



॥ अतरी पेठ्यू ज्ञानज्यांत ॥

उत्तर महाराष्ट्र विद्यापीठ, जळगाव

NORTH MAHARASHTRA UNIVERSITY,

P.E.NO.80, UMAVINAGAR, JALGAON- 425 001 (M.S)

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जा.क्र.: उमवि/१२ /विज्ञान विद्याशाखा /१६३३/२००३.

दिनांक : १८/०६/२००३

* परिपत्रक क्र. १३५/२००३ *


विषय :- जून, २००३ पासून सुधारित अभ्यासक्रम लागू करणेबाबत.....

विद्यापीठ अनुदान आयोगाचे निर्देशाप्रमाणे व विद्यापीठ अधिकार मंडळाने घेतलेल्या निर्णयानुसार जून, २००३ पासून विज्ञान विद्याशाखेतील पदव्युत्तर विषयांचे खालील सुधारित अभ्यासक्रम लागू करण्यात येत आहेत. कृपया याची नोंद घ्यावी व योग्य ती कार्यवाही करावी.

एम्.एस्सी. (भाग-२)

- १) रसायनशास्त्र.
- २) प्राणीशास्त्र.
- ३) वनस्पतीशास्त्र.
- ४) भूगोल. (एम्.ए./एम्.एस्सी.)

सहपत्र :- यरीलप्रमाणे अभ्यासक्रमाच्या प्रती .


उपकुलसचिवाकरिता.

प्रति,
मा.प्राचार्य,
सर्व संबंधित संलग्नित महाविद्यालये.

प्रतिलिपी :-

- १) मा.अधिष्ठाता, विज्ञान विद्याशाखा.
- २) मा.अध्यक्ष, विज्ञान विद्याशाखे अंतर्गत येणारी सर्व अभ्यासमंडळे, उ.म.वि., जळगांव.
- ३) मा.कुलगुरु कार्यालय, उ.म.वि., जळगाव.
- ४) मा.कुलसचिव कार्यालय, उ.म.वि., जळगाव.
- ५) मा.परीक्षा नियंत्रक, उ.म.वि., जळगाव.
- ६) मा.उपकुलसचिव, संलग्नता विभाग, उ.म.वि., जळगाव
- ७) मा.पध्दती विश्लेषक, संगणक विभाग, उ.म.वि., जळगाव.
- ८) मा.सहा.कुलसचिव, परीक्षा (गोपनीय) विभाग, उ.म.वि., जळगाव. (सोबत-अभ्यासक्रमाच्या ५ प्रती)
- ९) मा.सहा.कुलसचिव, परीक्षा विभाग, संबंधित विद्याशाखा, उ.म.वि., जळगाव.
- १०) मा.कक्षाधिकारी, सभा व दफ्तर विभाग, उ.म.वि., जळगाव.

॥ अंतरी पेटधू ज्ञानज्योत ॥



**North Maharashtra University,
Jalgaon.**

Syllabus for M.Sc. (Part-II)

(Semester-III & IV)

BOTANY

W.E. From June, 2003

॥ अंतरी पेटवू ज्ञानज्योत ॥

NORTH MAHARASHTRA UNIVERSITY, JALGAON

Syllabus for M.Sc. (Part-II)

BOTANY.

(Semester-III & IV)

(W.E.F. June, 2003)

SEMESTER - III

- BOT 3.1 Biotechnology
BOT 3.2 Plant Physiology and Biochemistry
BOT 3.31 Algae Special Paper-I
BOT 3.32 Mycology and Plant Pathology Special Paper-I
BOT 3.33 Angiosperm Special Paper-I
BOT 3.34 Plant Physiology Special Paper-I
BOT 3.4 Practical (I) Based on BOT 3.1 and BOT 3.2
BOT 3.5 Practical (II) Based on BOT 3.31 or BOT 3.32 or BOT 3.33 or BOT 3.34

SEMESTER - IV

- BOT 4.1 Developmental Botany
BOT 4.21 Algae Special Paper-II
BOT 4.22 Mycology and Plant Pathology Special Paper-II
BOT 4.23 Angiosperm Special Paper-II
BOT 4.24 Plant Physiology Special Paper-II
BOT 4.31 Algae Special Paper-III
BOT 4.32 Mycology and Plant Pathology Special Paper-III
BOT 4.33 Angiosperm Special Paper-III
BOT 4.34 Plant Physiology Special Paper-III
BOT 4.4 Practical (I) Based on BOT 4.1
BOT 4.5 Practical (II) Based on BOT 4.21 and BOT 4.31 or BOT 4.22 and BOT 4.32 or BOT 4.23 and BOT 4.33 or BOT 4.24 and BOT 4.34.

॥ अंतरी पेटवू ज्ञानज्योत ॥

North Maharashtra University, Jalgaon.

Syllabus for M.Sc. (Part-II)

BOTANY.

(Semester-III & IV)

(W.E.F. June, 2003)

M.Sc. BOTANY : SEMESTER - III

BOT 3.1 BIOTECHNOLOGY (60 Lectures)

1. **Introduction, Definition, Fundamentals of Biotechnology.** (2 Lect.)
Applications, Scope of Biotechnology in India. (16 Lect.)
2. **Plant Tissue Culture**
i) Introduction, History, Scope and Importance.
ii) Selection and designing of tissue culture laboratory, selection of crop for micro-propagation, Nutrients, Media, Construction of green house, production management.
iii) Micro-propagation, process and its application in agriculture and forestry.
iv) Embryo culture
v) Haploid culture
vi) Protoplast isolation and Fusion
vii) Introduction to somaclonal variation
viii) Secondary metabolite productuin
ix) Synthetic seed production. (6 Lect.)
3. **Fermentation Biotechnology**
i) History of fermentation
ii) Principles of microbial growth - Batch, continuous, synchronous culture.
iii) Application of fermentation
a. Brewing of Beer
b. Citric acid fermentation
c. Antibiotic (Penicillium) production (6 Lect.)
4. **Biomass production**
i) Introduction
ii) Concept of SCP, its need and applications
iii) Mass culture of Algae for protein
iv) Mushroom culture. (6 Lect.)
5. **Biofertilizers**
i) Definition and types
ii) Rhizobium, BGA, Azolla and Earthworm culture. (5 Lect.)
6. **Enzyme technology**
i) Introduction, classification and immobilization of enzymes
ii) Industrial applications of enzymes in
a. Food industry
b. Fermentation industry
c. Pharmaceutical industry (5 Lect.)
7. **Fuel Biotechnology**
i) Biomass as a potential energy source
ii) Energy crops- wood, sugar & starch crops, hydrocarbons producing crops.
iii) Biogas production - substrate, digester, micro-organisms.
iv) Bioethanol production

(5 Lect.)

8. **Environmental Biotechnology**

- i) Introduction
- ii) Sources of wastes & Pollutants hazards from wastes and pollutants.
- iii) BOD sensors
- iv) Waste water treatments
 - a. Aerobic
 - b. Anaerobic

(6 Lect.)

9. **Genetic Engineering**

- i) Restriction endonucleases
- ii) Cutting, joining of amplification of DNA
- iii) Construction of plasmid & cosmid.
- iv) Plant gene vectors viruses.
 - a. GMV
 - b. Ti plasmid
- v) Plant gene cloning e.g. production of herbicide resistance.

(3 Lect.)

10. **Human and Animal Health**

- i) Principles of immunity.
- ii) Natural and aquaried immunity
- iii) Monoclonal antibodies.

REFERENCE BOOKS

1. Aneja K.R. (1996) Experiments in microbiology, plant pathology tissue culture and Mushroom cultivation, Wishwa Prakashan, New Delhi.
2. Atkinson F. (1972) Cultivation of edible mushrooms. Faber & Faber Ltd. London.
3. Bhojwani S.S. and Razdan M.K. (1983) Plant tissue culture theory and practice. Elsevier science Pub. Amsterdam.
4. Dubey R.C. (1995). A Text book of Biotechnology, S.Chand and Co. Ltd. New Delhi.
5. Evans D.A. et.al. (1983) Handbook of plant cell culture Vol. 1-3. McMillan, New Delhi.
6. Jogdand S.N. (1993). Advances in Biotechnology, Himalaya Pub. House, Delhi.
7. Pathak Y.G. (2000). Mushroom-production and Processing Technology, Agrobios, India.
8. Smith J.E. (1996). Biotechnology, Cambridge University Press, Cambridge.
9. Swaminathan M.S. (1991), Biotechnology in agriculture. McMillan, Madras.
10. Gupta, P.K. (1999). Elements of Biotechnology, Rastogi Pub. Meerut.

BOT 3.2 PLANT PHYSIOLOGY AND BIOCHEMISTRY (60 Lectures)**(A) PLANT PHYSIOLOGY**

1. **Mineral salt absorption linked to metabolism :** (4 Lect.)
 - i) Carrier concept (Van Don Honert 1937) in detail.
 - ii) Lundgardh's hypothesis.
 - iii) Bennet Claskers hypothesis.
2. **Translocation of organic solutes :** (4 Lect.)
 - i) Definition
 - ii) Mechanism
 - iii) Different theories.
3. **Biological Oxidation & Reduction :** (4 Lect.)
 - i) Introduction
 - ii) Oxidation & Reduction
 - iii) Redox reaction in biological system
 - iv) Oxidation-reduction potential and its measurement.
 - v) Biologically important Redox Systems.
4. **Photosynthesis :** (7 Lect.)
 - i) Mechanism (Chemical equations expected)
 - ii) With reference to carbon-fixation in CAM.
 - iii) Chemosynthesis
 - iv) Photorespiration.

5. **Respiration :** (7 Lect.)
 i) Mechanism (Chemical equations expected)
 ii) With special reference to organization of respiratory chain in mitochondria.
 iii) Phosphorylation
 iv) Cyanide resistant pathway (HMP)
6. **Nitrogen metabolism :** (7 Lect.)
 i) Nitrogen fixation
 a. Non-symbiotic
 b. Symbiotic
 ii) Ammonification and Nitrification
 iii) Reductive amination and Transamination
7. **Fat Metabolism:** (7 Lect.)
 i) Mechanism
 ii) Synthesis of fatty acids.
 iii) Synthesis of glycerol
 iv) Condensation of fatty acids and glycerol to produce lipids
 v) L and B oxidation
 vi) Glyoxylate pathway
8. **Dormancy and seed germination:** (7 Lect.)
 i) Definition
 ii) Causes of seed dormancy
 iii) Mechanism of seed dormancy
 iv) Methods of breaking seed dormancy.
9. **Stress physiology:** (4 Lect.)
 i) What is stress - Definition
 ii) Types of stresses:
 a. Water stress-drought, cold and salt.
 b. Temperature stress - high and low.

(B) BIOCHEMISTRY

1. **Biochemistry :** (4 Lect.)
 i) Hydrogen ion concentration
 ii) PH and Buffers
2. **Chemistry, Classification & properties Biological compounds:**
 i) Amino acids
 ii) Proteins
 iii) Nucleic acids and their compounds.
 iv) Vitamins
 v) Enzymes
 vi) Hormones - Auxins, Gibberellines, Cytokinins, Abscissic acid, Phenolic compounds and ethylene.

RECOMMENDED BOOKS

- Amarsingh (1977) Practical Plant Physiology. Kalyani Publishers, Dew Delhi, India
- Anand, B.K. & S.K. Manchanda. (1976) Text book of Physiology. Manchanda - Tata McGraw Hill Publications Co. Ltd.
- Arditt, J. (1969) Experimental Plant Physiology Holt, Rinehart & Winston Inc, New York, U.S.A.
- Asbard, P.O. & K. Rodahl (1970) A Text Book of work Physiology. McGraw Hill Kogakusha Ltd. Tokya./New York.
- Bewley, Derek, J. and Black M. (1985) Seeds : Physiology of Development and germination. Plenum Press, New York.
- Bidwell, R.G. (1979) Plant physiology. McMillan Publishing Co. Inc. New York, London.
- Bonner, J. and Varner J.E. (Eds.) (1976) Plant Biochemistry 3rd Edn. Pb. Academic Press. Inc. Ltd., London, U.K.
- Brett, C. and Waldran, K. (1970) Physiology and biochemistry of plant cell walls. Lodon Unuintyman, Boston, USA.

9. Conn, E.E. and Stumpf, P.F. (1976) *Outlines of Biochemistry* Wiley Eastern Ltd., New Delhi, India.
10. De Robertis, E. D.P. and De Robertis, E.M.T. (1987). *Cell and Molecular Biology*. VIII Eds. Lea & Febiger International Edition Info-Med. Honkong.
11. Devlin, R.M. & A.V. Barker. (1967) *Photosynthesis*. Van Nostrand, Reinhold Books Ltd. London, U.K.
12. Devlin, R.M. and Whittam, F.H. (1986) *Plant physiology IV edn*. CBS Publishers & Distributors, New Delhi, India
13. Fogg, G.E. (1972) *Photosynthesis*, Hodder & Stoughton, London, Sydney Auckland, Toronto.
14. Geise, A.C. (1979) *Cell physiology*. W.B. Saunders Company, Toronto.
15. Grewal, R.C. (2000) *Plant Physiology*. Campus Books International, Darya Ganj, New Delhi.
16. Hess, D. (1975) *Plant Physiology*. Norosa Publishing House, New Delhi.
17. Hill, Robert and C.P. Whittingham. (1957) *Photosynthesis*. London : Methuen and Co. Ltd. New York. ?John Willey & Sons. Inc.
18. Hopkins, W.G. (1995) *Introduction to plant physiology*. John Wiley & Sons.,
19. Leeniger, A.L. (1984) *Principles of Biochemistry* CBS Publishing & Distributors, New Delhi, India
20. Mehta, S.L.; Lodha, M.L. and Sane, P.V. (Eds.) (1989). *Recent advances in plant Biochemistry*. Pb. ICAR, New Delhi.
21. Meinder, H. & T.A. Monsfield (1968) *Physiology of Stomata*. Tata McGraw Hill Publications Co. Ltd. Bombay & New Delhi.
22. Nobel, P.S. (1999) *Physico-chemical and environmental Plant Physiology*. (II Edn.) Academic Press, Sandiago, USA.
23. Noggle, G.R. & G.J. Fritz (1982) *Introductory plant physiology*. Prentice Hall of India Pvt. Ltd. New Delhi.
24. Polladin, V.J. (1988) *Plant physiology*. Arihant Publishers, Jaipur, India.
25. Robinowitch, E. and Govindjee (1970) *Photosynthesis*. Wiley Eastern Pvt. Ltd. New Delhi.
26. Salisbury, F.B. & C. Ross (1977) *Plant physiology*. Prentic Hall of India Pvt. Ltd. New Delhi.
27. Steward F.C. (1965) *Plant at work*. Addition-wesley Publishing Company, Inc. Reading, Massachusetts, London, J.K.
28. Strafford, G.A. (1967) *Essentials of plant physiology*. Heinemann Educational Books Ltd. London.
29. Street, H.E. (1963). *Plant Metabolism*, Perganan Press, Oxford, U.K.
30. Street, H.E. and Opik, H. (1980) *The Physiology of Flowering Plants*. Edward Arnold Ltd., London, U.K.
31. Witham, F.H., D.F. Blaydes and R.M. Devlin (1971) *Experimentas in plant physiology*. Van Nostrand Reinhold Co. New Delhi.

BOT. 3.31 ALGAE

SPECIAL PAPER-I (60 Lect.)

1. **General Topics:** (10 Lect.)
 - i) History of algology in India.
 - ii) Comparative account of general characters of different groups of algae
 - iii) Systems of classification of algae according to F.E. Fritsch, G.M. Smith, G.W. Prescott and H.C. Bold and W.J. Wynnae
 - iv) Modern Trends in algae systematics.
2. **Discussion on morphology, taxonomy, life cycle, phylogeny and interrelationships of algae belonging to the following classes (F.E.Fritsch):** (40 Lect.)
 - a) Cyanophyceae,
 - b) Chlorophyceae,
 - c) Euglenophyceae,
 - d) Xanthophyceae,
 - e) Phaeophyceae,
 - f) Rhodophyceae
 - g) Bacillariophyceae

3. **Brief discussion in relation to the morphology and systematic position of the following :**
(10 Lect.)
- Chrysophyceae,
 - Dinophyceae,
 - Desmophyceae,
 - Prasionophyceae,
 - Cryptophyceae
 - Chloromonadophyceae.

RECOMMENDED BOOKS

- Bold, H. and Wynne. M.I. (1978) Algal structure and reproduction. Prentice Hall of India Private Ltd., New Delhi.
- Boney A.D. (1978) Phytoplankton Edward Arnold (Publishers) Ltd. London.
- Chapman, V.J. and Champman D.J. (1979) The algae. English Language Book. Society and Macmillan, London.
- Desikachary, T.V. (1959) Cyanophyta. ICAR, New Delhi.
- Fritsch, F.E. (1979). The structure and production of Algae Vol. I & II Vikas Pub. House Pvt. Ltd. New Delhi.
- Gonzalves, E. (1981) Oedogoniales ICAR, New Delhi.
- Iyengar, M.O.P. and Desikachary T.V. (1981) Volvocales ICAR, New Delhi.
- Lee, R.E. (1989). Phycology Cambridge University Press, Cambridge.
- Misra, J.N. (1966) Phaeophyceae ICAR, New Delhi.
- Morris, I (1967) An Introduction to the algae Hutchinson University Press. Oedogoniales ICAR, New Delhi.
- Iyengar, M.O.P. and Desikachary T.V. (1981) Volvocales ICAR, New Delhi.
- Lee, R.E. (1989). Phycology Cambridge University Press, Cambridge.
- Misra, J.N. (1966) Phaeophyceae ICAR, New Delhi.
- Morris, I (1967) An Introduction to the algae Hutchinson University Press.
- Pal, B.P. and Sunderlingam et.al. (1962) Characeae, ICAR, New Delhi.
- Philipose, M.T. (1960) Chroococcales, ICAR, New Delhi.
- Ramanathan, M.S. (1964) Ulotrichales ICAR, New Delhi.
- Randhawa, M.S. (1959) Zygnemataceae ICAR, New Delhi.
- Sarode, P.T. and N.D.Kamat (1984). Freshwater diatoms of Maharashtra, Saikrupa Publication, Aurangabad.

M.Sc. Botany Sem. III

BOT. 3.32 : MYCOLOGY AND PLANT PATHOLOGY

SPECIAL PAPER-I (60 Lect.)

- History of Mycology.** (1 Lect.)
- International code and Botanical nomenclature. (4 Lect.)
Principles, major rules, revisions and recommendations, effective and valid publications, typification, rejection of names of taxa, starting date point, priority and authority.
 - Outline classification proposed by Bessey (1950), Ainsworth (1973), Hawksworth et.al. (1995), Alexopoulos et.al. (1996).
 - Ultrastructure of fungal cell, cell-wall composition, septa, rhizomorph.
- Discussion of fungi with reference to phylogeny, interrelationship and life cycle pattern of following.**
 - Myxomycotina : (8 Lect.)
Ceratiomyxales, Dictyosteliales, Acrasiales, Labyrinthulales, Trichiales, Stemonitales, physarales
 - Mastigomycotina : (6 Lect.)
Plasmodiophorales, Chytridiales, Blastocladales, Lagenidiales, Saprolegniales, Perenosporales.
 - Zygomycotina : (4 Lect.)
Entomophthorales, Mucorales, Endogonales.

- iv) Ascomycotina : (16 Lect.)
Endomycetales, Protomycitales, Taphrinales, Eurotiales, Erysiphales, Meliolales,
Clavicipitales, Sphaeriales, Phacidiales, Pezizales, Laboulebeniales, Myriangiales,
Hysteriales, Dothidiales, Pleosporales.
- v) Basidiomycotina : (15 Lect.)
Auriculariales, Dacrymycetale, Tulasnellales, Aphyllophorales, Agaricales,
Lycoperdales, Nadulariales, Phallales, Podaxales, Ustilaginales, Uredinales.
- vi) Deuteromycotina : (6 Lect.)
Blastomycetes, Hyphomycetes, Coelomycetes.

RECOMMENDED BOOKS

1. Ainsworth et.al. (1965-73). The fungi, An advanced treatise Vol.I-IV B, Academic Press, London.
2. Alexopoulos & Mims (1979). Introductory Mycology Wiley Eastern Ltd. New Delhi.
3. Alexopoulos, Mims and Blackwell (1996). Introductory Mycology (4th Ed.). John. Wiley and Sons. Inc. New York.
4. Aneja K.R. (1996). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation. Wishwa prakashan, New Delhi.
5. Bornett & Hunter (1972). Illustrated genera of imperfect fungi. Minnesota.
6. Barron G.L. (1968). The genera of Hyphomycetes from soil. Williams and Wilkins, Battimore.
7. Bessey E.A. (1950). Morphology and Taxonomy of Fungi, The Blakriston Ed., Bhiladelphia.
8. Bhide et.al. (1987). Fungi of Maharashtra, M.A. C.S. Inst. Pub. Poone (M.S.)
9. Bilgrami et.al. (1979-81). Fungi of India (Part I & II). Today and Tomorrow's Pub. New Delhi.
10. Bilgrami K.S. (1991). Fungi of India, International Book House, New Delhi.
11. Boner, J.T. (196). The cultural slime modes. Princaton, Univ. Press.
12. Burnett, J.H. (1986). Fundamentals of Mycology Edward Arnold, London.
13. Clement & Shear (1931). The Genera and Fungi, H.W. Wilson, New York.
14. Cummins G.B. (1979). Illustrated genera of rust fungi, Burgens Pub. Co. Minncapolin.
15. Cummins G.B. (1971). The Rust Fungi of cereals, grasses and bamboos, Spiringles, Verlag, New York.
16. Dayal R. & Kiran U. (1989). Zoosporic fungi of India, Inter India Pub. New York.
17. Dennis R.W. G. (1977). British Ascomycetes (3rd Ed.) J. Cramer, Vaduz, Germany.
18. Ellis M.B. (1971). Demeticeous Hypomycetes, CMI Publication Kew Survey, London.
19. Gauman E.A. (1928). Comparative Morphology of Fungi, MacGrawHill Pub. New York.
20. Hawksworth D.L. (1977). Mycologist Handbook CBI, Kew.
21. Kamat M.N. (1959). Handbook of Mycology Vol. I & II Prakash Pub. Pune.
22. Kamat M.N. (1959). Introductory Plant Pathology Prakash Pub. Pune.
23. Lakhanpal & Mukerji (1981). Indian Myxomycetes, J. Cramer Vaduz.
24. Mehrotra and Aneja (1991). An Introduction to Mycology Wiley Eastern Ltd. New Delhi.
25. Mundkur & Thirumalachar (1952) Ustilaginales of India. CMI Pub. Kew Survey, England.
26. Mahadevan & Sridhar (1982). Methods in physiological plant pathology. IInd Ed. Sivakarni Pub. Madras.
27. Pathak V..R. (1972). Essential of plant pathology prakash pub. Jodhpur.
28. Pathak, Khatri, Pathak (1996). Fundamentals of plant pathology, Agro Botanical Pub. Bikaner, India.
29. Sarbhoy A.K. (1983). Advanced Mycology, Today and Tommorrow's Pub. New Delhi.
30. Subramanian C.V. (1981). Hyphomycetes. Academic Press London.
31. Tondon R.N. (1968). Mucorales of India. ICAR Pub. New Delhi.
32. Thind K.S. (1977). Myxomycetes of India, ICAR New Delhi.
33. Vasudeva R.S. (1963). Indian Cercosporae, ICAR New Delhi.
34. Webster J. (1980) Introduction to Fungi, 2nd Ed. Cambridge Univ. Press. Cambridge.
35. Wolf and Wolf (1947-1969). The fungi. Vol.I & II. John Wiley and Hafner New York.

BOT. 3.33 : ANGIOSPERM

SPECIAL PAPER-I (60 Lect.)

- 1. **Study of Cronquist's system of classification (1968, 1988) with reference to : (36 Lect.)**
 - i) Outline of the system
 - ii) Refinements over his earlier system of 1968
 - iii) Salient features of the system
 - iv) Merits and demerits of the system
 - v) Description, characterization and critical tendencies of the subclasses
 - vi) Discussion on the following orders (Sensu Cronquist)
 - vii) Piperles
 - viii) Hamamelidales
 - ix) Caryophyllales
 - x) Dilleniales
 - xi) Euphorbiales
 - xii) Asterales
 - xiii) Najadales
 - xiv) Arales
 - xv) Cyperales
 - xvi) Zingiberales
 - xvii) Liliales

(6 Lect.)
- 2. **Modern Trends In Plant Taxonomy:**

Role of the following:

 - i) Ultrastructure
 - ii) Serology
 - iii) Cytochemistry
 - iv) Biosynthesis pathways
 - v) Numerical Taxonomy

(6 Lect.)
- 3. **Biosystematics :**

Concept, aims and objectives of Biosystematics, categories and methods in biosystematics, comparison of classical taxonomy and biosystematics.

(6 Lect.)
- 4. **Floristics :**
 - i) Principles, distinction between flora and vegetation
 - ii) Floral composition and elements in Maharashtra
 - iii) Floral composition and elements in the flora of India

(6 Lect.)
- 5. **Herbaria :**
 - i) Kinds of herbaria
 - ii) Major herbaria of the world
 - iii) Herbaria as multipurpose resource institute

RECOMMENDED BOOKS

- 1. Cronquist, A. (1968) Evolution and Classification of Flowering Plants. Netwon, New York, U.S.A.
- 2. Cronquist, A. (1988). The Evolution and Classification of Flowering Plants. (IInd Ed.) NYBG, New York, U.S.A.
- 3. Davis, P.H. and V.M. Heywood (1963) Principles of Angiosperms Txonomy. Oliver and Boyd, Edinbburg.
- 4. Heywood, V.H. (1968) (Ed.) Modern Methods In Plant Taxonomy, Academic Press, London, U.K
- 5. Hooker, J.D. (1907) A. Sketch of the flora of British India, Imp. Gazeteer, London, U.K.
- 6. Lawrence, G.H.M. (1951). Taxonomy of Vascular Plants, MacMillan, New York, U.S.A.
- 7. Naik, V.N. (1984). Taxonomy of Angiosperms. Tata McGraw Hill Publ. Co. Ltd., New Delhi, India.
- 8. Sivrajan, V.V. (1984). Introduction to principles of plant Taxonomy. Oxfort QIBH Publ. Co. New Delhi, India.

BOT. 3.34 : PLANT PHYSIOLOGY PAPER-I (60 Lect.)

1. **Cell organization :** (12 Lect.)
Methods of studying cell structure (gross and ultra), functions of membrane cell wall, plasmodesmata, plasma membrane, mitochondria, plastids, endoplasmic reticulum, lysosomes, ribosomes, origin and evolution of Eukaryotic cells.
2. **Genome, organization, structure of DNA, RNA, DNA sequencing, Replication of DNA, Transcription, RNA processing, Genetics code, protein synthesis.** (12 Lect.)
3. **Phytochemistry :** Chemistry of organic acids, phenols, alkaloids, tannins, lignins, pigments, terpenes, flavonoids, plant growth substances.
4. **Bioenergetics :** Definition, Bioenergetics of photosynthesis, Luminescence, chlorophyll fluorescence. (12 Lect.)
5. **Instrumentation :** (12 Lect.)
 - i) Phase contrast microscope
 - ii) Chromatography (Different types)
 - iii) Electrophoresis
 - iv) Colorimetry
 - v) pH meter
 - vi) Spectrophotometer
 - vii) Conductivity Bridge.

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M.Sc. Bot. Sem. III**BOT. 3.4 : PRACTICAL-I (24 Practicals)****(Based on Papers BOT 3.1 & 3.2)****BIOTECHNOLOGY (12 Pract.)****1&2. Study of instruments used in Bio-technology laboratory.**

- i) pH meter.
- ii) Centrifuge
- iii) Laminar air flow
- iv) Spectrophotometer
- v) One-pan balance
- vi) Autoclave
- vii) Electrophoresis
- viii) Shaking machine
- ix) BOD-Incubator
- x) Hot air oven
- xi) Flame photometer
- xii) Turbidometer

Working, principles and applications of any six from the above.

3. Preparation of M.S. Medium.
4. Embryo culture of Maize
5. Micro-propagation of economically important plants.
- 6&7. Citric acid fermentation and assay.
- 8&9. Mass culturing of blue-green algae.
10. Mushroom cultivation.
11. Extraction and estimation of proteins from plants by Lowry's method.
12. Immobilization of enzyme/encapsulation of embryo.

PLANT PHYSIOLOGY AND BIOCHEMISTRY (12 Pract.)

13. Determine diurnal fluctuations in titratable acid number. (TAN) values of CAM succulents (e.g. Aloe, Bryophyllum, Kalanchoo etc. based on any one).
14. Determine the absorption spectrum of chlorophyll pigments and estimate the amount of Chla, Chlb and total chlorophylls by spectrophotometer method.
15. Estimate the amount of CO₂ evolved during respiration by continuous current air method.
16. Extraction and separation of free amino acids of germinating seeds by circular paper chromatography.
17. Extraction and separation of free sugars from sapota, grapes, zizyphus, orange fruits by ascending paper chromatography.
18. Estimation of ether soluble fat oil of Ricinus/Arachis seeds by soxhlets apparatus.
19. To study the activity of enzyme amylase in germinating Sorghum/Triticum seeds.
20. To study the activity of enzyme lipase on suitable substrate (Arachis/Ricinus).
21. To study the activity of enzyme protease (from germination beans of any leguminous plants).
22. To extract and estimate the amount of Ascorbic acid present in green paper (raw) / lemon juice (Fresh).
23. Extraction of Alkaloids, from Tobacco.
24. Determine the DPD of the green plant material potato tubers.

Note : Visit to biotechnology laboratory, fermentation industry, biotechnology Institutes starch factory etc.

BOT 3.5 : PRACTICAL BASED ON THEORY PAPERS BOT 3.31**Algae Special Paper-I (24 Practicals)**

- I. Chlorophyceae.
- Volvocales : *Chlamydomonas, Pandorina, Eudorina, Volvox.*
 - Chlorococcales : *Chlorococcum, Chlorella, Trebouxia, Tetreedron, Characium, Charasiosiphon, Ankistodesmus, Selenestrum, Oocystis, Botryococcus, Coelastrum, Scenedesmus, Pediasstrum, Hydrodictyon, Protosiphon, Crucigenia* (Any eight)
 - Ulotrichales : *Ulothrix, Uronema, Microspora, Sphaeroplea, Cylindrocapsum, Ulva, Enteromorpha, Schizomeris, Monostroma* (Any Six).
 - Chaetophorales : *Stigeoclonium, Chaetophora, Drapanaldia, Drapanaldiopsis, Fritschella, Coleochaetae, Trentopohlia, Cephaluros* (Any six).
 - Udophorales : *Cladophora, Rhizoclonium, Pithophora, Chaetomorpha, Sponogomarpha* (Any four).
 - Oedogoniales : *Oedogonium, Bulbocheeta, Oedocladiu* (Any two)
 - Conjugates : *Spirogyra, Zygnema, Mougeotia, Sirogonium, Sirocladium, Cosmarium, Euastrum, Pleurotaenium, Closterium, Cylindrocystis* (Any eight).
 - Siphonales : *Caulerpa, Bryopsis, Dichotomositin, Codium, Helimoda, Boergensenia, Valonia, Neomeris, Acetabularia, Chamaedoris* (Any eight).
 - Charales : *Chara, Nitella*
- II. Euglenophyceae : *Euglena, Phacus, Lepocinclis, Trachelomonas.*
- III. Xanthophyceae : *Vaucheria, Botrydium*
- IV. Chysophyceae : *Dinobryon, Symura*
- V. Bacillariophyceae : *Coscinodiscus, Melosira, Cyclotella, Chaetoceros, Cymbella, Bidulphia, Navicula, Nitschia, Synedra, Pinnularia, Fragillaria, Gyrosigma, Pleurosigma, Gomphonema* (any eight)
- VI. Phaeophyceae : *Ectocarpus, Sphacelaria, Dictyota, Pedina, Stoechospermum, Spathoglossum, Dictyopteris, Lyngaria, Sargassum, Turbinaria, Zonaria, Rosenvingia, Laminaria, Fucus, Cystoseira, Chnoospora, Macrocystis, Nereo-cystis Postelsia* (Any twelve)
- VII. Rhodophyceae : *Parphyra, Compsopogon, Batrachospermum, Liagora, Scinia, Gelidium, Gelidiella, Grateloupia, Gracilaria, Hypnea, Rhodymenia, Champia, Ceraminum, Caloglossa, Acanthophora, Chondrus, Laurencia, Polyisiphonia, Asparagopsis, Halymenia, Botrycladia, Namlion Amphiroa* (Any twelve).
- VIII. Cyanophyceae : *Chroococcus, Gleocapsa, Gleothece, Merismopedia, Aphanothece, Coelospherium, Microcystis, Oscillatoria, Phormidium, Lyngbya, Arthospira, Spirulina, Gleothrichia, Cylindrospermum, Nostoc, Anabaena, Nostochopsis, Hapalosiphon, Stigonema, Tolypothrix, Rivularia, Calothrix, Dichothrix* (Any Dixteen).
- IX. Artificial key of the genera based on morphology and reproduction.
- X. Botanical excursions for fresh/marine water algae.

Note : Classification of algae should be followed according to F.E. Fritsch.

M.Sc. Botany Sem. III**BOT 3.5 : PRACTICAL BASED ON THEORY PAPER BOT 3.32****Mycology and Plant Pathology (24 Practicals)****Practical 1 to 3**

Myxomycotina (Any 10) :

Ceratiomyxa, Lycogala, Hemitrichia, Trichia, Arcyria, Physarum, Fuligo, Craterium,, Diderma, Didymium, Stemonitis, Dichea, Lamphroderma, Plasmodiphora.

Practical 4 to 6

Mastigomycotina (Any 10)

Synchytrium, Physoderma, Saprolegnia, Achlya, Aphanomyces, Dictyuchus, Olpidium, Allomyces, Albugo, Phythium, Phytophthora, Plasmopara, Perenospora, Bremia, Sclerospora.

Practical 7 to 8

Zygomycotina (Any five)
Rhizopus, Mucor, Zygorhynchus, Pilobolus, Entomophthora, Choanephora, Syncephalastrum, Absidia.

Practical 9 to 13

Ascomycotina (Any 20)
Taphrina, Protomyces, Saccharomyces, Eurotium, Erysiphe, Uncinula, Phyllactinia, Sphaerotheca, Podosphaera, Microsphaera, Meliola, Chaetomium, Phyllachora, Hypoxylon, Xylaria, Daldinia, Claviceps, Balantia, Peziza, Morchella, Rhytisma, Usnea, Parmellia, Elsinoe, Parodiella, Bagnetiella, Didymosphaeria, Botryosphaeria.

Practical 14 to 18 .

Basidiomycotina (Any 20)
Melampsora, Dasturella, Puccinia, Ravenelia, Uromyces, Monosporidium, Cerotellium, Olivea, Chaconia, Phragmidium, Hemilea, Endophyllum, Maseccela, Haphalophragmiopsis, Graphiola, Ustilago, Sphacelotheca, Tohyposporium, Dossansia, George-fi-scheria, Tilletia, Urocystis, Auricularia, Tremella, Polyporus, Paria, Fomes, Schizophyllum, Ganoderma, Clavaria, Daedalia, Hexagonia, Irpex, Coprinus, Pleurotus, Itajahya, Podaxis, Lycopedron, Geaster, Cyathus, Nidularia.

Practical 19 to 21

Deuteromycotina (Any 10)
Fusarium, Curvalaria, Alternaria, Cladosporium, Memmoniella, Cercospora, Beltrania, Phyllosticta, Pestalotia, Colletotrichum, Ciliochorella, Helminthosporium, Pyricularia.

Practical 22

Formation of artificial key based on appropriate characters.

Practical 23

Isolation of aquatic fungi by baiting in the laboratory.

Practical 24

Botanical excursions, collection of fungal specimens, tour report and submission of fungal specimen.

BOT 3.5 : PRACTICAL-II BASED ON PAPER BOT 3.33

ANGIOSPERM SPECIAL PAPER-I (24 Practicals)

Practical 1 .

Phytography of the plants.

Practical 2-4 .

Study of Angiospermic families locally as well as available in the region covering all the orders/series (Sensu Bentham and Hooker) (at least 40 families).

Practical 15-16:

Preparation of artificial dichotomous keys of (i) indented, (ii) bracketed types based on vegetative as well as reproductive (floral) characters.

Practical 17-24:

Identification of plant specimens upto species level with the help of flora/s.

- N.B. :** i) Students should visit nearby localities and submit the report with field observations. This local report may be submitted (duly signed by the concerned teacher) at the time of practical examination.
- ii) Botanical excursions are compulsory (one short and one long tour is expected)
- iii) Submission of 30 herbarium specimens alongwith the report of botanical excursions.

BOT 3.5 : PRACTICAL-II BASED ON PAPER BOT 3.34**PLANT PHYSIOLOGY SPECIAL PAPER-I (24 Practicals)**

1. Extraction and separation of organic acids by two dimensional paper chromatography.
 2. Extraction and separation of sugars by two dimensional paper chromatography.
 3. Extraction and separation of amino acids by two dimensional paper chromatography.
 4. Estimation of ascorbic acid.
 5. Extraction and separation of alkaloids by two dimensional paper chromatography.
 6. Estimation of oxalic acid.
 7. Extraction and separation of liquids by thin layer chromatography.
 8. Estimation of lignins.
 9. Estimation of polyphenols.
 10. Determine the activity of enzyme polyphenol oxidase.
 - 11,12. Colorimetric estimation of DNA and RNA.
 13. Isolation of DNA from cauliflower.
 14. Isolation of RNA from yeast.
 15. Isolation of chloroplasts and demonstration of Hill reaction.
 - 16,17. Separation of proteins on the basis of molecular weight using SDS PAGE electrophoresis.
 - 18-20. Colorimetric estimation of nitrogen from plant material.
 - 21-22. Estimation of amino nitrogen from plant material.
 - 23-24. Extraction and estimation of total alkaloids from plant material.
-

M.Sc. Botany Sem. IV**BOT 4.1 : DEVELOPMENTAL BOTANY (60 LECTURES)****(A) ANATOMY (25 Lectures)**

- (5 Lect.)**
- I. Apical Meristems :**
- a. Classification based on origin and development of initiating cells, plane of division, function and position in plant body.
 - b. Study of the following theories of zonation and differentiation :
 1. Apical cell theory
 2. Histogen theory
 3. Tunica-carpus theory
 4. Korper-Kappe theory
 - iii.
 - a. Cytohistological zonation
 - b. Concept of quiescent center
- (6 Lect.)**
- II. Study of classifications of stomata :**
- (A) Based on mature structure :
- i.
 - a. Classification by Vesque (1989)
 - b. Metcalfe and Chalk (1950)
 - c. Stace (1965)
 - d. Stebbins and Khush (1961)
 - ii. Part's Classification (1965)
 - iii. Classification by Von Cotthem (1970)
- (2 Lect.)**
- III. Study of classification of Trichomes:**
- i. Ramayya's Classification (1972)
- (4 Lect.)**
- IV. Study of Vascular Tissue :**
- i. Cambium :
 - a. Origin of cambium
 - b. Structure of cambium
 - c. Types of cambium
 - ii. Differentiation of Xylem elements and their phylogenetic specialization
 - iii. Development of sieve tube elements and their ultrastructure.
- (4 Lect.)**
- V. Study of Woods. :**
- i. Structure of Dicotyledonous and Gymnospermous woods
 - ii. Reaction Wood
 - iii. Sap wood and Heart wood.
 - iv. Distribution of axial parenchyma :
 - a. Apotracheal : Diffuse, Diffuse-in-aggregates
 - b. Paratracheal : Vasicentric, Aliform, Aliform confluent
 - c. Boundary parenchyma
- (4 Lect.)**
- VI. Study of Anomalous Secondary Growth :**
- (A) Dicotyledonous stems :
- i. Normal cambium with abnormal activity
 - ii. Abnormal cambium with abnormal activity
- (B) Monocotyledonous stems :
- i. Dracaena
 - ii. Palms

(B) EMBRYOLOGY (25 Lectures)

1. **Historical events in Embryology :** (2 Lect.)
Introduction, Contribution of various workers in brief in the development of science of embryology such as : Theophrastus, Pliny, Grew, Camerarius, Amici, Schleiden, Hofmeister, Strasburger, Hanstein.
2. **Microsporangium :** (3 Lect.)
Development, structure and function of microsporangium. Recent information on Tapetum, Pollenkitt and Tryphine, Microsporogenesis, Pollen associations, Male gametophyte - structure, development and spermatogenesis, study of certain abnormal developments (i) Pollen formation in Cyperaceae, (ii) Pollen embryo sac.
3. **Megasporangium :** (3 Lect.)
Development, structure and function of megasporangium, megasporogenesis, types of female gametophytes, nutrition of embryo sac.
4. **Pollination and fertilization :** (5 Lect.)
Self-pollination, methods of pollination, structure and function of stigma and style, pollen germination : sticking and hydration, pollen-tube formation and growth, sperm-cell; pollen-pistil interaction : pollen recognition, acceptance, rejection, pollen incompatibility entry of pollen tube into stigma, style and embryo sac, transfer of tube embryo sac contents, fusion of gametes, fusion of nuclei; discussion on fertilization in *Tambourissa* and *Butomopsis*, and its significance.
5. **Embryo :** (5 Lect.)
a. Development and structure of Dicotyledonous embryo, Schnarf's, classification (1929) of dicot. embryos, salient features of each type.
b. Development of Monocotyledonous embryo. The grass and palm embryos.
c. Embryogeny in *Paeonia* and its significance.
d. Nutrition of Embryo.
6. **Endosperms:** (2 Lect.)
Development, structure and function, physiology and cytology of endosperm, disfunction of endosperm.
7. **Polyembryony :** (2 Lect.)
Introduction, classification of polyembryony, simple polyembryony, multiple embryony, nucellar, integumentary and endothelia, polyembryony, zygotic, suspensor, and synergial polyembryony, causes of polyembryony.
8. **Experimental Embryology :** (3 Lect.)
Anther and pollen culture, ovary culture, ovule culture, nucellar culture, endosperm culture, embryo culture.

(C) PALYNOLOGY (10 Lectures)

1. **Introduction :** Concept, historical account, scope. (1 Lect.)
2. **Pollens :** (3 Lect.)
Development of pollengrains - meiotic and post-meiotic processes differentiation of wall layers, exine stratification, polarity, symmetry, pollen ultrastructure.
3. **Spore/pollen development in plants :** (3 Lect.)
Algae to angiosperms with respect to/reference to wall composition, ornamentation, aperture, wall composition.
4. **Applied palynology :** (3 Lect.)
Geopalynology, Melittopalynology, Pollen allergy, Aerobiology, Palynotaxonomy,

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ANATOMY

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BOT 4.21 ALGAE SPECIAL PAPER-II (60 Lectures)

(14 Lect.)

I. Cell Biology :

Cell structure- Prokaryotic, Mesokaryotic and Eukaryotic.

The nucleus and nuclear divisions.

The cytoplasm and subcellular organelles.

Cell membranes, Cell wall, Flagella, Cell division and Cytokinesis, Chromosome numbers of algae.

(8 Lect.)

II. Genetics and Molecular Biology.

Algal mutants and their uses. Extra-Chromosomal Inheritance, Nucleus-Cytoplasm Interactions, Sex Chromosomes, Plasmid - DNA.

(8 Lect.)

III. Biochemistry and Physiology.

i. Biochemical characteristics of algal pigments, carbohydrates, lipids, proteins, extra cellular products and secondary metabolites.

ii. Nutritional types, mineral nutrition, macronutrients and micronutrients.

iii. Mechanism of nitrogen fixation, factors affecting nitrogen fixation.

iv. Calcification and silicification.

(12 Lect.)

IV. Culturing of Algae :

i. Definition, general requirements for culturing of algae, culture media.

ii. Preparatory culture and isolation of algae, streak culture, nutritive solution, dilution, culture and solid culture.

iii. Continuous culture.

iv. Synchronous culture.

v. Mass culture of algae.

vi. Mass production of algae for food and feed.

vii. Cultivation of algae in waste water.

V. Marine algal cultivation, necessity, principles methods and status in India.

(6 Lect.)

VI. Algal Utilization.

(12 Lect.)

i. Industrial uses : Kelp industry, Agar-agar, Alginates, Carrageene and other products of marine algae.

ii. Agriculture uses : Blue-green algae as biofertilizer organic manure seaweeds of fodder for cattle seaweeds liquid fertilizers, Biogas from sea weeds.

iii. Human food : Fresh water algae and marine algae used as human food.

iv. Role of algae in medicine.

M.Sc. Botany Sem.IV**BOT 4.22 MYCOLOGY AND PLANT PATHOLOGY****SPECIAL PAPER-II (60 Lectures)**

1. **Soil Microbiology.** (15 Lect.)
Structure of soil, soil profile, distribution and role of microbes in soil, Humus and it's role in agriculture, Rhizosphere and Rhizoplane, Microbial associations in soil, Nitrogen fixation.
2. **Industrial Mycology** (20 Lect.)
Preservation and maintenance of pure culture, methods of sterilization. Principles of microbial growth, batch, continuous and synchronous cultures, assay methods for fermentation products, physical, chemical and biological methods, Fermentation process for following products : Alcohol, Citric acid, Vitamins, Enzymes, Antibiotics (Penicillin), Mushroom cultivation-Important steps involved in the cultivation of button (*Agaricus*) and Dhingri (*Pleurotus*) Mushrooms on large scale level. Fermentation of Tea, Coffee, Cocoa and retting/rotting of fibres.
3. **Fungal toxins affecting man and animals, mycotoxins of food and feed stuffs, Ergot toxins, Mushroom toxins.** (5 Lect.)
4. **Fungal Genetics.** (8 Lect.)
Incompatibility system, Tetrad analysis, Parasexual cycle, Industrial Strain improvement in *Penicillium*, Yeast and Mushroom.
5. **Fungal Ecology** (6 Lect.)
Fungi in extreme environment, Thermophilic and Psychrophilic fungi, Heterotrophy and it's consequences, practical exploitation of saprotrophy, Fungi as control agents-Entomogenous, nematophagous and Mycoparasites.
6. **Fungi and Biotechnology** (6 Lect.)
Industrial fungi, Mycoprotein, Pharmaceutical industries, Growth hormones. Miscellaneous products – Zeralenone, Mycoinsecticides, Micoweedicides, Mycorrhiza mass cultivation and Uses in agriculture and forestry.

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 Purkayastha & Chanda (1976). Indian Edible Mushroom, Firma Klam Pvt. Ltd., Calcutta.
 Purohit S.S. and Mathur S.K. Biotechnology Fundamentals and Applications.
 Reed Gerald-Editor. Prescott and Dunn's Industrial Microbiology, CBS Publ. & Dist. Delhi.
 Singh B.D. (1998). Biotechnology, Kalyani Publishers, New Delhi.
 Smith J.E. & D.R. Berry (1975). Filamentous fungi Vol.I, II, III, John Willey, New York.
 Smith G. (1969). An Introduction to Industrial Mycology, Edward, Arnold, London.

- Subba Rao N.S. (1977). Soil Microorganisms and plant growth, Oxford & IBH Publ. Co. New Delhi.
- Thoma R.W. (1977). Industrial Microbiology, Stroudsburg, Pennsylvania.
- Wicklow and Carrol (Eds.) (1980). Fungal Ecology, Marcel Dekker Inc. New Delhi.

BOT 4.23 ANGIOSPERM SPECIAL PAPER-II (60 Lectures)

1. (A) **WOOD ANATOMY** (15 Lect.)
Hard and soft woods, elements of wood, their structure and distribution, properties and uses of wood in relation to structure and composition, anatomy and identification of important timbers.
 - (B) **ECOLOGICAL ANATOMY :**
Organographic anatomical peculiarities of ecological significance of the following.
 - a) **Hydrophytes :**
 - i. Submerged
 - ii. Free-floating
 - iii. Anchored floating
 - iv. Amphibious
 - b) **Xerophytes :**
 - i. Microphyllous
 - ii. Sclerophyllous
 - iii. Trichophyllous
 - iv. Malacophyllous.
 - c) Halophytes
 - d) Parasites
 - e) Epiphytes.
- (10 Lect.)
2. **Embryology :**
Different schools of Embryology and their contributions. Artificial pollination; fertilization, sexual incompatibility, Endosperms, Endosperm ultrastructure and histochemistry, embryo as reaction system; Homologies, experimental embryogenesis. Embryo-endosperm relationship. (15 Lect.)
 3. **Palynology :**
Pollen units, pollen biochemistry and physiology, pollenkitt, pollen wall proteins, pollen germination in vivo and in vitro, pollen storage and viability, pollen sterility, pollen polymorphism, melitopalynology, palynology and basis of Angiosperm phylogeny. (20 Lect.)
 4. **Floral Anatomy and Morphology :**
 - a. Basic vascular supply to different floral parts.
 - b. Vascular patterns of 3-4 and 5 merous flowers.
 - c. Vascularisation of hypogynous, perigynous and epigynous flowers, nature of inferior ovary; axial and appendicular theories.
 - d. Morphological nature of stamen : Primitive stamen, the peltate stamen, the diplophyllous stamen, the telome theory as applied to the stamen.
 - e. Morphological nature of carpel : Primitive carpel, form of carpel, closure of carpel, fundamental nature of carpel: axial or appendicular, the sui-gensis theory, topographic and anatomical interpretations, phylogenetic relationship of placentation types of Angiosperms.
 - f. Floral anatomy as an aid in morphology.
 - g. Role of floral anatomy in relation to taxonomy.

RECOMMENDED BOOKS

ANATOMY

- Carlquist, S. (1961) *Comparative Plant Anatomy*, Hold, Rinehart and Winston, New York, U.S.A.
- Cutter, E.G. (1969) *Plant Anatomy : Experiment and Interpretation. Part-I : Cell and Tissues*, Edward Arnold, London.
- Cuttler, D.F. (1978) *Applied Plant Anatomy*, Logman, London and New York.
- Eames, A.J. (1961) *Morphology of the Angiosperms*, McGraw Hill, New York, U.S.A.
- Eames, A.J. and MacDaniels, L.H. (1947) *An Introduction To Plant Anatomy*, IInd Ed. McGraw Hill, New York and London.
- Esau, K. (1960) *Anatomy of Seed Plants*, Wiley, New York, U.S.A.
- Esau, K. (1965) *Vascular Differentiation in Plants*. Hold, Rinehart and Winston, New York, U.S.A.
- Fahn, A. (1982) *Plant Anatomy*, IIIrd Ed. Pergamon Press, Oxford, U.K.
- Foster, A.S. (1949) *Practical Plant Anatomy*, IInd Ed. Van Nosrand, New York, U.S.A.
- Metcalf, C.R. and Chalk, L. (1950) *Anatomy of Dicotyledons Vol. I-II*. Clarendon Press, Oxford, U.K.
- Metcalf, C.R. (1960) *Anatomy of The Monocotyledons. I. Gramineae*. Clarendon Press, Oxford, U.K.
- Tomlinson, P.B. (1961) *Anatomy of The Monocotyledons-II. Palmae* (Ed. C.R.Metcalf), Clarendon Press, Oxford, U.K.
- Lyndon, R.F. (1990) *Plant Development. The Cellular Basis*. Unnin Hyman, London, U.K.
- Esau, K. (1977) *Anatomy of Seed Plants*, (IInd Ed.) John Wiley and Sons, New York, U.S.A.
- Carlquist, S. (1988) *Comparative Wood Anatomy : Systematic, Ecological and Evolutionary Aspects of Dicotyledonous Wood*. Springer-Verlag, Berlin, Germany.
- Mauseth, J.D. (1988) *Plant Anatomy*. The Benjamin/Cummings Publ. Co. Inc. Menio Park, California, U.S.A.
- Nair, M.N.B. (1998) *Wood Anatomy and Major Uses of Wood*. Faculty of Forestry, University Putra Malaysia, Malaysia.
- Steeves, T.A. and I.M. Sussere (1989) *Patterns In Plant Development* (IInd Ed.) Cambridge University Press, Cambridge, U.K.

EMBRYOLOGY

- Johri, B.M. (Ed.) (1984) *Embryology of Angiosperms*. Springer-Verlag, Berlin, Heidelberg, New York, U.S.A.
- Bhojwani, S.S. and S.P. Bhatnagar (1974) *The Embryology of Angiosperms*. Vikas Publishing House (P.) Ltd., New Delhi, India.
- Davis, G.L. (1966) *Systematic Embryology of Angiosperms*, John Wiley & Sons, New York, U.S.A.
- Maheshwari, P. (1950) *An Introduction To the Embryology of Angiosperms*. McGraw-Hill Book Co., New York, U.S.A.
- Percival, M.S. (1965) *Floral Biology*, Pergamon Press, Oxford, U.K.
- Maheshwari, P. (Ed.) (1963) *Recent Advances In The Embryology of Angiosperms*. International Society of Plant Morphologists, University of Delhi, India.
- Proctor, M. and Yeo, P. (1973) *The Pollination of Flowers*. Wiliam Collins Sons, London.
- Raghavan, V. (1986) *Embryogenesis in Angiosperms : A Developmental And Experimental study*, Cambridge University Press, New York, U.S.A.
- Raghvan, V. (1997) *Molecular Embryology of Flowering Plants*, Cambridge University Press, Cambridge, U.K.
- Raghvan, V. (1999) *Developmental Biology of Flowering Plants*, Springer-Verlag, New York, U.S.A.
- Raven, P.H., Evert, R.F. and S.E. Eichhom (1992) *Biology of Plants* (Vth Ed.) Worth, New York, U.S.A.

PALYNOLOGY

- Shivanna, K.R. and B.M. Johri (1985) *The Angiosperm Pollen : Structure and Function*, Wiley Eastern Ltd., New York, U.S.A.
- Erdtman, G. (1966) *Pollen Morphology and Plant Taxonomy : Angiosperms*, Hafner, New York, U.S.A.
- Erdtman, G. (1969) *Handbook of Palynology*. Hafner, New York, U.S.A.
- Fægri, K. and J.Iversen (1964) *Text Book of Pollen Analysis*. Hafner, New York, U.S.A.

- Faegri, K. and Van Der Pijl L. (1979) *The Principles of Pollination Ecology*. Pergamon Press, Oxford, U.K.
- Nair, P.K.K. (1970) *Pollen Morphology of Angiosperms*. Vikas Publ. House (P.) Ltd., New Delhi, India.
- Stanley, R.G. and H.F. Linskens (1974) *Pollen Biology, Biochemistry and Management*, Springer, New York, U.S.A.
- Nair, P.K.K. (1970) *Pollen Morphology of Angiosperms : A Historical And Phylogenetic Study*. The Scholar Publishing House, Lucknow, India.
- Shivanna, K.R. and Rangaswamy, N.S. (1992) *Pollen Biology : A Laboratory Manual*, Springer-Verlag, Berlin, Germany.
- Shivanna, K.R. and Sawhney V.K. (Eds.) (1997) *Pollen Biotechnology For Crop Production and Improvement*, Cambridge University Press Cambridge, U.K.

BOT 4.24 PLANT PHYSIOLOGY SPECIAL PAPER II (60 Lect.)

1. **Water Relation of plants :** (30 Lect.)
Leaching of substances from plants, exudates, stomatal, physiology, Transfer and Transport systems in plants, salt, stress physiology causes, physiological process and phases as affected by salts stress. Parameters for salts resistance, screening techniques.
2. **Crop Product in Physiology :** (30 Lect.)
Foliar nutrition, Fertilizers, their uses and limitations.
Metabolism : Recent information of photo-synthesis and chemnosynthesis, respiration nitrogen, metabolism, lipid metabolism, secondary plant products, sulphus metabolism, interaction between photochemistry and activity of enzymes. Photoassimilation of organic compounds.

BOT 4.31 : ALGAE SPECIAL PAPER - III

(60 Lectures)

- I. **Review of Hydrobiological work of algae in India :** (4 Lect.)
 - i) Hydrobiological work of algae from ponds, lakes and reservoirs of India.
 - ii) Hydrobiological work of algae from rivers of India.
- II. **Ecological Classification of Algae :** (8 Lect.)
 - i) Phytoplankton
 - ii) Benthic algae
 - iii) Thermal Algae
 - iv) Snow algae
 - v) Lithophytes
 - vi) Soil Algae
 - vii) Epiphytes
 - viii) Endophytes
 - ix) Symbiotic algae
 - x) Parasitic algae
- III. **Fresh-Water bodies :** (14 Lect.)
Lentic and lotic environment- General considerations, physical and chemical factors and their influence, phytoplankton nature, adaptation, periodicity and succession, biota of lentic and lotic series and its features.
- IV. **Marine environment :** (8 Lect.)
General considerations, Physical and chemical factors, marine phytoplankton nature, seasonal growth cycles, and productivity, marine benthic algae, shore types and zonation patterns and factors governing them.

- V. **Algae and Sewage Disposal :** (14 Lect.)
Sewage disposal necessity, composition of sewage-Physical, Chemical and biological, Treatment of waste water - pretreatment, primary treatment, secondary treatment (Biological), methods in closed systems.
Algal stabilization ponds, types, algal flora and succession, design and maintenance, Role of algae in stabilization of waste and monitoring of water quality.
- VI. **Cultural eutrophication, algae causing bloom, odour toxicity and fouling. Effects and control measures of eutrophication, trophic state indices.** (5 Lect.)
- VII. **Algae and water pollution :** (5 Lect.)
Pollution, pollution tolerant genera and species, assessment of water quality with the help of Palmer's pollution index. Saprobitic algae and Saprobity index.
- VIII. **Control of algae :** Physical, Chemical and Biological control of algae. (2 Lect.)

M.Sc. Botany Sem.IV

BOT. 4.32 MYCOLOGY AND PLANT PATHOLOGY

SPECIAL PAPER-III (60 Lectures)

1. **History of plant pathology.** (1 Lect.)
2. **Physiological plant pathology.** (15 Lect.)
Concept of plant disease, expression, inoculum potential, production and distribution, mechanism of infection. Effect of environment on multiplication of pathogens and outbreak of diseases, defence mechanism, disease resistance, physiology of diseased plants.
3. **Important fungal, Bacterial, Viral, Namatodal and MLO major plant diseases encountered in Maharashtra. Physical, Chemical and Biological control measures.** (15 Lect.)
4. **Medical Mycology. Mycotic infections, dermatophytes and deep mycoses.** (4 Lect.)
5. **Seed Pathology . Method of study, external and internal seed borne diseases, quarantine laws and seed certification, storage mycoflora and toxins.** (5 Lect.)
6. **Market pathology : Post harvest fungal diseases of fruits and vegetables.** (4 Lect.)
7. **Forest pathology : Forest diseases, management and wood decay.** (4 Lect.)
8. **Enzymes and Toxins in plant diseases :** (12 Lect.)
Composition of cell wall material, mode, action, classification, assay of the pectolytic, cellulolytic, lignolytic and proteolytic enzymes. Classification, mode of action of host specific and non-specific toxins, role of toxins in disease development.

REFERENCE BOOKS

- Agrios G.N. 1969. Plant pathology. Academic Press, New York.
- Ainsworth G.C. 1952. Medical mycology. Pitman Press, London.
- Bakshi B.K. 1976. Forest Pathology. Controller of Pub. New Delhi.
- Bilgrami and Dube 1976. Modern plant pathology. Vikas Pub. House Pvt. Ltd. New Delhi.
- Butler E.J 1973. Fungi and plant diseases in plants. Thecker spinck & Co. Calcutta India.
- Cochrane V.W. 1958. Physiology of fungi, Wiley Chapman and Hall, New York.
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- Duggar B.M. 1998. Fungus diseases of plants, Agro Bot. Pub. New Delhi.
- Ellis M.B. 1976. Medical Mycology. Led and Febiger, Philadelphia.
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- Nene Y.L. 1976. Fungicides in Plant Disease Control. Oxford & IBH Publishing Co. New Delhi.
- Pathak, V.R. 1972. Essential of Plant pathology. Prakash Pub. Jodhpur.
- Pathak, Khatri, Pathak. 1996. Fundamentals of plant pathology. Agro Botanical Pub. Bikaner (India)
- Robertis, Boothroyd 1972. Fundamentals of plant pathology. Toppan Co. Ltd., Tokya.
- Sharma Rajni. 2000. Plant Pathology. Campus Books International, New Delhi.
- Singh R.S. 1982. Plant Pathology. Oxford and IBH Pub. Co. New Delhi.
- Singh R.S. 1990. Plant diseases (6th Ed.) Oxford & IBH Pub. O. New Delhi.
- Stakman & Harrar. 1957. Principles of Plant Pathology, Ronald Press. Co. New York.
- Suryanarayana D. 1978. Seed pathology. Vikas Pub. House Pvt. New Delhi.
- S.A.J. 1972. Principles of plant pathology. The MacMillan Press. India.
- Walker J.C. 1975. Plant Pathology, McGraw Hill Book Co. Inc. New York.

BOT 4.33 ANGIOSPERM SPECIAL PAPER-III (60 Lectures)

1. **Ethnobotany :** (10 Lect.)
-Scope and interdisciplinary approaches, abstract and concrete relationships, methods of ethnobotanical study, ethnobotany in the context of development and conservation of resources, forest management and national priorities, tree motifs, floral motifs.
2. **Arboriculture :** (15 Lect.)
Objectives in tree planting, selection of tree species on the basis of crown, shape, branching habit, growth rate, suitability to edaphic factors, and any other pertinent features of important trees suitable for roadside avenues, after care, need for manuring, maintaining shape, cavity repair.
3. **Floriculture and Landscape gardening:** (15 Lect.)
Seasonal and perennial types of flowering plants, selection colour schemes, some plant varieties for local cultivation, cultivation of Rose and Jasmine, formal and informal gardens, characteristic features and symbolism of (i) Japanese, (ii) Moghal and, (iii) English gardens.
4. **Origin of Angiosperms :** (20 Lect.)
 - a) Characteristics of the group.
 - b) Gymnospermous characters in Angiosperms.
 - c) Theories of origin of Angiosperms with reference to time, place and possible ancestors (All theories to be studied).
 - d) Origin of monocotyledons.
 - e) Angiosperm – Monophyletic or polyphyletic.

RECOMMENDED BOOKS

1. Grindal, E.W. (1960). Everyday Gardening In India. D.B. Taraporewala Sons. & Co. (P.) Ltd. Bombay, India.
2. Jain, S.K. (1981) (Ed.) Glimses of Indian Ethnobotany. Oxford & IBH Publ. Co. New Delhi, India.
3. Jain, S.K. (1987). A manual of Ethnobotany, Scientific Publishers, Jodhpur, India.
4. Jain, S.K. (1991) Contributions to Indian Ethnobotany, Scientific Publishers, Jodhpur, India.
5. Jain, S.K. (1991) Dictionary of Indian Folk Medicine And Ethnobotany, Deep Publication, New Delhi, India.
6. Jain, S.K. and V.Mudgal (1999) A Hand Book of Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
7. Joshi, P. (1995) Ethnobotany of Primitive Tribes in Rajasthan. Printwell, Jaipur, India.
8. Naik, V.N. (1984) Taxonomy of Angiosperms. Tata McGraw Hill Publ. Co.Ltd. New Delhi, India.
9. Sahni, K.C. (2000) The Book of Indian Trees (11nd Ed.) Oxford Univ. Press, Mumbai, India.
10. Singh, S.P. (1986) Planting of Trees. B.R.Publishing Corporation, Delhi, India.
11. Vishnu Swarup (1997) Ornamental Horticulture. Macmillan India Ltd., New Delhi, India.

BOT 4.34 PLANT PHYSIOLOGY SPECIAL PAPER-III
(60 Lectures)

(10 Lect.)

1. **Plant growth regulation concept of growth regulations.**
2.
 - a) **Phytochromes** : Distribution, Biosynthesis properties, metabolism, translocation, mechanism of action (at subcellular and molecular level) chemical and immuns assays. (20 Lect.)
 - b) Naturally occurring growth regulators (other than phytochromes) such as Triacntenol, Brassinolides and polyamines.
 - c) Synthetic growth substance
 - i. Growth Promoters
 - ii. Morphactins
 - iii. Growth inhibitors.
 - d) Applications of plant growth regulators in Agriculture, Horticulture and tissue culture.
 - e) Growth and Development :
 - i. Concept
 - ii. Growth indices (RGR, LAR, LNR)
 - iii. Polarity
 - iv. Uneven Growth
 - v. Rhotomorphogenesis
 - vi. Harmonal regulation of growth and differentiation
 - vii. Physiology of flowering
 - viii. Sevsence and Abscersion.

4. **Tissue Culture :** (30 Lect.)
 "In vitro" conditions, laboratory organization, aseptic manipulations, nutrient media, totipotency of plant cells, types of culture, protoplast culture isolation and purification, growth pattern in tissue culture, organogenesis, embryogenesis, cytodifferentiation, application of tissue culture in basic and applied aspects of plant physiology and plant propogation.

REFERENCE BOOKS

- Bijrachaya, D. (1999) Experiments in plant physiology. A laboratory manual Narosa Publishing House, New Delhi, India
- Bewley, J.D. and Black, M. (1982) Physiology and biochemistry of seeds in relation to germination, Viability, dormancy and environmental control Pb. Sprirga-Verlag, Berlin, Germany.
- Bewley, J.D. and Black, M. (1985). Seeds physiology of development and germination. Plenum Press, New York.
- Dodds, J.H. and Roberts, L.W. (1985). Experiments in Plant Tissue Culture Cambridge University Press, New York, U.S.A.
- David, A.E., William, R.S. Phillip, V.A. (1986) Handbook of Plant Cell Culture. Vol.IV Pb. MacMillan Publishing Co. New York.
- Gardena, F.P., Pearce, R.B., Mitchel, R.L. (1988) Physiology of Crop Plant. Pb. Scientific Publishers, Jodhpur.
- Jarvis, P.G. and Mansfield, T.A. (Eds.) (1981) Stomatal Physiology Pb. Cambridge Univ. Press., Cambridge, U.K.
- Kramov, P.J. and Kozlowski, T.T. (1979) Physiology of woody plants. Pb. Academic Press, New Work, U.S.A.
- Krishnamoorthy, H.N. (1981) Plant Growth Substances, Including Application sin Agriculture, Pb. Tata McGraw Hill, New Delhi, India.
- Levitt, J. (1980) Responses of plants to exvironmental stresses. Vol. I and II (2nd Ed.) Pb. Academic Press, New York, U.S.A.
- Malik, C.P. (Ed.) (1979). Current advances in plant reproductive biology. Pb. Kalyani Publishers, Ludhiana, India.
- Multon, J.L., Reimbert, A.M., Marsh, D. and Eydt A. J. (1989) Preservation of storage of grains, Seeds and their bi-products. CBS publishing and distributors, New Delhi, India.
- Nobel, P.S. (1999) Physiochemical and environmental Plant Physiology. Academic Press, Sandioyo, U.S.A.

- Purohit, A.N. and Gurumurti, K. (1978) Views on physiology of Flowering Bishensingh Mahendrapal Singh, Dehra Dun, India
- Razdan, M.K. (1993) An Introduction to plant Tissue Culture. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, India.
- Reinert, J. and Bajaj, Y.P.S. (1988) Applied and fundamental Aspects of plant cell, Tissue and organ Culture. Pb. Narosa Publishing house, New Delhi, India.
- Robinowitch, E. and Govindjee (1969) Photosynthesis. Johnwiley and Sons. Inc. London, U.K.
- Salisbury, F.B. and Ross, C.W. (1986) Plant Physiology CBS Publishers Distributors, New Delhi, India.
- Street, H.E. and Opicle, H. (1984) The physiology of flowering plants Pb. Edward Arnold Ltd., London, U.K.
- Taiz, L. and Zeiger, E. (1998). Plant Physiology (2nd Edn.) Sinouer Associates Inc. Masschusettes.
- Thiman, K.T. (Ed.) (1980). Senescence in plants CR Press Inc. RocaBaton, Florida, U.S.A.
- Vince-Prue, D. (1975). Photoperiodism in plants. Pb. McGrawhill, London, U.K.
- Wareing, P.F. and Phillips, I.J.D. (1981) Growth and Differentiation in plants. 3rd Edn. Pb. Pergamon Press. Oxford, U.K.
- Wilkins, M.B. (Ed.) (1987) Advanced plant physiology. Longman Scientific and Technical and John Wiley & Sons. Inc. New York, U.S.A.

REVIEWS AND JOURNALS

1. Annual Review of Plant Physiology.
2. Botanical Review
3. Plant Physiology
4. Planta
5. Plant and Soil
6. Physiologia Plantarum
7. J. Plant and Cell Physiology
8. Journal of Experimental Botany
9. Journal of Plant Biology.

BOT 4.4 PRACTICAL BASED ON BOT. 4.1

(DEVELOPMENTAL BOTANY)

(24 Practicals)

ANATOMY (8 Practicals)

1. Study of root and shoot apices from permanent slides.
 - 2,3 Study of stomatal types by peeling method
 - a. Dicotyledons
 - b. Monocotyledons
 4. Study of trichomes covering different types.
 5. Isolation and study of wood elements by acid maceration method (preparation of permanent slides by students)
 - 6,7. Double stained preparation of woods :
 - a. Dicot. woods (Covering all types)
 - b. Gymnosperm wood (Any two coniferous woods)
 8. Study of anomalous structures in stem form.
 9. Permanent or prepared slides :
 - i) Bignonia (Phloem wedges)
 - ii) Aristolochia, Tinospora (Any one) (Fissured xylem)
 - iii) Boerhavia, Mirabilis, Chenopodium, and Amaranthus (Medullary bundles) (Any two)
 - iv) Achyranthes
 - v) Salvadoria, Combretum (Interxylary or included Phloem) (Any one)
 - vi) Dracaena
- Note :** Submission of permanent slide preparation at least 2 dicot. woods, 2 Gymnosperm wood, and 2 whole mounts of wood maceration is necessary.

EMBRYOLOGY (8 Practicals)

1. Types of flowers.
2. Types of placentation and types of ovules.
3. Study of the development of microsporangium, megasporogenesis microspores, male gametophyte of angiosperms with the help of permanent slides
4. Study of megasporogenesis and female gametophytes of angiosperms from permanent slides.
5. Study of endosperm types.
6. Study of embryogenesis (from permanent slides).
- 7-8. Dissection and mounting of different stages embryo development using suitable materials. (to be done by students); multiple embryos in *Citrus* seeds.

PALYNOLOGY (8 Practicals)

1. Study of pollen development, tetrad types, pollen units - monad, dyad, tetrad, polyad, pollinia.
- 2-4. Pollen/spore preparation using suitable technique.
6 - slides of angiosperms type
2 - slides Gymnosperms.
2 - slide Bryophyte type
2 - slide Pteridophyte type
- 5-7. Study of pollen morphology, polarity, symmetry, shape, size, sporoderm stratification, aperture, N.P.C.
8. Pollen analysis from honey using suitable technique and permanent slides.

Note : Submission of ten palynological slides is compulsory.

PRACTICAL ON BOT. 4.5 BASED ON BOT. 4.21 AND BOT 4.31

ALGAE SPECIAL

(24 Practicals)

- 1&2. Culture Techniques Isolation & Purification of algal culture.
3. Mass Culture of *Chlorella*/*Scenedesmus*/*Spirulina*/any member of BGA.
4. Algal Biofertilizer technology.
- 5&6. Biomass estimation, total chlorophyll fresh and dry wt.
7. Algae of unusual habitats viz., epiphytes, lithophytes, symbiotic and aerophytes.
8. Soil and paddy field algae.
- 9&10. Algae of ponds, lakes, streams and rivers.
11. Algae of east and west coast of India (Marine Phytoplankton & Seaweeds)
12. Quantitative studies of phytoplankton using standard methods - lakes simple drop method/haemocytometer method.
13. Study of Palmers pollution index for assessing the water quality of any polluted habitat.
- 14-18. Water analysis - pH, turbidity dissolved oxygen, free CO₂, BOD, COD, Carbonate, bicarbonate, total alkalinity, chlorides, hardness, nitrate, phosphate, total solids (any six).
- 19,20. Extraction and separation of aminoacids and carbohydrates of algae by circular chromatography paper.
- 21,22. Cytological studies of *Chara*, *Cladophora*, *Pithophora*, *Oedogonium*, *Spirogyra* and *Hydrodictyon* (any two).
- 23,24. Botanical excursions for collection of algae from ponds, lakes, rivers polluted habitats & marine water.

M.Sc. Botany Sem.IV**BOT 4.5 MYCOLOGY AND PLANT PATHOLOGY PRACTICAL-II**

(24 Practicals)

(Based on Papers BOT 4.22 and BOT 4.32)

1. Isolation of fungal pathogens.
2. Isolation of Bacterial pathogens
- 3&4. Isolation and enumeration of micro-organisms from soil by serial dilution plating method.
5. Isolation of *Rhizobia* from root nodules.
6. Study of seed pathology
7. Study of Fruit pathology
- 8-9. Evaluation of minimum inhibitory concentration (MIC) of fungicide.
10. Study of diseases caused by Bacteria, viruses (Any two).
11. Study of diseases caused by Mastigomycotina and plasmodiophorales (Any three).
12. Study of diseases caused by Ascomycotina (Any three)
13. Study of diseases caused by Basidiomycotina (Any three)
14. Study of diseases caused by Deuteromycotina (Any three)
- 15-16. Biochemical studies of diseased plants by chromatography (Sugar/Amino acids).
- 17-18. Biochemical studies of diseased plants. (Enzymes/Proteins/ Polyphenol)
- 19-20. Citric Acid fermentation and Assay.
- 21-22. Alcohol fermentation and Distillation.
- 23-24. Spawn preparation and mushroom cultivation.

Note : Visit to fermentation industries, research institute, Agriculture Univ. etc. long and short tours for collection of phytopathological organisms are essential.

BOT 4.5 PRACTICAL-II (Based on Papers 4.23 & 4.33)**ANGIOSPERM SPECIAL PAPER-II & III**

(24 Practicals)

- 1-2 Identification of six important timbers with the help of anatomical characters :
- 3-9 Study of anatomical features of ecological interest of the following :
 - 1-2 Hydrophytic leaves (Any two) :
Potamogeton, Ceratophyllum, Hydrilla, Ottelia, Vallisneria, Typha, Limnophila, Phylla nodiflora, Bacopa monierjii, Nymphaea, Nelumbo.
 - 3-4 Hydrophytic stem or petiole (Any two) :
Limnophila, Hydrilla, Potamogeton, Bacopa monieri, Nymphaea, Nelumbo.
 - 5 Xerophytic leaves (Any two) :
Euphorbia neirifolia, Calotropis sp., Pentatropis sp., Nerium sp. Ficus benghalensis.
 - 6 Xerophytic stem (Any two) :
Casuarina equisetifolia, Tamarix sp., Capparis decidua, Caralluma sp. Euphorbia tirucaulli, Sarcostema sp.
 - 7 Specialized structure (Any one):
 - a) Cladode of Asparagus sp.
 - b) Phyllode of Acacia auriculiformis.
 - 8 Parasites (Any one):
Stiga gesneroides, Cuscuta chinensis.
 - 9 Epiphytes :
Study of velamen tissue (either from root material or permanent slide)
- 10-14 Study of floral anatomy, floral ontogeny and nodal anatomy :
10. Study of vasculature of hypogynous, perigynous and epigynous flowers (permanent slides)
- 11 Study of nature of inferior ovary (permanent slides)
- 12 Ontogeny of flower(permanent slides)
- 13 Study of nodal patterns of mature nodes.
- 14 Study of nodal patterns of seedling nodes.

- 15-17 Embryology
Dissection and mounting of stages of embryo development, multiple embryos and endosperms from locally available materials.
- 18-24 Palynology
18. To observe pollen fertility
19. To study pollen polymorphism.
20-21 Pollen analysis of given honey samples: unifloral and multifloral types.
22-24 Palynotaxonomy of some selected taxa (Either family or a genus).

BOT. 4.5 PRACTICAL (Based on Papers-II BOT 4.24 & BOT 4.34)

PLANT PHYSIOLOGY SPECIAL PAPER-II AND III

(24 Practicals)

1. Determine activity of RuDPase in C3, C4 and CAM plants by spectrophotometric method (leaves of Spinach and Arachis/Sugarcane and Aloe/Bryophyllum.)
2. Determine the activity of PEP ase in C3, C4 and CAM plants by spectrophotometric method (Spinach/Arachis, Maize/Sugarcane and Aloe/Bryophyllum).
- 3&4 Estimation of the activity of nitrate reductase, (Leaves of any leguminous plants).
5. Determine activity of lipase by spectrophotometric method during various stages of germination in oil seeds Carthamus, Sunflower, Ricinus (any one).
6. Determine the activity of enzymes catalase and peroxidase and study the in vitro effects of salts (NaCl, Na₂SO₄, KCl, MgCl₂ on the activities of the enzymes (leaves of Ipomoea, Carthamus, Spinach (any one plant material).
7. Estimation of proline from plant parts under control and stress (drought and salt) conditions.
8. Estimation of free and bound amino acids from plant material (leaves of lettuce or of any leguminous plant).
9. Study of change in organic constituents during senescence in leaves.
10. Culture of plant tissue in vitro.
11. Assessment of growth in vitro culture - cells, tissues.
12. Study of stomatal physiology
13. Study of deficiency symptoms
14. Effects of deficiency on chlorophyll biosynthesis.
- 15-16. Estimation of carbohydrates (reducing, non-reducing sugars, total sugars and starch.)
17. Demonstration of photosystem II activity.
18. Determine the activity enzyme IAA oxidase.
19. Study of suspension culture.
- 20-24. Physiological analyses of growth and yield of a crop plant (RGR, LAR, LWR and yield components).