation types of Maharashtra.

PLANT ECOLOGY (50 Periods)

Chapter 1Introduction: **02**

Definition, scope and importance of ecology, Branches of ecology

Chapter 2Phytosociology: **05**

2.1 Introduction,definition
2.2 Qualitative characters-
Physiognomy,Phenology,Periodicity,AspectionandStratification.
2.3 Sampling techniques of population:
i)Quadrat method-:a) List b) List count c) Chart.
ii) Point method.
2.4 Quantitative characters-:
a) Frequency b)Density c) Abundance.
2.5 Raunkiaer`s law of frequency and Frequency diagram.

Chapter 3 Community dynamics: **06**

3.1 Succession: Definition, Causes,and , types.
3.2 Evolution of plant communities.
3.3 Process ofSuccession:Xerosere, Hydrosere. Climax concept:
Monoclimax,Polyclimax,
3.4 EcologicalNiche.

Chapter 4Ecological adaptations: **05**

Adaptation to water-:Hydrophytes, Xerophytes, Mesophytes and Amphibiousplants withRespect to peculiar characters with examples.

Chapter 5Ecosystems: **06**

5.1 Concept and kind (Natural and Manmade).
5.2 Components of natural ecosystem.
5.3 Natural-Pond ecosystemand Manmade-crop land ecosystem.
5.4 Food Chain, Food webs, andHomeostasis.
5.5 Ecological pyramids and Energy relations.
5.6 Effect of man on naturalEcosystem.

Chapter 6Natural Resources and their conservation. **05**

6.1 Introduction
6.2 Types of natural resources
6.3 Concept and necessity of conservation.
6.4 Biodiversity. In-situ and Ex-situ conservation.

Chapter 7-Energy Conservation. **07**

7.1 Sources of energy :Conventional and Non-conventional energy
7.2 Conventional sources of energy:
- a) coal
- b) oil
- c) natural gas
- d) thermal power
- e) firewood
- f) hydropower
- g) Nuclear power

7.3 Non-conventional sources of energy :
- a) solar energy
- b) wind energy
- c) Tidal energy
- d) Biomass based energy

7.4 Prospective alternatives for energy:
- a) Petro plants,
- b) Biogas.

Chapter 8Pollution **05**

8.1 Concept and definition
8.2 Kinds and causes of pollution
8.3 Study of air, water, soil pollutionWith reference to causes, hazards andremedial measures.
8.4 Green house gasses andGreen house effect.

Chapter 9Biogeochemical cycles. **04**

9.1 Elements and their distribution
9.2 The cycling process
9.3 Biogeochemicalcycles:Characteristic features of biogeochemical cycles.
9.4 Types:
a) Gaseous nutrient cycles-Carbon,Oxygen and Nitrogen cycle.
b) Sedimentarynutrient cycle.

Chapter10 Bioremediation: **05**

10.1 Introduction needand scope of bioremediation
10.2 Phytoremediation:-
- a) Recovery of heavy metals from soil.
- b) Reclamation of industrial waste andmunicipal waste water.

PHYTOGEOGRAPHY(10 Periods)

Chapter11 Phytogeography: **04**

11.1 Main Botanical Regions of India.

11.2 Detailedstudyof vegetation types in Maharashtra.

Chapter12EcologicalIndicators: **03**

12.1 Introduction

12.2 Plant as indicators:-soil pH, ground water, minerals, metals and pollution

Chapter13 Endemism. **02**

Causes and Types,

Chapter 14Biogeography. **01**

Dispersal: Barriers andmeans of dispersal.

RE**EFFERENCE BOOKS**

1. Agrawal, K.C.(1996) Environmental Biology,Agro-Botanical Publisher, Bikaner India
2. Ambasta, R.S.(1988) A Text of Plant Ecology, Student Friends & Co. Varanasi, India.
3. Ambasta,R.S.(1990) Environmental and Pollution, Student Friends & co. Varanasi,India.
4. Chapman, J.L. and Reiss, M.J.(1998) Ecology : Principles and Applications. CambridgeUniversity Press, Cambridge.
5. Dash, M.C.(1993) Fundamentals of Ecology, Tata McGraw Hill Publishing Co. Ltd. New Delhi, India.
6. Heywood, V.H. and Watson, R.T.(1995) Global Biodiversity Assessment, CambridgeUniversity Press, Cambridge.
7. Hill, M. K. (1997) Understanding Environmental Pollution, Cambridge University Press,Cambridge.
8. Kapur, P. And Govil, S.R.(2000) Experimental Plant Ecology.S.K.Jain for CBS Publishers and Distributors, New Delhi India.
9. Kothari, A.(1997) Understanding Biodiversity: Life Sustainability and Equity. Orient Longman.
10. Krebs, C.J.(1989) Ecological Methodology. Harper and Row, New York, USA.
11. Kumar, H.D.(1996) Modern Concept Of Ecology (4^{th} Ed.) Vikas Publishing House (P.) Ltd. New Delhi.
12. Kumar, H.D. (1997) General Ecology, VikasPublishing House (P.) Ltd. New Delhi,
13. Kochhar, P.L..- Plant Ecology, Genetics and Evolution, S. Nagin & Co. Ltd. New Delhi,
14. Moore,P.W. and Chapman,S.B. (1986) Method in Plant Ecology. Blackwell ScientificPublications.
15. Mukherjee B. Environmental Biology, Tata McGraw HillPublishing Co. Ltd. New Delhi, India.

16. Odum,E,P.(1983) Basic Ecology, Saunders, Philadelphia.

17. Odum, E. P. (1986) Fundamental of Ecology, Natraj Publishers, Dehra –Dun, India.

18. Purohit, S.S. and R. Ranjan. Ecology and Environmental Pollution, Agro-Bios Publishers,Jodhpur, India.

19. Sharma, P.D..- Ecology And Environment, Rastogi publication, Meerut, India.

20. Subrahmanyam, N. S. And Sambamurty, A.V.S.S. (2000), Ecology Narosa Publishing House, New Delhi, India.

21. Swaminathan, M. S. And Kocchar, S. L.(Eds.)(1989) Plant and Society. MacmillanPublications Ltd. London, U.K.

22. Verma, P. S. and V.K. Agrawal,- Principles of ecology. S. Chand & co. (Pvt.) Ltd. Ram Nagar, New Delhi. India.

----------XXXX----------

BOT.- 356.1 PAPER-VI [OPTIONAL PEPR-I]
PLANT BIOTECHNOLOGY [60 periods]
Semester-I

AIMS AND OBJECTIVE :

1. To introduce the students with current status and future of biotechnology in India.
2. To acquaint with advance knowledge of different instruments related to biotechnology.
3. To acquaint with the importance of interdisciplinary approaches of Biotechnology.
4. To recognize the impact of biotechnology on socioeconomic aspects of life.
5. To develop the knowledge of industrial application of biotechnology.
6. To develop the skills among the students for employment or entrepreneurship.

Chapter 1. Introduction **02**

1.1. Definition, Scope and importance.
1.2. Biotechnology in India.

Chapter 2.Equipments: Structure, Principle, Working and Uses of the following: **06**

2.1 Autoclave
2.2 Laminar Air FlowCabinet
2.3 pH Meter
2.4 Centrifuge
2.5 Spectrophotometer
2.6 Hot air oven.

Chapter 3. Plant Tissue Culture: **06**

3.1 Significance and scope of plant tissue culture.
3.2 Differentiation andtotipotency in plants.
3.3 Nutritional Media-tissue nutrition. Conventional and liquid media.
3.4 Preparatory steps for tissue culture-selection of explants and sterilization.
3.5 *In situ* transfer of tissue and maintenance of plants.

Chapter 4. Types of Culture-Tools and Techniques: **06**

4.1 Tissue culture of specialized plant materials (Anthers, Pollens, Protoplast, and somatic hybridization, Embryo and Endosperm culture).
4.2. Indirect organogenesis- Callus culture, types and morphological nature of callus.
4.3. Micro propagation
4.4. Advantage, limitations and application of micro propagation.
4.5. Germplasm conservation and cryopreservation
4.6**.** Production of synthetic and artificial seeds.

Chapter 5 . Commercial production o banana/ sugarcane by micro propagation/tissueculture **08**

5. 1 Selection of mother plant
5.2 Initiation

5.3 Multiplication
5.4 Elongation and rooting
5.5 Primary and secondary hardening
5.6 Marketing

Chapter 6. Fermentation Technology: 08

6.1. Principles of microbial growth.- Batch culture, continuous culture,synchronous culture
6.2. Microbes involved, substrates, Fermentation process, optimum conditions,product recovery, flow sheet and uses of the following:
a) Citric Acid
b) Vinegar
c) Antibiotics- Penicillin
d) Vitamins (B-complex)

Chapter 7. Biomass and Bioenergy: 08

7.1 Biomass as a source of energy
7.2 Composition of Biomass
7.3 Biomass conversion into energy
a. Non-biological methods- Pyrolysis, Gassification,Liquification.
b. Biological methods- Aerobic and anaerobic digestion.
7.4 Biogas production
7.5 Biofuels
7.6 Petrocrops

Chapter 8. Single cell Protein (SCP): 06

8.1 Microorganisms used in SCP
8.2 Production of SCP, *Spirulina* and Yeast
8.3 Nutritional value of SCP
8.4 Advantages of SCP

Chapter 9. Genetic Engineering: 10

9.1 History and development of genetic engineering- milestone.
9.2 Restriction endonucleases. – Types, naming systems, mode of action.
9.3 Vectors for gene cloning- Types, plasmids, cosmids, Bacteriophages.
9.4 *Agrobacterium tumefeciens* vectors (Octopine and Nopalin Plasmids)
9.5 Gene cloning in prokaryotes- out line, procedure.
9.6 Isolation of gene of interest.
9.7 Insertion of isolated gene into the vector.
9.8 Transformation.
9.9 Selection of transformed cell.

REFFERENCE BOOKS:

1. Aneja, K.R. (1996) Experiments in Microbiology, Plant Pathology, Tissue Cultureand Mushroom Cultivation, Wishwa Prakashan, New Delhi. India

2. Bhojwani S.S. and Razdan M.K. (1983). Plant Tissue Culture, Theory and Practice.Elscrir Science Pub, Amsterdam.

3. Casida, IE. (1991) Industrial microbiology, Wiley Eastern Ltd. New Delhi. India.

4. Dubey, R.C. (1995) A Text Book of Biotechnology, S. Chand and Co. Ltd NewDelhi, India.

5. Evans D.A. and et.al. (1983) Handbook of Plant Cell Culture. Vol. 1-3. McMillan,New Delhi, India.

6. Gupta, P.K. (1999) Elements of Biotechnology, Rastogi Pub!. Meerut, India,

7. Jogdand, S.N. (1993) Advances in Biotechnology. Himalaya Publ. House. New Delhi,India.

8. Kumar, U. (2000) Methods in Plant Tissue Culture, Agrobios, Jodhpur. India.

9. Purohit, S.S. (2003). Agricultural Biotechnology, Agrobias, Jodhpur, India. Smith, I.E. (19%). Biotechnology, Cambridge University Press. Cambridge.

10. Plant Biotechnology – The Genetic manipulation of Plants by Adrain Slater, NigelScott and Mark Flower, Oxford University Press.

11. Ciddi Veerasham, Medicinal Plant Biotechnology, CBS Publishers.

12. MascarenhasA.F.,Handbook of Plant Tissue Culture, ICAR New Delhi.

13. Plant Cell and Tissue Culture by S. Narayanaswamy. Tata McGraw Hill Publishing Company Pvt. Ltd. New Delhi.

14. KumarU.,Methods in Plant Tissue Culture, Agrobios.

15. Trigiano andGray,Plant Tissue Culture – Concepts and Laboratory Exercises, CRC Press. USA.

16. RazdanM.K., An Introduction to Plant Tissue Culture. 2nd Edition, Oxford &IBH Publishing Co.Pvt. Ltd.

17. Gamborg O.L.and G.C.Philips, Plant Cell, tissue and Organ Culture. Fundamental Methods Narosa Publishing House, New Delhi.

18. Timir Baran Jha and Biswajit Ghosh, Plant Tissue Culture – basic and Applied Universities Press Pvt. Ltd. Hyderabad.

19. ChawlaH.S.,Introduction to Plant Biotechnology. 2nd edition. Oxford & IBH publishing Co. Pvt. Ltd. New Delhi.

20. SatayanarayanaU.,Biotechnology Books & Allied Products (P) Ltd., Kolkata-700010

----------XXXX----------

BOT. 356.2: PAPER VI [OPTIONAL PAPER-II]

GARDENING[60 periods]

Semester-I

AIMS and OBJECTIVES:

1. To know the concept of garden.
2. To study the different characters of garden.
3. To know about regular activities in gardening.
4. To study the different ornamental garden plants.
5. To study about the techniques of Pot culture, Bonsai, Topiary, Lawn, Rockery.

GARDENING

Chapter 1. Introduction: **05**

- 1.1 Definition of garden and gardening
- 1.2 Importance of garden
  - a) Aesthetic
  - b) Academic
  - c) Economic
- 1.3 Types of Garden:
  - a) Formal garden
  - b) Informal garden
  - c) Botanical garden
  - d) Special types of garden :
    - i) Vertical Garden
    - ii) Bog or Marsh Garden
    - iii) Roof garden

Chapter 2. Planning of Gardens: **07**

- 2.1. Consideration of following in planning:
  Originality in planning, variety and surprise, color scheme, fragrance,privacy, comfort and flexibility.
- 2.2. Study of physical, structural and biological features of the gardens such as
  - a) Fences
  - b) Hedges and borders
  - c) Paths and avenues
  - d) Arches and Pergolas
  - e) Water garden
  - f) Rockery
  - g) Lawns
  - h) Green house

Chapter 3. Soil Management: **07**

- 3.1 Soil: Nature and types
- 3.2 Manures:

a) Bulky organic manures-Compost and composting, Vermi-compost,Green manures, Farm Yard Manure (FYM)
b) Concentrated organic manures-Liquid manures

3.3 Fertilizers (N, P, K)
3.4 Agrochemicals: Insecticides, Pesticides and Fungicides
3.5 Irrigation techniques

Chapter 4. Garden Tools and Implements: **03**

4.1 Implements: Sickle, Trowel, Rake, Hoe, Secateurs, Prunning sheers,Grafting and budding knife.
4.2 Uses and maintenance of following:
a) Budding and grafting knife
b) Mower
c) Sprayer

Chapter 5. Indoor Gardening: **03**

5.1 House plants for indoor gardening and characters of indoor plants.
5.2 Selection of house plant and popular indoor plants.
5.3 Maintenance of indoor plants.
5.4 Hanging baskets

Chapter 6. Pot Culture: **03**

6.1 Containers
6.2 Selection of plants
6.3 Potting and repotting
6.4 Maintenance and importance

Chapter 7. Bonsai Technique: **04**

Principle, Containers Selection of plants, Techniques, Styles, Maintenance and importance

Chapter 8. Study of Ornamental Plants: **09**

8.1 With reference to botanical name, cultivation practices, ornamental value andchoice of place with at least 2 examples each of:
a) Annuals
b) Shrubs
c) Climbers
d) Special group of ornamental plants
i) Palms ii) Cycads
iii) Ferns iv) Ornamental grasses and Bamboos.

Chapter 9. Topiary: **03**

9.1 Introduction
9.2 Selection of plants
9.3 Methods / Training
9.4 Importance

Chapter 10. Lawns: **04**

10.1 Preparation of soil
10.2 Selection of grasses

10.3 Planting methods
10.4 Maintenance and after care
10.5 Importance.

Chapter 11. Garden Operations: **05**

11.1 Preparation and importance of seed beds and seed pans
11.2 Collection and sowing of seeds
11.3 Seedling transplantation
11.4 Transplantation of large tree
11.5 Preparation of pits
11.6 Pruning and Mulching

Chapter 12. General account of pests and diseases in garden plants with respect to Pathogen , host, symptoms, damage and control**.** **02**

Chapter 13. Floriculture Industries (Dry flowers): **05**

13.1 Introduction
13.2 Indian market of Dry flowers
13.3 Selection of Materials
13.4 Techniques of drying
i) Air drying (in shade)
ii) Sun drying
iii) Press drying
iv) Oven drying
v) Micro-wave oven drying
13.5 Dried plant products in Indian market
13.6 Storage and care.

REFERENCE BOOKS:

1) Day, S.C. (2003) A Art of Miniature Plant Culture. Agrobias. Jodhpur, India.

2) Alex Laurie and Ries V.C. (2003) Floriculture : Fundamentals and Practices.

3) Bose, T.K. and Mukherjee, D. (1997) (Ed.) Percy Lancaster's Gardening in India.Oxford and IBH Publ. (P.) Ltd,, New Delhi, India.

4) I.Perey Lancaster (1997) Gardening in India. Oxford and I B H Publishing Co.Pvt.Ltd,New Delhi.

5) Dej, S.C. (2003) Complete Home Gardening. Agrobias, Jodhpur, India.

6) Dhopte, A.M. (2003) Principles and Techniques for Plant Scientists. Agrobios,Jodhpur, India.

7) Khan, M.R. (1995) Horticulture and Gardening, Nirali Prakashan, Punc. India.

8) John Brookes Weidfeld and Nicolson, Garden paradise(1987)- The History and design of the great Islamic gardens, London.

9) Pramila Mehra. Gardening for every one- Hind pocket book private limited, NewDehli.

10) Ethene Reuss Clarke Collins Aura (1988) Garden Hand book, Wlliam Collins Sons & Co. ltd.

11) Anne Swinton Collins Aura (1988) Garden Hand books- Bonsai, Wlliam Collins Sons & Co.ltd 1988.

12) Philip Swindells Collins Aura (1988) Garden Hand books- Water gardening, Wlliam CollinsSons & Co. ltd.

13) Hessayon, D. G. Century London (1987) Century Hutchinson Ltd.

14) R. N. Parkar. (1986) Fourty common Indian trees-Avishkar Publishers Distributors,Jaipur.

15) Gupta, R. K. ( )Multipurpose trees for Agroforestry & wasteland utilization, Oxford & IB H Publishing Co.Pvt.Ltd, New Delhi.

----------xxxx-------

BOT. 356.3: PAPER-VI (OPTIONAL PAPER-III)

SEED TECHNOLOGY(60Periods:)

Semester- I

AIMS and OBJECTIVES:

1) To know scope and importance of the discipline.
2) To study various techniques in seed production.
3) To study various factors related to seed production.
4) To study seed protection aspects.
5) To study commercial aspects of seed production.

Chapter 1. Seed: **04**

1.1. Definition
1.2. Development of seed
1.3. Functions of parts of seed

Chapter 2. Seed Technology: **04**

2.1. Definition
2.2. Role and goals of seed technology in crop production

Chapter 3. Seed Dormancy: **04**

3.1. Causes of seed dormancy.
3.2. Methods of breaking the seed dormancy

Chapter 4. Principles of Quality Seed Production: **04**

4.1. Stage of Seed Multiplication
4.2. Seed purity, Genetic purity.

Chapter 5. Methods of certified seed production: **04**

5.1. Isolation
5.2. Seed inspection
5.3. Rouging

Chapter 6. Types of cultivars (variety): **04**

Composite, synthetic, Hybrid, Role of producer,
Seed production agencies.

Chapter 7. Harvesting-: Drying, Processing, seed sampling: **02**

Chapter 8. Seed testing: **04**

8.1 Physical purity.
8.2 Genetic purity
8.3 Seed viability and vigour test

Chapter 9. Seed Law and Seed Certification: **03**

Seed certification agency - Structure, role and duties.

Chapter 10. Seed Deterioration: **02**
Causes and remedial measures.

Chapter 11. Seed storage, pest and diseases of seed, seed aging: **01**

Chapter 12.Marketing agencies, planning and economics of seed production: **02**

Chapter 13. Seed processing and packing: **04**

SEED PATHOLOGY

Chapter 14.Seed pathology: **03**
- 14.1 Introduction
- 14.2 Significance of seed borne diseases.

Chapter 15. Types of micro-organism associated with seeds and diseases caused by them: **04**

Chapter 16. Location of seed borne inoculum and seed infection: **04**
- 16.1 Factors affecting the seed infection
- 16.2 Longevity of seed borne diseases.

Chapter 17. Control of seed borne pathogens: **03**

Chapter 18. Quarantine and post-entry quarantine: **04**

REFERENCE BOOKS:

1. Agrawal R. L. (1980) Seed Technology, Oxford and IBH Publication Co. New Delhi, India.
2. Copeland,L. O,. M. B. Mc Donald.(2001) Kluwer Academic Publishers, 2nd Printing (2004). Now part of springer science and business media.
3. Agrawal, V.K. and Sinclair, J.B. (1987) Principles of Seed Pathology, Vol. I and III CBS Pub.New Delhi, India.
4. Agrawal, P.K. and Dadlani M (1987) Techniques in Seed Science and Technology, South Asian Publishers, New Delhi, India.
5. Agrawal V.K. and Nene Y.L. (1985) Seed Bora Diseases of Field Crops and their control.Indian Council of Agricultural Research, New Delhi, India.
6. Suryanarayan,D. (1978) Seed Pathology, Vikas Publishing House Pvt. Ltd. Bombay, India.
7. Mukadam, D.S. and Gangawane, L.V. (1982) Methods In Experimental Plant Pathology. Botany Dept. Marathwada University, Aurangabad, India.
8. Neergard (1977) Seed Pathology Vol.1 MacMillan Press Ltd. London, U.K.
9. Nema, N.P. (1986) Principles of Seed Certification and Testing. Allied Publishers,New Delhi, India.

BOT. 356.4: PAPER-VI (OPTIONAL PAPER-IV)
ETHNOBOTANY [60 Periods]
Semester-I

AIMS AND OBJECTIVES:

1. To know scope and importance of Ethnobotany;And its relation to economic botany
2. To expose various disciplines of ethnobotany and its development in Indian concept.
3. To study sources of ethnobotany.
4. To aware the students about ethnology of certain tribes in Maharashtra.
5. To study Indian ethno medicines used against human and veterinary diseases.
6. To study role of ethnobotany emphasizing conservation, abstract concrete relationship in Indian concept.

Chapter 1. Ethnobotany: An Organized Science: 04

- 1.1. Introduction, definition and scope
- 1.2. Man and Plant relationship: Concrete and Abstract
- 1.3. Comparison of Ethnobotany and Economic Botany
- 1.4. Landmarks of Indian Ethnobotany
- 1.5. Sub-disciplines of Ethnobotany

Chapter 2. Methods in Ethnobotanical Studies: 04

- 2.1. Ethnobotanical field work
- 2.2. Herbaria as an aid to ethnobotanical study
- 2.3. Ethnobotanical study with the help of literature
- 2.4. Archeological remains

Chapter 3. Ethnology of Tribes in North Maharashtra: 04

1. Pawara
2. Bhil
3. Kokani
4. Thakur
5. Katkari

Chapter 4. Study of Ethnobotany of plants from Indian region used against: 20

Human Diseases: w.r.t. Botanical Name of plants, family, parts used, mode of preparation and administration of medicine, for followings.

a) Cough, Cold, Bronchial problems
b) Headache, Toothache,
c) Arthritis and Rheumatism.
d) Fever
e) Stomach problems: Indigestion, Worms, Diarrhoea, and Dysentery
f) Eye complaints: Improving eye sight and curing diseases.
g) Healing wound: Cuts, Bruises, Sprains, Fracture.
h) Skin diseases: Boils, Burns, Sores, Piles,
i) Urinary diseases
j) Diabetes

k) Antifertility agents
l) Contraceptives
m) Antivenom

Chapter 5. Veterinary Diseases: **04**

5.1. Diarrhoea and Dysentery
5.2. Foot and Mouth disease
5.3. Maggot's infected sores
5.4. Yoke galls
5.5. Bone fracture

Chapter 6. Monographic Studies: **04**

Monographic studies based on Individual plant and tribe:

a) *Madhuca longifolia* (Mahua)
b) Ethnobotany of Mikirs of India.

Chapter 7. Ethnobotany of North Maharashtra: **05**

w.r.t. Botanical Soures and administration

7.1. Ethnobotany of food plants and beverages
7.2. Plants used as Toothbrush
7.3. Fish stupefying.
7.4. Ethnology of vernacular names.
7.5. Fodder resources

Chapter8. Abstract Relationship: w.r.t. plant/parts used, family, people/tribe concerned with themes and quotations of the following: **05**

A. a. Folksongs
b. Folk proverbs
c. Plants motifs
B. a. Sacred plants
b. Sacred groves with special reference to Maharashtra
c. Plants used to in festivals

Chapter 9. Plants and parts used for following purposes **05**

9.1. House construction:
a) Doors and Windows
b) Walls
c) Roofs
d) Thatching
e) Furniture
9.2. Basketry
9.3. Toys
9.4. Musical instruments
9.5. Agricultural implements
9.6. Fencing
9.7. Fibers

Chapter 10. Beyond inventorying: **05**

10.1. Indigenous Biotechnology:
a) Ranu tablet
b) Leather technology in relation to reptile skin technology

10.2. Jaggery extraction
10.3. Biodiversity acts, Bioprospecting and Ethnobotany
10.4. Kitchen gardens

REFERENCE BOOKS :

1. Jain, S.K. (Ed.) (1981) Glimpses of Indian Ethnobotany. Oxford & IBH, New Delhi,India.
2. Jain, S.K. (Ed) (1995) A Manual of Ethnobotany (IInd Ed.) Scientific Publishers, Jodhpur, India.
3. Jain, S.K. and V.Mudgal (1999). A Hand Book of Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehradun, India
4. Jain. S.K, (1991) Contributions to Indian Ethnobotany, Scientific Publishers, Jodhpur, India:
5. Jain, S.K. (1989) Methods and Approaches In Ethnobotany. Society of Ethnobotanists, Lucknow, India.
6. Jain S.K. (1996) Ethnobiology In Human Welfare. Deep Publication, New Delhi,India.
7. Jain, S.K., B.K.Sinha and R.C. Gupta (1991) Notable Plants in Ethnomedicine in India, Deep Publication, New Delhi, India.
8. Joshi P. (1995) Ethnobotany of Primitive Tribes hi Rajasthan Printwell, Jaipur, India.
9. Martin, G.J. (1995) Ethnobotany: A Methods Manual, Chapman and Hall, London,U.K.
10. Saklani, A. and S.K. Jain (1994) Cross Cultural Ethnobotany of Not East India, New Delhi.
11. Singh, V.and R. P.Pandey (1998) Ethnobotany of Rajasthan, Scientific Publishers, Jodhpur..
12. Martin G. J. (1995) Ethnobotany : A Methods Manual , Chapman & Hall, London,U.K.
13. Sinha, Rajiv, K and S.Sinha (2001) Ethnobiology, Sura Publications, Jaipur, India.
14. Maheshwari, J.K. (1996). Ethnobotany In South Asia. Scientific Publishers, Jodhpur,
15. Patil D.A. (2008) Useful plants, Navyug Publishers and Distributors, New Delhi, India.
16. Patil D.A. (2008) Herbal cures traditional approach, Avishkar Publishers, Distributors, Jaipur, India,
17. Sambamurthy, A.V.S.S. and Subramanyam, N.S. (1989). A Text of Economic Botany, Wikes Eastern Ltd., New Delhi, India
18. Swaminathan, MS. and Kocchar, S.L. (Eds.) (1989) Plants Society, MacMillan Publications, Ltd. London, U.K.
19. M. V. Patil and D. A. Patil, Ethnological Studies of Nasik District, Daya Publication house New Delhi
20. S. B. Pawar and D.A. Patil, Ethnological Studies of Jalgoan District, Daya Publication house New Delhi

-------XXXX------

BOT. 361: PAPER-I

DIVERSITY OF HIGHER CRYPTOGAMS (60 Periods)

Semester-II

AIMS AND OBJECTIVES:

1. To study salient features of cryptogamic plants.
2. To make students aware of the status of cryptogams as a group in plant kingdom.
3. To study the life cycles of selected genera.
4. To study economic importance of cryptogamic plants.

BRYOPHYTES (30 Periods)

Chapter 1.Introduction: **06**

1.1. General characters of Bryophyta
1.2. Classification of Bryophyta up to classes giving reasons with at least two examples of each class as per G. M. Smith (1955).
1.3. Alternation of generation in Bryophytes.
1.4. Contribution of Indian Bryologists.
   a) Prof. Shiv Ram Kashyap
   b) Prof. B. P. Pandey

Chapter 2. Life History of *Marchantia* with respect to: **06**

2.1. Systematic position, habit and habitat
2.2. External and internal morphology of gametophytes.
2.3. Reproduction-Vegetative and sexual.
2.4. Structure of sex organs.
2.5. Fertilization,
2.6. Structure and development of sporophyte,
2.7. Dehiscence of capsule and dispersal of spores,
2.8. Structure and germination of spores

Chapter 3. Life History of *Anthoceros* with respect to: **06**

3.1. Systematic position, habit and habitat
3.2. External and internal morphology of gametophytes.
3.3. Reproduction-Vegetative and sexual.
3.4. Position and Structure of sex organs.
3.5. Fertilization,
3.6. Structure and development of sporophyte,
3.7. Dehiscence of capsule and dispersal of spores,
3.8. Structure and germination of spores
3.9. Evolutionary features of sporangium is to be emphasized.

Chapter 4. Life History of *Polytrichum* with respect to: **06**

4.1. Systematic position, habit and habitat
4.2. External and internal morphology of gametophytes.
4.3. Reproduction-Vegetative and sexual
4.4. Position and structure of sex organs.

4.5. Fertilization,
4.6. Structure of sporophyte,
4.7. Dehiscence of capsule and dispersal of spores,
4.8. Structure and germination of spores

Chapter 5.Economic importance of Bryophytes: **02**

Chapter 6. General topics **04**

6.1. Evolution of Bryophytic Gametophytes according to Regressive and Progressivetheories.
6.2 Evolution of Bryophytic sporophytes according to the Theory of sterilization and Theory of reduction.

PTERIDOPHYTES (30 Periods)

Chapter 7. Introduction: **06**

7.1. General characters of Pteridophytes.
7.2. Classification of Pteridophytes upto classes giving reasons with at least two examples of each class according to Prof G. M. Smith.
7.3. Contribution of Indian Pteridologists.
  a) S. S. Bir / Sporne K. R.
  b) N. S. Parihar

Chapter 8. Life History of *Psilotum* with respect to: **06**

8.1. Systematic position,
8.2. Habit and habitat
8.3. External morphology of sporophyte
8 4. Internal morphology of sporophyte
8.5. Reproduction, vegetative and asexual
8.6. Morphological nature of synangium.
8.7. Dehiscence of synangia
8.8. Structure and germination of spores,
8.9. Structure of mature gametophyte (Prothallus),
8.10. Structure of mature male and female sex organ.
8.11. Fertilization.
8.12. Development and structure of embryo.
8.13. Alternation of generation.

Chapter 9. Life History of *Lycopodium* with respect to: **06**

9.1. Systematic position,
9.2. Habit and habitat
9.3. External morphology of sporophyte.
9.4. Internal morphology of sporophyte.
9.5. Reproduction. –Vegetative and Asexual
9.6. Position and structure and dehiscence of sporangium.
9.7. Structure and germination of spores.
9.8. Structure of gametophyte
9.9. Structure of mature sex organs.
9.10. Fertilization.

9.11. Development and structure of embryo.
9.12. Protocorm and its morphological nature
9.13. Alternation of generation.

Chapter 10. Life History of *Marsilea* with respect to: 06

10.1. Systematic position,
10.2. Habit and habitat
10.3. External andinternal morphology of sporophyte,
10.4. Reproduction,
10.5. External and internal morphology of sporocarp,
10.6. Morphological nature and dehiscence of the sporocarp.
10.7. Structure of microspore and megaspore.
10.8. Structure of male and female gametophytes
10.9. Fertilization
10.10. Development and structure of embryo,
10.11. Alternation of generation,

Chapter 11.Economic importance of Pteridophytes: 02

Chapter 12. General topics: 04

12.1. Stellar Evolution in pteridophytes
  a) Concept,
  b) Types – (i) Protostele, (ii) Siphonostele, (iii) Solenostele
  c) Evolution of steles.
12.2. Heterospory and seed habit in pteridophyta.

REFFERENCE BOOKS:

BRYOPHYTES and PTERIDOPHYTES

1. Ganguli, H.G. and A.K.Kar (2001) College Botany Vol. 11 Books and Allied Press, Ltd.Kolkata, India
2. Pandey, B.P. (1995) A Text Book of Botany Bryophyta, S Chand and Co, Ltd. NewDelhi, India
3. Parihar, N.S. (1972) An Introduction to Embryophyta, Vol.1 Bryophyta. Central BookDepot, Hydrabad, India
4. Puri, P. (1985) Bryophyta A Broad Perspective, Atma Ram and Sons, New Delhi, India.House.Pvt Ltd. New Delhi.
5. Saxena A.K. and R.M.Sarabhai (1992).Text Book of Botany-Vol. II Embryophyta.RatanPrakashanManair, Agra, India.
6. Sporne, K R. (1965) The Morphology of Pteridophytes The Hutchinson Univ. Lib.,London, U.K
7. SundaraRajan, S (1995) Introduction to Pteridophyta, Wiley Eastern Limited, NewDelhi, India
8. Vashishta, P.C. (1994) Botany -Pteridophyta. S. Chand and Co.Ltd. New Delhi,India.

----------XXX----------

BOT. 362 Paper II
Gymnosperms and Paleobotany [60 periods]
Semester-II

AIMS AND OBJECTIVES:

1. To study Gymnosperms with respect to distinguishing characters, comparison with Angiosperms, and classification.
2. To study the life cycles of *Pinus* and *Gnetum*.
3. To study the scope of Paleobotany, types of fossils and geological time scale.
4. To study the various fossil genera representing different fossil groups

GYMNOSPERMS (35 Periods)

Chapter 1. Introduction: **07**

1.1. Distinguishing features of the group.
1.2. Comparison of Gymnosperms with Angiosperms.
1.3. Economic importance of Gymnosperms.
1.4 Classification of Gymnosperms by K. R. Sporne up to orders giving reasons**.**

Chapter 2. Life cycle of *Pinus* with respect to: **14**

2.1. Distribution in India.
2.2. Systematic position.
2.3. External morphology.
2.4. Internal morphology
  a) Primary structure of root, stem and leaf.
  b) Secondary structure of stem.
2.5. Reproductive structures (development of male and female gametophyte is not expected)
  a) Male cone
  b) Male gametophyte
  c) Female cone
  d) Female gametophyte
2.6. Pollination
2.7. Fertilization.
2.8. Structure of embryo and polyembryony
2.9. Seed: structure and germination
2.10. Alternation of generation

Chapter 3. Life cycle of *Gnetum* with respect to: **14**

3.1. Distribution in India.
3.2. Systematic position.
3.3. External morphology.
3.4. Internal morphology
  a) Primary structure of root, stem and leaf.
  b) Anomalous Secondary growth in *Gnetum ula*.
3.5. Reproductive structure (development of male and female gametophyte is not expected)

a) Male cone
b) Male gametophyte
c) Female cone
d) Female gametophyte

3.6. Pollination
3.7. Fertilization.
3.8. Structure of embryo and polyembryony
3.9. Seed structure and germination
3.10. Alternation of generation.
3.11. Resemblance with Angiosperms.

PALEOBOTANY (25 Periods)

Chapter 4. Introduction **03**

4.1 Definition and scope of Paleobotany
4.2 Contribution of Birbal Sahani in Paleobotany.

Chapter 5. Fossils: **10**

5.1 Definition
5.2 Fossilization process
5.3 Condition favorable for fossilization.
5.4. Geological time scale.
Eras, Periods, Epochs, general and nomenclature of fossils.
Major plant fossils located in India.
5.5. Types of fossils: Impression, Compression, Petrifaction,
Cast, Coal ball, Amber

Chapter 6. Study of the following fossil groups w.r.t morphology and structure:12

6.1. Psilopsida- *Rhynia*
6.2. Lycopsida: i) *Lepidodendron* ii) *Lepidostrobus*
6.3. Sphenopsida: i) *Calamites* ii) *Annularia*
6.4. Pteridopsperm: *Lyginopteris oldhamia* (stem)
6.5. Bennettitales: *Cycadeoidea* (flower)
6.6. Angiosperm- Petrified wood (dicot), *Rhizopalmoxylan*

REFFERENCE BOOKS:

GYMNOSPERMS:

1. Datta, S. C. (1966) Introduction to Gymnosperms, Asia Pub. House, New Delhi. India
2. Datta, S. C. (1998) Systematic Botany. 4th edition, New Age International Pvt. Ltd. New Delhi. India
3. Gangulee, H. C. and A. K. Kar (1998) College botany vol. II, New central book agency (p) Ltd. Kolkata. India
4. Chopra, G. L. (1962) Introduction to Gymnosperms Asia Pub. House, New Delhi. India
5. Vashishta, P. C. (1983) Botany for degree students: Gymnosperms, S. Chand & Co. New Delhi. India

6. Sporne, K. R. (1967) Morphology of Gymnosperms, Hutchinson university library London, U. K.

7. Padey, B. P. (1982) College botany vol. II, S. Chand & Co. New Delhi. India

PALEOBOTANY:

1. Delevoryas, T. (1962) Morphology and Evolution of fossil plants, Holt Reihart & Winston, New York.

2. Swarge, K. R. (1966) Indian fossil Pteridophytes, CSIR New Delhi. India.

3. Stewart, Wilson. N. (1983).Paleobotany and evolution of plants, Cambridge University Press.

4. Arnold, Chester, R (1972). An introduction to paleobotany McGraw-Hill Publ. Co.Ltd., New York.

5. Andrews Henry N. (1961) Studies in Paleobotany, John Wlley & Sons, USA.

6. Dick, M. W. and Edwards D. (1983) Contribution to paleobotany, The white friars press ltd. Tonbridge.

7. Shukla,Ashok C. & Shital P. Misra(1975) Essentials of Paleobotany. Vikas Publ. House, New Delhi, India.

8. Chapman, MeyenS. V. and Hall, Fundamentals of Paleobotany Cambridge University Press, Cambridge, London, U.K.

9. Norman, F. Hughes 1976 Paleobotany of Angiosperms origin, Cambridge University Press, Cambridge, London, U.K.

10. Mishra, S R Text Books of Paleobotany Discovery Publication House Pvt. Ltd. 2010

BOT.363 PAPER- III
PLANT BREEDING [60 Periods]

AIMS AND OBJECTIVES:

1. To introduce the student with science of plant breeding
2. To introduce the student with branch of plant breeding for the survival of human being from starvation.
3. To study the techniques of production of new superior crop verities.

Chapter 1.Introduction: **02**

1.1 Definition, Principles, aims, objectives, scope and importance.

Chapter 2. Mode of Reproduction in Relation to Breeding Methods: **03**

2.1 Methods of Reproduction - Vegetative, Asexual and Sexual.
2.2 Mode of Reproduction – Self Pollination, Cross Pollination and Geitonogamy.

Chapter 3. Variation: **04**

3.1 Definition, measurement
3.2 Types and causes of variation.

Chapter 4.Crop improvement Methods. **03**

4.1 Plant introduction and acclimatization
4.2 Selection
4.3 Hybridization
4.4 Mutation breeding

Chapter 5. Introduction: **04**

5.1 Plant Introduction centers of origin of crop plants and Acclimatization purposes.
5.2 Functions of plant introduction agencies.
5.3 Procedure, Purpose, Merits and Demerits of Introduction

Chapter6. Selection: **06**

6.1 Definition, Procedure, Merits and Demerits of the following.
a) Mass Selection
b) Pure line Selection
c) Recurrent Selection
d) Clonal Selection

Chapter 7. Hybridization: **07**

7.1 Definition and Types of Hybridization
7.2 Hybridization Procedure
a) Selection of Parents
b) Selfing of Parents
c) Hybridization Technique
d) Harvesting hybrid seeds and raising F1 generation.
e) Trials, multiplication and distribution

Chapter 8. Male Sterility **3**

8.1 Genetic male sterility
8.2 Cytoplasmic male sterility
8.3 Genetic Cytoplasmic male sterility
8.4 Use of male sterility in hybrid seed production

Chapter 9.Methods of Hybridization : **10**

9.1 Improvement in Self and Cross Pollinated Crops through Hybridization
9.2 Procedure Merits and Demerits of the Following Methods
a) Pedigree method
b) Bulk method
c) Back cross method
d) Single cross
e) Double cross
f) Synthetic cross

Chapter 10. Heterosis: **03**

10.1 Definition and History.
10.2 Effects of Hybrid Vigor.
10.3 Causes of Heterosis.
10.4 Utilization and Limitations.

Chapter 11. Mutation Breeding: **05**

11.1 Definition and Types of Mutation.
11.2 Classification of Mutagens.
11.3 Processes of Mutation, Gama Garden.
11.4 Application of Mutation Breeding.
11.5 Merits and demerits.

Chapter 12.Polyploidy. **03**

12.1 Role of Polyploidy in crop evolution. E.g. Wheat,*Raphano brassica*, Nicotiana.
12.2 Utilization of Allopolyploidy in Plant Breeding.
12.3 Utilization of Autopolyploidy in Plant Breeding.

Chapter 13. Breeding for Disease and Insect Resistance. **04**

13.1 Mechanism of disease development.
13.2 Nature of disease resistance.
13.3 Causes of disease resistance.
13.4 Sources of disease resistance.
13.5 Merits and demerits.

Chapter 14. Improved Seed Production and Certification **03**

14.1 Importance of quality seed in agriculture
14.2 Plant variety testing
14.3 Seed quality control
14.4 Seed certification- purpose and minimum standards

REFERENCE BOOKS:

1. Agrawal, R.L. (1998) Fundamentals of Plant Breeding and Hybrid seed production. Oxford and IBH Publishing Co. New Delhi, India.
2. Allard, R.W. (1960) Principles of plant breeding. John Wiley and Sons, New York.
3. Breeding Crops Plants by Hayes H.K., Shree Publishers.
4. Chaudhary, H.K. (2001) Plant Breeding, Theory and Practice, Oxford IBH (P.) Ltd. New Delhi, India.
5. Gupta, P.K. (1998). Genetics, Plant Breeding and Evolution. Rastogi Publication, Meerut, India.
6. Xijendro Das,L.D (1998) Plant Breeding, New age International Publication.India
7. Phundan, Sings (2006) Essential of Plant Breeding. Kalyani Publishers New Delhi.
8. Poehlman, J.M. and Borthakur D. (1995) Breeding Asian Field Crops. Oxford IBH (P.) Ltd. New Delhi, India.
9. Phundan,Singh (2006) Principles of Plant Breeding Rastogi. Publication – Meerut, India.
10. Sheenivas, Y.S.Seed Technology and Seed Pathology, Shree Publishers.
11. Sharma, J.R. (1994) Principles and Practice of Plant Breeding. Tata McGraw Hill publishing Company Ltd. New Delhi.
12. Singh, B. D. (2006) Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
13. Singh, B.D. (1996) Plant Breeding, Kalyani Publishers.

-------XXXX------

BOT.- 364 PAPER- IV

PLANT BIOCHEMISTRY [Periods 60]

Semester-II

AIMS and OBJECTIVE:
1. To introduce the students with current status of biochemistry.
2. To recognize the impact of Biochemistry on socioeconomic aspects of life.
3. To develop the knowledge of industrial application of Biochemistry

Chapter-1.Biochemistry: **04**

1.1 Definition, Scope and Importance
1.2 Hydrogen ion concentration
1.3 PH and Buffers

Chapter-2 – Biomolecules **12**

2.1 Carbohydrates: Definition classification and biological importance's of carbohydrates.
- a) Mono-, di- and tri- saccharides of biological importance.
- b) Polysaccharides and mucopolysaccharide of biological importance

2.2 Lipids: Definition and classification of lipid [simple. Compound and derived)
- a) Structure, classification and properties of fatty acids
- b) Essential and non-essential fatty acid with physiological importance

2.3 Amino acids, peptides and proteins: Definition. Classification and properties of amino Kids, essential and nonessential amino acids with physiological importance.
- a) Peptides - Definition of peptide bond Structure and function of peptides of biological significance
- b) Proteins - Classification, physico-chemical properties, structure [primary and secondary]

Chapter-3. Plant Secondary Metabolites: **14**

Definition, characteristics (source, structure, general properties,) of:-

a) Tannins	b) Lignin	c) Phenolics
d) Alkaloids	e) Terpenoids	f) Flavonoids
g) Vitamins	h) Phytohormones	

Chapter-4: Enzymes: **06**

4.1 Introduction and Definition
4.2 Nomenclature of enzymes
4.3 Classification of enzymes, properties.
4.4 Enzyme specificity
4.5 Mechanism of enzyme action :-
- a) Lock and Key model
- b) Induced fit model

4.6 Enzyme inhibitors activators
4.7 Isozymes and their significance.

Chapter-5 Biophysicochemical Techniques: 14

5.1 Principle and application of ultra filtration, Vacuum evaporator, distillation assembly and soxhlet apparatus

5.2 Spectrophotometer and colorimeter: Beer's and Lambert's law and its significance.

a) Principle and working of a simple colorimeter.

b) Principle and application of UV-VIS spectrophotometry.

5.3 **Isotopes in Biochemistry:** Measurement of radioactivity: principle and application, Auto radiography, Application of radioisotopes in biochemistry.

5.4 Electrophoresis: Principle, types and applications

5.5 Centrifugation: Principle and theory of RCF. Types and applications of centrifuges.

Chapter-6 .Biosensors: 10

6.1 Concept of biosensors, biochips,biofilms and biosurfactents

6.2 Types of biosensors- conventional and microbial.

6.3 Environmental, medical and industrial applications of biosensors

REFERENCE BOOKS:

1. Conn Erie and Stumpf P.K., (1992) Outline of biochemistry- Wiely Eastern, New Delhi Latest edition.
2. Rastogi, S.C (1993), Biochemistry –., Wiely Eastern ltd, Pune Second Edition.
3. Stryer Lubert Biochemistry –, W.H. freeman and co , New York , fourth edition.
4. Agrawal G.R and Agrawal R.A., Krishna (1998-99)Text book of biochemistry – Prakashan media (p) ltd, Meerat
5. Satyanaragana U., (2004)Biochemistry- book and allied pub. ltd, kolkato, , second edition.
6. Jain J.L., Jain Sanjay., Jain Nitin (2005)Fundamentals of biochemistry –., S. Chand and company ltd, New Delhi, First multi colour edition
7. Nelson,D.L. and M.M.Cox (2005),Lehninger's Principle of Biochemistry, Publisher David N.Nelson, Michael Cox, edition fourth.
8. Agraval, (19989-1999), textbook of Biochemistry, Krishna Pakashan, edition tenth.
9. Satyanarayana, U.and U.Chakrapani (2006), textbook of Biochemistry, third edition
10. Price,N.C. and Stevens (2000) Fundamentals of Enzymology, edition
11. Frifielder, .D, W.(1983) Physical biochemistry- H.Freeman and Co. New York,
12. Holmes and H.Peck Analytical biochemistry-, academic press, New York.
13. Wilson and Goulding Biophysical technique-, ELBS edition, latest edition.
14. Upadhyaya and Upadhyaya and Nath Biophysical chemistry (principle and technique) – Himalaya Pub. Nagpur, latest edition.

-----XXXX------

BOT. 365: PAPER-V

EMBRYOLOGY AND PALYNOLOGY[60 Periods]

AIMS and OBJECTIVES:

1. To know scope and importance of Embryology and palynology.
2. To study structure and development in microsporangium and megasporangium.
3. To study microsporogenesis and megasporogenesis.
4. To study male and female gametophytes.
5. To study fertilization, endosperm ,embryo formation and polyembryony.
6. To study structure of pollen morphology and aerobiology
7. To study interdisciplinary approaches of palynology

EMBRYOLOGY (40 Periods)

Chapter 1. Definition and Scope: **01**

Chapter 2. Microsporangium: **05**

Structure of tetrasporangiate anther, anther wall, tapetum, tapetum types, sporogenous tissue.

Chapter 3. Microsporogenesis and Development of Male Gametophyte: **06**

3.1 Microsporogenesis- Meiosis in spore mother cells, Cytokinesis (Successive and Simultaneous type), Types of pollen tetrad.

3.2 Structure and development of male gametophyte

Chapter 4. Megasporangium (Ovule): **09**

4.1 Structure andTypes of Ovules- Orthotropous, Anatropous, Amphitropous, Campylotropous, Circinotropous.

4.2 Megasporogenesis and Development of Female Gametophyte (Embryo Sac):

a. Megasporogenesis
b. Deveopment of female gametophyte (Embryo sac): Structure of typical (8 nucleated) embryo sac, Types of embryo sac- monosporic *(Polygonum)*, bisporic (*Allium)*and tetrasporic (*Peperomia)*

Chapter-5. Pollination: **02**

5.1 Introduction , Definition

5.2 Pollination through various agencies:

a) Anemophily
b) Entamophily
c) Hydrophily
d) Ornithophily
e) Cheiropterophily

Chapter 6. Fertilization: **05**

6.1 Entry of Pollen tube into the Ovule: Porogamy,Chalazogamyand Mesogamy

6.2 Discharge of pollen tube contents in embryo sac, fusion of gametes-syngamy and triple fusion.
6.3 Significance of double fertilization.

Chapter 7. Polyembryony: 04
7.1 Definition
7.2 Causes of Polyembryony
7.3 Classification of Polyembryony

Chapter 8. Endosperm: 02
8.1 Types- Nuclear, Cellular, Helobial.
8.2 Ruminate endosperm

Chapter 9.Embryo:
9.1 Embryo development in dicot- *Capsella bursa- pastoris* in monocot- *Sagittaria***04**

Chapter 10. Role of Embryology in Taxonomy: 02

PALYNOLOGY (20 Periods)

Chapter 11. Introduction : **02**
Definition, Scope and Importance of Palynology

Chapter 12. PollenMorphology: 05
12.1 Structure of Microspore/ Pollen
12.2 Polarity,Symmetry,Shape and Size of Pollen
12.3 Apertures Types-a-Simple b- Compound
12.4 NPC Classification
12.5 Pollenwall Features- Sporoderm Stratification and Sculpturing

Chapter 13.Pollen Viability and Storage: 04
13.1 Pollen viability,factors affecting viability
a) Pollen Cytology
b) Humidity,Temp.
13.2 Pollen storage- Short and Long term storage
13.3 Significance of storage of Pollen grains

Chapter 14.Aerobiology and Pollen Allergy : 05
14.1. Aeropalynological Survey in India and Abroad
14.2. Determination and quantification of aeroallergens:
a) Sampling methods
b)Gravity sedimentation method
c) Filtration
d) Precipitation

Chapter 15. Interdisciplinary Approaches of Palynology 04
15.1 Mellistopalynology
15.2 Forensic palynology
15.3 Paleopalynology

15.4 Palynotaxonomy
15.5 Aerobiology and Pollen Allergy

REFERENCE BOOKS:
EMBRYOLOGY AND PALYNOLOGY

1. Bhattacharya, Kashinath,Manas Ranjan Majumdar and Swati Gupta Bhattacharya(2006) A Text Book Of Palynology, New Central Book Agency (P) Ltd. Kolkata.
2. Bhojawani, S.S. and S.P. Bhatnagar (2011) The Embryology of Angiosperms,Vikas Publication House (P) Ltd., New Delhi, India
3. Erdman, G.(1969) Handbook of Palynology,Hafner, New York,USA.
4. Maheshwari, P. (1950) An Introduction to the Embryology of Angiosperm, Tata McGraw-Hill Publishing Company Ltd. New Delhi, India
5. Nair, PKK. (1970) Pollen Morphology of Angiosperm, Vikas Publication House (P) Ltd., New Delhi, India
6. Nair, PKK. (1970) Pollen Morphology of Angiosperm: A Historical and Phylogenetic Study, A Scholar Publishing House,Lucknow, India
7. Nair, PKK. (1980) Glimpses in Plant Research-V.Modern Trends in Plant Taxonomy,Vikas Publishers ,New Delhi, India
8. Pandey, B.P (2009) A Text Book of Botany Angiosperms, S.Chand and Company Ltd. New Delhi, India
9. Vasishta,P.C. (1984) Plant Anatomy Pradeep Publications, Jalandhar India
10. Sanjay Kumar Singh-Embryology of Angiosperms (2009) Campus Books International, New Delhi
11. Shivanna, K. R. and Johri B.M. (1985) The Angiosperm Pollen : Structure and Function, Wiley Eastern Ltd., New York, USA
12. Pandey S. N. and A Chadha (2006 Reprint) Plant Anatomy and Embryology, VikasPublishing House Pvt Ltd.New Delhi.

----------xxxx----------

BOT. 366.1: PAPER- VI (OPTIONAL-I)

BOTANICAL TECHNIQUES [60 Periods]

Semester – II

AIMS AND OBJECTIVES

1. To study the scope and importance of Botanical techniques.
2. To know about instruments and their utility in subject Botany.
3. To know about measurement of microorganisms by studying micrometry.
4. To study the different stains and staining.
5. To study the killing, fixing and Microtomy of plant material.
6. To study Chromatography and cultural techniques in Botany.
7. To understand the methods used in whole mount preparation, wood maceration and cytology.

hapter 1. Introduction, Scope and importance of botanical techniques: 02

Chapter 2. Stains and staining: 08

2.1. Theory of Staining

2.2. Type and procedure of staining for following,

(a) Bacterial
(b) Fungal
(c) Cytological
(d) Anatomical

2.3. Temporary and permanent double stained preparation of free hand sections.

Chapter 3. Study of Different Instruments: 10

3.1. Study of Rotary Microtome
3.2. Camera lucida
3.3. Laminar air flow
3.4. Autoclave
3.5. Oven
3.6. Incubator

Chapter 4 Microtomy: 08

(A) Killing and Fixing of Material.

a) Collection of material.
b) Types of Fixative
c) Techniques of fixing

(B) Technique

a)	Washing	b)	Dehydration
c)	Cleaning	d)	Infiltration
e)	Embedding	f)	Sectioning
g)	Mounting of ribbon	h)	Staining

Chapter 5. Micrometry: 06

5.1 Introduction.
5.2 Stage micrometer.
5.3 Ocular micrometer.
5.4 Calibration of microscope- under low power,

High power and Oil emersion.

5.5 Measurements.

Chapter 6. Culture Techniques: 10

6.1 Concept of mixed and pure culture
6.2 Glassware - Types
6.3 Sterilization Methods for glassware and media.
6.4 Nutritional requirements for various organisms
6.5 Common media used for cultivation of Algae, Fungi and Bacteria
  a) Allen and Arnoni medium for algae.
  b) PDA medium for Fungi
  c) Nutrient Agar, MacConkeys Agar medium for Bacteria.
6.6 Source of inoculums for algae, Fungi, Bacteria
6.7 Enrichment and isolation method.
  a) Streak plate method.
  b) Pour plate / dilution method.
  c) Slide culture

Chapter 7. Whole mount, Cytological method and wood maceration: 05

7.1. Permanent whole mount museum specimens.
7.2. Cytological methods:
  a) Smear
  b) Squash
  c) Making of smear and squash permanent
7.3. Wood maceration techniques.

Chapter 8.Chromatography : 05

8.1 Introduction – Definition and principle of chromatography
8.2 Types(Any Two)
  a) Paper chromatography -Unidirectional - Ascending and descending,
  b) Two dimensional.
  c) Thin layer chromatography -Plate and column
8.3 Procedure for preparation of paper chromatogram and thin layer chromatogram
8.4 RF Value

Chapter 9. Spectrophotometry: 02

9.1. Introduction
9.2. Principle and Working of spectrophotometer
9.3. Application of spectrophotometer

Chapter 10. General principles of Biophysical Chemistry Instruments 04

10.1 pH Meter
10.2 Centrifuge

REFFERENCE BOOKS:

BOTANICAL TECHNIQUES:

1. Aneja, K,R. (1996) Experiments in Microbiology, Plant Patholc Tissue Culture and Mushroom Cultivation (IInd Ed,) Wishwa Prakasn New Delhi, India.
2. Dwivedi, J.N. and R.B.Singh (1990). Essentials of Plant Techniques ,ScientificPublishers, Jodhpur, India
3. Modi, H.A. (1996) Elementaiy Microbiology Vol.V. Ekta Prakashan, Ahmadabad.
4. Starrier, R.Y. Ingrahaan, J.L., Whalis, M.L. and P.andPainter (1993) GeneralMicrobiology (5th Ed) The Macmillan Press Ltd, London, U.K.
5. Prasad andPrasad . Outline of microtechniques. Emkay publication Delhi (1975).
6. L. R. Patki, B. L. Bhalchandra, I. H. Jeevaji forwarded by Dr. (Mrs) V. M. Sapkal. An introduction to microtechniques. S. Chand & co. ltd. New Delhi.
7. V. K. Sharma.(1991) – Techniques in microscopy and cell Biology, Tata Mc Graw HillPublishing Co. Ltd. New Delhi.
8. Upadhaya Nath "Biophysical chemistry" Himalaya Publication, Mumbai.
9. Sadasivan, Manicum "Biochemical analysis" New age Publication, New Delhi.
10. De Robertis and De Robertis 2005 (8^{th} Edition), Cell and Molecular Biology.
11. Krishnamurthy K. V. (1988) Methods in Plant Histochemistry.
12. Powar C.B 2005 (3^{rd}Edition) "Cell Biology" , Himalaya Publication, Mumbai.
13. Verma P. S. and Agrawal V.K. 2006, "Cell Biology", Genetics, Molecular Biology, Evolution and Ecology S. Chand and Company New Delhi.

----------XXXX---------

BOT. 366.2 PAPER-VI (OPTIONAL-II)

PHARMACOGNOSY [60Periods]

AIMS AND OBJECTIVES:

1. To know history, scope and importance of Pharmacognosy.
2. To study classification, cultivation, collection and processing of plant drugs.
3. To study morphology, botanical and chemical characterization and analytical methods of crude drugs.
4. To prepare Ayurvedic recipes.
5. To make student aware about biopiracy and legislation about medicinal Plants.

Chapter 1. Introduction of Pharmacognosy: 08

- 1.1 Definition, History and scope
- 1.2 Important systems of medicine
- 1.3 Organized and unorganized crude drug's

Chapter 2. Classification of Plant Drugs: 08

- 2.1 Taxonomical, morphological, chemical, therapeutic and alphabetical
- 2.2 Chemical nature of crude drug:
- 3.3 Concept of therapeutic active chemical constituents.

Chapter 3. Cultivation of Plant Drug: 08

- 3.1 Methods of propagation
  a. Sexual b. Asexual
- 3.2 Factors affecting cultivation
  - a) Temperature and humidity
  - b) Rainfall
  - c) Soil and Soil fertility
  - d) Fertilizers
  - e) Pest and pest control

Chapter 4. Collection and processing of crude drugs: 08

- 4.1 Collection
  - a) Root
  - b) Stem and bark
  - c) Leaf
  - d) Flower
  - e) Fruits and Seeds
  - f) Gums and resins
- 4.2 Processing
  - a) Harvesting
  - b) Drying
  - c) Garbling/Dressing,
  - d) Packing e. Storage

Chapter 5. Analytical Pharmacognosy: 08

5.1 Drug aduleration and types of adulterants
5.2 Methods of drug evaluations in brief
a. Morphological
b. Microscopic
c. Chemical
d. Physical
e. Biological

Chapter 6. Preparation of following Ayurvedic medicines with respect to Botanical source, part used and method of preparation : 06

6.1 Triphala churna
6.2 Sukhsarak Vatti (triphala+sonamukhi+Jire+Ajwon)
6.3 Kumariasav
6.4 Arjunarishtha (Aristha)
6.5 Maka Telam (*Eclipta Alba*)

Chapter 7. Botanical source, distribution, botanical characterization of drug constituents and uses of the following drugs: 10

7.1 Root drug:
a) *Asparagus racemosus* (Shatavari)
b) *Withania somnifera* (Ashwagandha)
7.2 Rhizome:
a) *Zingiber officinale* (Adrak)
b) *Curcuma domestica* (Halad)
7.3 Stem bark drug:
a) *Holarrhena pubescens* (Dudh kuda)
b) *Teminalia arjuna* (Arjun sadada)
7.4 Stem drug:
a) *Tinospora cordifolia* (Gulvel)
b) *Acacia Catechu* (Black Catechu)
7.5 Leaf drug:
a) *Adathoda zeylanica* (Adulsa)
b) *Lawsonia inermis* (Hena)
7.6 Fruit drug:
a) *Terminalia bellerica* (Behada)
b) *Terminalia chebula* (Hirda)
7.7 Entire plant:
a) *Ocimum sanctum* (Tulasi)
b) *Mentha spicata* (Pudina)

Chapter 8.Drug Ethics: 04

8.1 Biopiracy of medicinal plants from India
8.2 Drug legislation and patenting

REFERENCE BOOK:

1. Jeffery, B. and Harborn. Photochemical Methods: A guide to Modern Techniques of Plant analysis. Springer, 1998.
2. Khandelwal, K.R. Practical Pharmacognocy, Pragati Books Pvt. Ltd.

3. Kokate, C.K. Purohit A.P. and GokhaleS.B. Pharmacognocy (degree), Nirali Prakashan.
4. Iyengar, M.A. Study of Crude drugs, Manipal Power Press, Manipal.
5. Iyengar, M.A. Pharmacognocy Lab. Manipal Power Press, Manipal.
6. Rangari, V.D. A Textbook of Pharmacognocy and Photochemistry. Vol-I and II
7. Daniel, M. Chemotaxonomy –
8. Wallis, T.E. Textbook of Pharmacognocy. J.A, Churchill Ltd. London

--------XXXX---------

BOT. 366.3: PAPER- VI: [Optional paper-III]

PLANT PATHOLOGY [60 Periods]

AIMS AND OBJECTIVES:

1. To know scope and importance of plant pathology.
2. To know the terminologies in plant pathology
3. To study the causes of plant diseases.
4. To study the control measures of plant diseases

Chapter 1. Introduction: **04**

1.1. Scope and importance, historical account of plant pathology.

1.2. Work of the following pathologists:

a) Theophrastus b) Prevost
c) De-Bary d) Butler
e) Mundkur, f) K.C.Mehta

Chapter 2. Terminology: - Define following: **03**

Disease, Pathogen, Host, Parasite, Pathogenecity, Immune, Inoculum, Innoculum Potential, Penetration, Infection, Systemic infection, Pathogenecity, Pathogenesis, Etiology, Incubation period , Disease cycle, Symptoms, Epidemology.

Chapter 3.Causes of Plant diseases: Introduction: **05**

3.1. Animate causes - A brief survey of diseases caused by the following organisms with examples of each- Bacteria, Viruses, Fungi, Nematodes and Mycoplasma.

3.2. Inanimate causes - A brief survey of diseases caused by:

a) Adverse climatic conditions such as high and low temperature
b) Unfavorable intensity of light
c) Excess water.
d) Deficiency and excess of minerals.
e) Chemical injuries caused by atmospheric pollutants,
f) Faulty applications of fungicides insecticides, and weedicides

Chapter 4. Inoculum dispersal: Introduction and definition: **04**

4.1. Active or Autonomous dispersal-Soil, Seeds, Plants.

4.2. Passive dispersal-

a) Wind b) Water
c) Insects d) Fungi
e) Nematodes f) birds
g) mammals h) man

Chapter 5. Development of Diseases (Pathogenesis): **04**

Introduction, inoculum potential

a). Landing of inoculum on the host,

b). Penetration: modes of penetration of viruses, bacteria, fungi and nematodes.

c) Mechanism of penetration.

I) Indirect penetration:

i) Through wounds

ii) Through natural openings – stomata, hydathodes and lenticels

II) Direct penetration-

i) Break down of structural barriers

ii) Break down of chemical barriers.

Chapter 6. General Principles of Disease Control: 13

6.1. Preventive therapy:

a) Avoidance of the pathogen
b) Exclusion of inoculum
c) Eradication
d) Protection
e) Disease resistance

6.2. Curative therapy

6.3. Mechanical control-

a) Choice of geographic area
b) Selection of field
c) Proper time of sowing
d) use of disease escaping variety
e) Selection of seed planting stock
f) high budding.

6.4. Control through cultural practices:

a) Crop rotation
b) Mixed cropping
c) Removal and destruction of diseased plants and plant organs.
d) Rouging
e) Destruction of alternate and collateral host.

6.5. Field sanitation :

a) Destruction of crop residue
b) Deep ploughing
c) Improved soil drainage system
d) Flooding and fallowing
e) Depth of sowing of seeds
f) Heat and uses of chemicals

Chapter 7. Legal control: 02

7.1 Introduction
7.2 Plant Quarantine - Definition, limitations and importance
7.3 Plant Quarantine Organization in India.

Chapter 8. Biological Control: 02

8.1 Introduction, definition, biocidaland biostatic control
8.2 Methods:

a) Organic amendment of soil with organic matter

b) Predaceous fungi method.

8.3 Mechanism: a) Exploitation b) Antibiosis c) Competition

Chapter 9. Chemical Control: **10**

9.1. Introduction, importanceand different types

9.2. Classification of chemicals according to their:

a) Mode of action: eradicants, protectants, chemotherapeutants.

b) Nature of pathogen against which used.

9.3. Chemicals used in plant diseases control, mode of action and uses :

a) Sulphur:

i. Inorganic-Sulphur powder, Wettablesulphurand Lime sulphur.

ii. Organic- Dithiocarbamates

b) Copper : Bordeaux mixture. Burgundy mixture, Copper oxychloride

c) Mercury :

i. Inorganic-Mercuric choride-($HgCl_2$), Mercurous Chloride(Hg_2Cl_2)

ii. Organic - Ceresan, Agrosan, Aresan

d) Heterocyclic nitrogen compounds: i. Captan. ii. Glyodin

e) Antibiotics: Introduction, definition, mode of action.
i. Streptomycin, ii. Tetracycline iii. Griseofulvin

Chapter 10. Control Through Disease Resistance : **03**

10.1 Use of resistant varieties, difference between disease escape, disease tolerance and disease resistance.

10.2. Development of resistant varieties:

a) Selection b) Hybridization c) Mutation

Chapter 11. Study of following diseases with respect to causal organism, symptoms and control measures; **10**

Animate Diseases:

a) Viral diseases: TMV/PXV

b) Bacterial diseases: Citrus canker

c) Fungal diseases:

i. Damping of seedling

ii. Powdery mildew of Teak/ Sisoo /Grapes

iii. Downy mildew of bajara (Green year disease of bajara)

iv. Ergot of bajara

v. Loose smut of wheat

vi. Tikka disease of groundnut

vii. Red rot of sugarcane

d) Mycoplasma diseases: Little leaf of brinjal

e) Nematodal diseases: Root knot of vegetables.

REFERENCE BOOKS:

1. Agrios, G.N. (2006) Plant Pathology Academic Press, London, U.K.

2. Agrios, G.N. (1997) Plant Pathology Academic Press, London, U.K.

3. Bilgrami, H.S. and Dube, H.C. (1976), Modern Plant. Pathology, Vikas Publishing House, Pvt. Ltd, New Delhi.

4. Buttler, E.J. (1973). Fungi aud Plant Diseases in Plants, Thacker Spink & Co.Calcutta, India.

5. Kamat, M.N. (1969). Introductory Plant Pathology.Prakash Printing Press. Poona. India.

6. Mehrotia. R.K. (1994).Plant Pathology. International Pub. House New Delhi, India.

7. Mehrotia. K. S. (1980). Plant Pathology. Tata Mc Graw Hill Publishing Co. Ltd. New Delhi, India.

8. Nene, Y.L. (1991) Fungicides In Plant Diseases Control, Oxford and IBH Pub. Com.New Delhi, India.

9. Pathak, V.N. (1972). Essentials of Plant Pathology, Prakash Pub.House, Jaipur, India.

10. Pathak, V.N., Khatri N.K. Pathak Maiush (1996), Fundamentals of Plant Pathology'. Agro Botanical Pub. Bikaner, India.

11. Rangaswami, G. (1973), Diseases of Crop Plants In India. Prentice Hall of India, Pvt.Ltd., New Delhi, India.

12. Roberti's, Boothroyd (1972). Fundamental of Plant Pathology.Toppan Co. | Ltd. Tokyo, Japan.

13. Singh, R.S. (1996) Plant Pathology, Oxford and IBH Pub.Co. New Delhi, India.

-------XXXX--------

BOT. 366.4 Paper VI :[Optional Paper-IV]

HORTICULTURE[60 Periods]

AIMS AND OBJECTIVES:

1. To know horticulture, its scope, importance and its disciplines.
2. To know the horticultural zones of India and Maharashtra
3. To understand different horticultural practices and their methods.
4. To study importance, principles and types of Bahar treatment.
5. To study role played by green and poly-houses in horticulture.
6. To study production technology, harvesting and marketing of crops grown especially in Khandesh region of Maharashtra.
7. To understand methods of preservation and preparation of preserved products prevailing especially in this part of the state.

Chapter 1. Introduction: **05**

- 1.1 Historical background
- 1.2 Definition, scope and importance
- 1.3 Horticultural zones of India and Maharashtra
- 1.4 Export and import potential of horticultural crops.
- 1.5 Different disciplines of horticulture
  - a) Pomology,
  - b) Olericulture
  - c) floricutlre
  - d) ornamental horticulture
  - e) Landscap horticulture

Chapter 2. Propagation of Horticultural Plants: **03**

- 2.1 Sexual propagation: Advantages and disadvantages
- 2.2 Asexual propagation:
  - i) Methods in brief
  - ii) Advantages and disadvantages

Chapter 3. Cutting: **03**

- 3.1 Definition
- 3.2 Methods of cutting:
  - i) Stem cutting: Softwood cutting, Hardwood cutting
  - ii) Leaf cutting
  - iii) Root cutting

Chapter 4. Layering: **03**

- 4.1 Definition
- 4.2 Methods of layering:
  - i) Simple layering
  - ii) Compound layering
  - iii) Serpentine layering
  - iv) Air-layering or Gootee

Chapter 5. Grafting: **03**

- 5.1 Definition
- 5.2 Methods of grafting:
  - i) Whip grafting
  - ii) Wedge grafting

iii) Tongue grafting

Chapter 6. Budding: **03**

6.1 Definition

6.2 Methods of budding

i) 'T' Shape budding

ii) Patch budding

Chapter 7. Training and Pruning of Plants: **05**

7.1 Definition

7.2 Difference between training and pruning

7.3 Objectives of training and pruning

7.4 Advantages of training and pruning

Chapter 8. Bahar Treatment: **03**

8.1 Definition, importance and principles

8.2 Types of Bahar (Methods not expected)

i) Ambe Bahar

ii) Mrig Bahar

iii) Hasth Bahar

Chapter 9. Production technology of some important horticultural Crops w.r.t: **09**

Commercial varieties, climate, soil, cultivation practices, pest and disease management, nutrition and water requirement, harvesting, processing, extraction of active ingredients, marketing:

a) Grapes

b) Tomato

Chapter 10. Preservation of Fruits and Vegetables: **15**

10.1 Introduction, importance and scope of fruits and vegetables preservation

10.2 Methods of preservation

a) Temporary preservation

i) Asepsis

ii) Exclusion of moisture i.e. Drying of vegetables e.g. Potato, Cabbage, Onions, Bitter Gourd, Green pea, Spinach

iii) Use of mild antiseptic

iv) Pasteurization

v) Low temperature

b) Permanent preservation

i) Sterilization and processing: use of sugar, salts, vinegar or preservation by food additives i.e. chemical preservatives: citric acid, potassium metabisulphite, sodium benzoate, sulphur dioxide

ii) Drying, Dehydration and concentration of fruits and vegetables

iii) Ionizing radiations

10.3 Preparation of preserved products

a) Mix fruit jam

b) Wood apple or guava jelly

c) Lemon/ Orange squash

d) Tomato ketchup

e) Ready to serve (RTS)

f) Fruit syrup (sharbat)

g) Candy

Chapter 11:- Polyhouse and green hose technology with reference to Ornamental Horticulture **08**

11.1. Scope and Importance

11.2. Types of structure

a) Greenhouse
b) Conservatory
c) Polyhouse
d) Glass house
e) Plastic tunnel.

11.3. Constraction of Various structure – materials, requirements and cost.

REFERENCE BOOKS:

1. Azad, K.C.and Sarma, V.K. (2000) Horticulture Technology (Vol I andII). DEEP & DEEP Publications, New Delhi, India.
2. Bal, J.S. (1997) Fruit Growing. Kalyani Publication, New Delhi, Ludhiyana, India.
3. Bose, T. (1996) Fruits Tropical and Subtropical. Naya Prakashan, Calcutta, India.
4. Edmond, J.B., Senn,T.L., Anderew, F.S. and Halfacr, R.G. (1990) Fundamentals of Horticulture. Tata McGraw-Hill Publishing Company Ltd. New Delhi, India.
5. Girdharlal, Siddhappa G.S. and Tandon, G.L. (1998) Preservation of Fruits and Vegetables. ICAR New Delhi, India.
6. Hartmann, H.T. and Kester (1989) Plant Propagation Principle and practice. Prentice Hall of India (P) Ltd. New Delhi, India.
7. Khan, M.R.(1995) Horticulture and Gardening. Nirali Prakashan, Pune, India.
8. Sen, S. (1992) Economic Botany. New Central Book Agency, Calcutta, India.
9. Sharma, N.K. and Arora, S.K. (1985) New Routes To increase Brinjal Production Fmr. Parlim 20 (6) 11-12.
10. Sharma, V.K. (2004) Advances in Horticulture. DEEP &DEEP Publications, New Delhi, India.
11. Sharma, V.K.(1999) Encyclopedia of Practical Horticulture
12. Singh, V.B.(1990) Fruits of NE Region. Wiley Eastern Limited, New Delhi.
13. Sonane, H.N., Deore B.P. and Patil, S.K.(1984) Vaishali (RHR 51) A High-yielding Variety of Brinjal for Maharashtra. J. of Maharashtra Agriculture Uni. 9(3): 341-342.
14. Vishnu Swarup (1997) Ornamental Horticulture. Macmillan Ltd.New Delhi, India.

-------xx--------

PRACTICAL PAPER-I [BOT. 301]

Based on BOT.-351, BOT.-353 BOT.361 and BOT.-363

LOWER CRYPTOGAMS

1. Study of life cycle of *Chara.*
2. Study of life cycle of *Ectocarpus.*
3. Study of life cycle of *Batrachospermum*.
4.&5 Study of range of thallus structure in algae with the help of materials or permanent slides:
   a) Unicellular thallus-*Chlamydomonas*, *Chlorella*.
   b) Colonial thallus –*Pandorina, Eudorina, Volvox. Hydrodictyon*
   c) Filamentous thallus - *Pithophora, Chaetophora, Coleochaetae, Stigeoclonium*, *Drapanaldia, Fritscheilla and Oedogonium.*
   d) Siphonaceous thallus -*Vaucheria. Caulerpa*
   e) Pseudoparenchymatous (Uniaxial/Multiaxial) thallus – *Batrachospermum, Polysiphonia*.
   f) Parenchymatous thallus -*Ulva, Enteromorpha*
6. Study of life cycle of *Albugo*
7. Study of life cycle of *Penicillium* sp.
   a) Mycelial structure
   b) Conidial phase
   c) Cleistothecium (P.S.)
8. Study of life cycle of *Puccinia graminis-tritici*: All stages.
9. Study of Myxomycetes-: *Stemonitis*
   Deuteromycetes – *Cercospora/ Alternaria* andLichens :any one form

[GENETICS AND MOLECULAR BIOLOGY]

10 A] Mitosis :squash technique. [any suitable material- root tips]
   B] Meiosis: Smear technique [Flower buds]
   C] Polytene chromosome [P.S.]
11 Isolation of DNA from suitable plant material
12 Solving of problems on monohybrid and dihybrid cross.

[HIGHER CRYPTOGAMS]

13. Study of life cycle of *Marchantia.*
14. Study of life cycle of *Anthoceros*.
15 . Study of life cycle of *Polytrichum*.
16 . Study of life cycle of *Psilotum* (P.S. and Specimens)
17 . Study of life cycle of *Lycopodium*.
18&19 Study of life cycle of *Marsilea*.
20. Study of types of Steles in Pteridophytes-P.S.

[**PLANT BREEDING]**

21. Floral biology in Self Pollinated and Cross Pollinated Species.
(i) Factors promoting self pollination(By demonstration Flower/Photograph)
   - Bisexuality (Hermaphroditism)---------- (Wheat, Rice)
   - Cleistogamy----------(Wheat, Rice)
   - Homogamy----------(Tomato, Lady's finger)

(ii) Factors promoting Cross pollination (By demonstration Flower/Photograph)

- Dichogamy (i) Protandary----------(Maize)
  (ii) protogyny---------- (Pearl millet)
- Unisexuality (i) Monoecious----------(Maize, Pumpkins)
  (ii) Dioecious---------- (Hemp, Asparagus)
- Self incompatibility ----------(Radish, Cabbage)

22 Techniques of Hybridization in Self Pollinated and Cross Pollinated Crops.

23 Estimation of heterosis (i) Standard heterosis
(ii) Mid- Parent heterosis
(iii) Useful or Economic heterosis

24 Pollen viability test by (i) Aceto-Carmine method
(ii) Sugar solution method

Note: Study tour is compulsory. Students are expected to submit detailedscientific tour report. (Algae, Fungi, Bryophyta and Pteridophyta).

--------XXXX-------

PRACTICALPAPER –II [BOT-302]

Based on BOT.-352, BOT.- 354, BOT.- 362, BOT.-364

[ANGIOSPERM TAXONOMY]

1-5 Study of any ten plant families representing **different groups** of angiospermsw.r.t systematic position, morphological characters, floral formula and floral diagram (*sensu* Bentham and Hooker)

6 Identification of genera and species by using any plant flora

7 Prepare an artificial key (indented or bracketed) based on vegetative and floral characters

[ADVANCE PLANT PHYSIOLOGY]

8 Qualitative assessment of microelements in plant ash (P, K, Mg, Mn, Ca, Na,)

9&10 Separation of amino acids from germinating seeds by ascending paper chromatography.

11 Study of lipase activity in germinating seeds.

12 Effect of hormone on germinating seeds.

[GYMNOSPERMS]

13&14 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 (stained preparation)
iv) Morphology of male cone – L. S. Permanent slide
v) Morphology of female cone – L. S. Permanent slide
vi) study of pollen grains.
vii) V. S. of mature ovule(Permanent slide)

15&16 Study of *Gnetum* with the help of Permanent slide/ specimen.

i) External morphology
ii) T. S. of stem
iii) T. S. of leaf
iv) Secondary growth in the stem of *Gnetum ula*
v) Morphology of male cone – L. S.
vi) Morphology of female cone – L. S.
vii) V. S. of mature ovule

[PALEOBOTANY]

17 Study of different types of fossils (Any three as per syllabus)

18&19 Study of the following with the help of slides and/ or specimens.

i) *Rhynia* ii) *Lepidodendron*
iii) *Lepidostrobus* iv) *Calamites*
v) *Annularia* vi) *Lyginopteris*
vii) *Cycadeoidea* viii) *Rhizopalmoxylon*

[BIOCHEMISTRY]

20 Biochemical tests for:
a) Carbohydrate b) Proteins c) lipids

21 Bichemical tests for
a) Tanins b) Alkaloids c) Phenols

22 To study the enzyme activity [amylase]

23 To study the principle and working and uses of
a) spectrophotometer / calorimeter b) centrifuge.

24 Isolation of lipids from oil seeds by using soxhlet apparatus.

----------XXXX----------

PRACTICAL PAPER-III [BOT.-303]

Based on BOT.- 355, BOT.- 356.1/BOT.- 356.2/BOT.- 356.3 / BOT.- 356.4 BOT.- 365, BOT.- 366.1/BOT.- 366.2/BOT.- 366.3 / BOT.- 366.4

PLANT ECOLOGY AND PHYTOGEOGRAPHY

1. To determine the minimum size of the quadrate by 'species area curve method'.
2. To study the vegetation by list count quadrate method. Calculate the frequency classes and plot a graph.
3. Study of soil with reference to soil texture, water holding capacity, pH, and test for carbonate, nitrate, and sulphate.
4. Demonstration, working and uses of any three of the following ecological instruments:
   - i) Rain gauze
   - ii) Cup anemometer
   - iii) Hair hygrometer
   - iv) Soil thermometer
   - v) Minimum and maximum thermometer
   - vi) Dry and wet bulb thermometer

5&6. Measurement of water .quality based on hardness. Dissolved oxygen, free CO_2, Chloride, total alkanity.

BOT. 316.1 :(PLANT BIOTECHNOLOGY)

7. Principle, Working and uses of following equipments:
   - a) Autoclave
   - b) Laminar air flow
   - c) pH meter
8. Principle, Working and uses of following equipments:
   - a) Centrifuge
   - b) Spectrophotometer
   - c) Hot air oven
9. Preparation of M.S. medium
10. Embryo Culture of Maize
11. Citric acid Fermentation and Bioassay
12. Observation ,studyand importance of following.
    - i) Spirulina
    - ii) Rhizobium
    - iii) Azatobacter
    - iv) Jatropha

BOT. 316.2: (GARDENING)

7. Techniques of pot culture.
8. Observation, listing and uses of various garden tools, manures and fertilizers.
9. Preparation and aftercare of a Bonsai.
10. Study of different indoor plants and preparation of hanging basket.
11. Study of different ornamental plants such as annuals, shrubs, climbers, Palms, cycads, ferns, ornamental grasses and Bamboos(two examples of each) with respect to Botanical name, ornamental value and place of choice.
12. Visit to suitable garden to study various salient features such as layout, components, list of plants and special features (if any).

Note: Students should submit the following at the time of examination.

a) Report of visit to garden.
b) Well maintained specimens from the following.
   i) Hanging basket
   ii) Bonsai
   iii) Potted-indoor plan

BOT. 326.3 : SEED TECHNOLOGY andSEED PATHOLOGY

7. Physical purity test
8. Germination test (Maize and Ground nut)
9. Seed moisture test.
10. Seed viability test. (Tetrazolium test andferric chloride for legume seeds)
11. Detection of seed microflora.
12. Seed processing, grading, packing.

NOTE: Students should submit at least photographs of five diseased specimens along with the report of field trip at the time of practical examination.

BOT.356.4 : (ETHNOBOTANY)

7to12 Study of the following plants with reference to their vernacular names, botanical names, family, plant parts used, uses, mode of preparation and administration from local area with the help of plants or their parts or specimens.

A) Food Plants:
   i. Tubers.
      a) *Dioscorea bulbifera* (Kadu Kand)
      b) *Pueraria tuberosa* (Bhui kohala)
   ii. Leaves .
      a) *Chenopodium murale* (Chil)
      b) *Amaranthus spinosa* (Kateri Matla)
      c) *Amaranthus viridis* (Matla)
      d) *Rivea hypocrateriformis* (Phangola)
   iii. Fruits :
      a) *Diospyros melanoxylon* (Tembrun)
      b) *Morinda pubescens* (Al, Ali)
      c) *Meyna laxiflora* (Aliv)
   iv Seeds:
      a) *Indigofera glandulosa* (Zhunja)
      b) *Sterculia urens* (Kadai)
      c) *Holoptelea integrifolia* (Papada)

B) Beverages. Flowers:
   Madhuca longifoia (Mahu)

C) Oil yielding : Seeds :
   Madhuca longifoia (Mahu, Tolambi)

D) Fiber yielding :Stem :
   Helicteris isora (Murud Sheng)

E) Bidi Wraper : Leaves:
   a) *Diospyros melanoxylon* (Tendu)
   b) *Bauhinia malabaricum (*Kustya)

F) Tooth Brush Stem:
   a) *Pongamia pinnata* (Karanj)

b) *Cassia auriculata* (Avali)
c) *Acacia nilotica* (Babul)
d) *Azadirachta indica* (Neem)

G) Gum yielding:
a) *Anogeiossus latifolia* (Dhawada)
b) *Sterculia urens* (Kadai)

H) Fish Poison: Stem Bark:
a) *Holoptelea integrifolia* (Papada)
b) *Lannea coromandelica* (Modhal)

I) Cloth washing: Fruits :
a) *Balanites aegyptiaca* (Hingenbet)

J) Ethnomedicine
i. Anti-dysentery
a) Fruit - *Helicteris isora* (Murud Sheng)
b) Fruit - *Cassia fistula* (Bahava)
c) Stem Bark - *Holarrhena pubescens* (Kuda)
ii. Skin diseases
a) Seed oil - *Psoralea corylifolia* (Bavachi)
b) Fruit - *Pongamia pinnata* (Karanj)
c) Stem Bark -*Azadirachta indica* (Neem)
iii. Bronchitis and Asthma:
a) Leaves - *Achyranthus aspera* (Aghada)
b) Fruit - *Solanum virginianum* (Bhuiringni)
c) Fruit - *Terminalia bellerica* (Behada)
iv. Rheumatism
a) Leaves – *Vitex negundo* (Nirgudi)
b) Leaves - *Cassia auriculata*(Awali)
c) Stem Bark -*Azadirachta indica* (Neem)
v. Tonic in Anaemic condition :
a)Stem - *Tinospora cordifolia* (Gulvel)
b)Root tuber - *Chlorophytum borivilianum* (Safed Musali)
c) Root tuber - *Asparagus racemosus* (Shatavari)
vi. Miscellaneous: Household utensils:
a) Fruit - *Lagenaria siceraria* (Dhudhi)

K) Musical Instruments:
a) Stem - *Bambusa arundinacea* (Bamboo) or *Bambusa vulgaris* (Kath-Bamboo)

EMBRYOLOGY AND PALYNOLOGY

13. Study of Microsporangium (P.S.)
14. Study of different types of ovules (P.S.)
15. Study of different types of pollen grains with help of Chitaley technique (Any suitable materials)
16. Study of germination of pollen grains (Any two suitable materials)
17. Mounting of embryo stages (Any locally available material)

BOT. 366.1: BOTANICAL TECHNIQUES:

18. Study of botatnical instruments (Any four) as per theory.
19to21 Microtomy of any suitable material.
22 Maceration of vascular tissues.
23-24 Calibration of microscope and measurement of spore.

BOT. 326.2 :PHARMACOGNOSY:

5&6 Microscopic and Macroscopic characters for recognizing Botanical source, External Morphology, Epidermal features like trichomes, stomata types, stomatal number, and stomatal index of following.

a. Adulsa (Adathoda zeylanica)
b. Datura (Datura metel)
c. Gulvel (Tinospoa cordifolia)

7 and 8. Preliminary photochemical screening for the powder drug of following (any three)

a. Root – Shatavari (*Asparagus racemosus*)
b. Rhizome- Adruk (*Zizngiber officinalis*)
c. Fruit- Beheda (*Terminalia belerica*)
d. Leaf – Adulsa (*Adathoda zeylenica*)
e. Bark – Dudhkuda (*Holarrhelaena pubscens*)

8 and10 Preparation of following drug (any two)

a. Triphala Churna
b. Sukhsarakwati
c. Kumari asav
d. Arjunarisht
e. Maka telum

BOT. 326.3 : (PLANT PROTECTION)

25-29 Study of the following plant diseases with reference to the causal organism,symptoms, nature of damage and control measures

1. Tobacco mosaic virus
2. Yellow vein mosaic of papaya
3. Citrus canker.
4. Powdery mildew.
5. Whip smut of sugarcane
6. Tikka disease of groundnut
7. Red rot of sugarcane
8. Root knot of vegetables.

30. Preparation of Bordeaux mixture/Burgundy's mixture and application on diseasedplant and observation of its effects.

BOT.326.4 :HORTICULTURE

18. Study of Garden Tools and Equipments
19. Study of Propagation- i) Media ii) Containers iii) Potting Iv) Reportting
20. Study of Propagation merthods by
    a. Cutting
    b. Layering
21. Study Propagation methods by
    a. Budding
    b. Grafting
22. to 24 Preparation and Preserved food products
    a. Mix fruit jam
    b. Wood apple or Guava jelly
    c. Lemon / Orrgange Squash
    d. Tomato Ketchup
    e. Reedy to serve – R.T. S./ Juices.

----------XXXX---------

Note: Students of T. Y. B. Sc. Class after completion of their graduation degree in Botany may get jobs in following industries and departments/ sectors

1. Seed production companies
2. Research laboratories related with biological sciences
3. NEERI, NCL, NIO, DRDO
4. Oil seed companies
5. Sugarcane, Cotton and textile industries
6. Forensic laboratories
7. NBPGR [National bureau of plant genetic recourses]
8. BSI [Botanical survey of India]
9. Museum and Herbarium Curator
10. Paleobotanical institutes
11. R & D Department of various NGO's
12. Department of Forest and Environments
13. Biofertilizer companies
14. Gardening and Horticulture agencies
15. SelfEmployment: Garden landscaping, bonsai flowers arrangement nursery development, event management.
16. Food and food preservation industries.
17. Plant tissue culture industries
18. Herbal cosmetic industries
19. Mushroom industries
20. Perfumeries
21. Fermentation industries
22. Social forestry
23. West land developments department
24. Pharmaceutical and Antibiotic industries
25. Production of bioenergy and Petrocrops development.

EQUIVALANCEOF PAPERS

SEMESTER-I

Paper	*Code*	*New*	*Paper*	*Code*	*Old*
I	BOT.351	Diversity of Lower Cryptogams	I	BOT.351	Cryptogams-I
II	BOT.352	Taxonomy of Angiosperms	II	BOT.352	Angiosperms Taxonomy
III	BOT.353	Genetics and Molecular Biology	III	BOT.353	Genetics and Plant Breeding
IV	BOT.354	Advanced Plant Physiology	IV	BOT.354	Molecular Biology
V	BOT.355	Plant Ecology and Phytogeography	V	BOT.355	Plant Ecology and Phytogeography
VI.	Optional [Anyone]		VI.	Optional [only one] Respective No. of Paper	
VI (a)	BOT.356.1	PlantBiotechnology	VI (a)	BOT.356.1	Gardening
VI.(b)	BOT.356.2	Gardening	VI.(b)	BOT.356.2	Botanical Techniques
VI(c)	BOT.356.3	Seed Technology	VI(c)	BOT.356.3	Plant Biotechnology
VI(d)	BOT.356.4	Ethnobotany			

SEMESTER-II

Paper	*Code*	*New*	*Paper*	*Code*	*Old*
I	BOT.361	Diversity of Higher Cryptogames	I	BOT.361	Cryptogams-II
II	BOT.362	Gymnosperms and Paleobotany	II	BOT.362	Gymnosperms and Paleobotany
III	BOT.363	Plant Breeding	III	BOT.363	Plant Physiology
IV	BOT.364	Plant Biochemistry	V	BOT.365	Plant Protection
V	BOT.365	Embryology and Palynology	IV	BOT.364	Plant Anatomy Embryology and Palynology
VI.	Optional [Anyone]		VI.	Optional [only one] Respective No. of Paper	
VI (a)	BOT.366.1	Botanical Techniques	VI (a)	BOT.366.1	Ethnobotany
VI.(b)	BOT.366.2	Pharmacognosy	VI.(b)	BOT.366.2	Pharmacognosy and Medicobotany
VI(c)	BOT.366.3	Plant pathology	VI(c)	BOT.366.3	Seed Technology and Seed pathology
VI(d)	BOT.366.4	Horticulture			