



CIRCULAR NO.SU/Sci./M.Sc./69/2021

It is hereby inform to all concerned that, the syllabus prepared by the concerned Board of Studies and recommended by the Dean, Faculty of Science & Technology the Hon'ble Vice-Chancellor has accepted the **Following Syllabus for affiliated Colleges and University Department** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Syllabus (under Choice Based Credit System)
1.	M.Sc. Zoology semester Ist and IInd.
2.	M.Sc. Environmental Science semester Ist and IInd.
3.	M.Sc. Botany semester Ist and IInd.

This shall be effective from the Academic Year 2021-22 and onwards.

All concerned are requested to note the contents of this circular and bring notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO. SU/SCI/2021/ 5355-66
Date:- 13.12.2021.

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Deputy Registrar,
Academic Section.

Copy forwarded with compliments to :-

- 1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **Head of the Department, Department of Botany**
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
- 3] **Head of the Department, Department of Zoology,**
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
- 4] **Head of the Department, Department of Environmental Science,**
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
- 5] **The Director, University Network & Information Centre, UNIC,**
with a request to upload this Circular on University Website.

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Copy to :-

- 1] The Director, Board of Examinations & Evaluation, Dr.BAMU, A'bad.
- 2] The Section Officer, [M.Sc.Unit] Examination Branch, Dr.BAMU, A'bad.
- 3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU, A'bad.
- 4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU, A'bad.
- 5] The In-charge, [E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.BAMU, A'bad.
- 6] The Public Relation Officer, Dr.BAMU, A'bad.
- 7] The Record Keeper, Dr.BAMU, A'bad.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.



M.Sc. Botany

Academic Flexibility

Credit Based Grading System

M. Sc. Botany

2021-2022


15/12/21.
Dean
Faculty of Science & Technology
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad

Effective from 2021 – 2022 for University Department and all affiliated Colleges

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

M.Sc. Botany

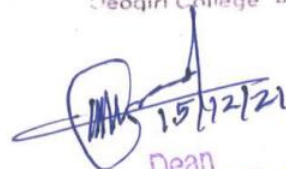
This syllabus was finalized in the meeting of Board of Studies in Botany held on 08-12-2021. The following members were present:

1. Prof. Ravi Patil	BOS Chairman
2. Prof. Arvind S. Dhabe	Member
3. Prof. Ashok M. Chavan	Member
4. Dr. Abhay N. Salve	Member

Chairman, BOS, Botany
Dr BAMU, Aurangabad



HEAD
P.G. Department of Botany
Deogiri College, Aurangabad



Dean
Faculty of Science & Technology
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad

Credit Based Cafeteria Approach
M. Sc. Course in Botany
Course Structure of M. Sc. Syllabus to be Implemented from 2021-2022.

Course Structure of M. Sc. Syllabus to be implemented from 2021-2022.										
Sr. No	Course No.	Title of the Course	Hrs	Credits Allotted	Theory				Practical	
					internal	External	Total (Maximum)	Minimum	Maximum	Minimum
Semester I										
01.	BOT 401	Cell and Molecular Biology	07	3T + 2 P	20	80	100	40	50	20
02.	BOT 402	Plant Biotechnology	07	3T + 2 P	20	80	100	40	50	20
03.	BOT 403	Biology & Diversity of Algae and Bryophytes	07	3T + 2 P	20	80	100	40	50	20
04.	BOT 404	Taxonomy of Angiosperms	07	3T + 2 P	20	80	100	40	50	20
05	IC001	Indian Constitution	02	2T	20	30	50	20	--	--
		Total		22 Credits						
Semester II										
06.	BOT 406	Cytology and Genetics	07	3 T + 2 P	20	80	100	40	50	20
07.	BOT 407	Plant Development and Reproduction	07	3T + 2 P	20	80	100	40	50	20
08.	BOT 408	Biology and Diversity in Fungi and Microbes.	07	3T + 2 P	20	80	100	40	50	20
09.	BOT 409	Plant Physiology and Metabolism	07	3T + 2 P	20	80	100	40	50	20
10	BOT 410	Research Methodology - I	03	3T	20	80	100	40	--	--
		Total		23 Credits						
Semester III										
11.	BOT 501	Biology and Diversity of Pteridophytes and Gymnosperms	07	3T + 2 P	20	80	100	40	50	20
12.	BOT 502	Plant Ecology and Conservation	07	3T + 2 P	20	80	100	40	50	20
1.	BOT 521 A BOT 521 B BOT 521 C BOT 521 D BOT 521 E BOT 521 F	Crop Genetics and Plant Breeding - I Plant Pathology-I Taxonomy of Angiosperms - I Advanced Plant Physiology and Biochem. –I Plant diversity and Conservation – I Seed Technology – I	07	3T + 2 P	20	80	100	40	50	20
15.	BOT 522 A BOT 522 B BOT 522 C BOT 522 D BOT 522 E BOT 522 F	Crop Genetics and Plant Breeding - II Plant Pathology-II Taxonomy of Angiosperms - II Advanced Plant Physiology and Biochem. II Plant diversity and Conservation – II Seed Technology – II	07	3T + 2 P Each	20	80	100	40	50	20
16	BOT 525 BOT 526 BOT 527	Service Course Plant Tissue Culture Medicinal Plants Applied Mycology	03	3T	--	--	100	40	--	--
		Total		23Credits						
Semester IV										
17.	BOT 503	Bio-prospecting and Plant Resource Utilization	07	3T +2 P	20	80	100	40	50	20
18.	BOT 504	Genetic Engineering and Bioinformatics	07	3T + 2P	20	80	100	40	50	20
19	BOT 505	Research Methodology - II	03	3T	20	80	100	40	--	--
20.	BOT 523 A BOT 523 B BOT 523 C BOT 523 D BOT 523 E	Advanced Genetics & Molecular Biology – III Plant Pathology – III Taxonomy of Angiosperms – III Advanced Plant Physiology & Biochem– III Plant diversity and Conservation – III	07	3T + 2P	20	80	100	40	50	20


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	BOT 523 F	Seed Technology – III								
21.	BOT 524 A BOT 524 B BOT 524 C BOT 524 D BOT 523 E	Research Component -Project Work	07	3T + 2 Project Work	20	80	100	40	50	20
		Total		23 Credits						

Total Credits required obtaining M. Sc. Degree in Botany

Semester I 22

Semester II 23

Semester III 23

Semester IV 23

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Total credits 91

*** At least one service course**


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BOT 401

Cell and Molecular Biology

Unit I. Cell Organelles:

- i) **Plasma membrane:** Molecular organization, current models and functions. Cell wall architecture, biosynthesis, assembly, growth and cell expansion.
- ii. **Plasmodesmata:** Structure and role in movement of molecules and macromolecules.
- iii) **Chloroplast and Mitochondria:** Ultrastructure, function and biogenesis. The organization of genome and patterns of gene expression.
- iv) **Vacuoles:** Tonoplast membrane, ATPases, transporters, as storage organelle.

Unit II. Other cellular organelles:

- i) Structure and functions of micro bodies, Golgi apparatus, Lysosomes and Endoplasmic reticulum.
- ii) **Nucleus:** Microscopic and submicroscopic organization. Structure and function of nuclear Envelope. The ultrastructure of nucleolus and its role in rRNA biosynthesis.
- iii) **Ribosomes:** Structure and site of protein synthesis. Mechanism of translation, details of initiation, elongation and termination. The structure and role of RNA.

Unit.III.

- i) **Nuclear DNA Content:** The C-value paradox, the COT value curve & its significance
- ii. **Restriction mapping:** Concept and techniques, multigene families and their evolution.

Unit IV. Cell Cycle and its molecular aspects: Control mechanism, the role of cyclin and cyclin dependent kinases, Retinoblastoma and E₂F proteins. Cytokinesis and cell plate formation. Mechanism of programmed cell death (Apoptosis) and Senescence.

Unit V. Cytoskeleton: Organization and role of microtubules and microfilaments. Implications in flagellate and other movements.

Practicals based on Bot-401

1. To determine mitotic Index in different plant materials.
2. Karyomorphological studies from slide/photograph.
3. Induction of mitotic abnormalities through chemical treatment.
4. Determination of chiasma Frequency in plants.
5. Fluorescence staining with FDA for cell viability and cell wall staining with calcofluor.
6. Demonstration of-SEM and TEM organelles.
7. Demonstration of acid phosphatases and succinic dehydrogenase activity in plants.
8. Localization of nuclear DNA by using Feulgen as a DNA specific stain.
9. Demonstration of native and SDS PAGE profiles of seed proteins.
10. Isolation of plant DNA and its quantification by spectrophotometric method.
3. Isolation of DNA and preparation of Cot curve.
11. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis and visualization by ethidium bromide staining.
12. Isolation of RNA and its quantification by spectrophotometric method.
13. Separation of plant RNA by agarose gel electrophoresis and visualization by ethidium bromide staining,
14. Demonstration of Western blotting.
15. Estimation of seed proteins by Lowry's method.

Suggested Readings (For BOT-401 Theory)

1. Lewin, B. 2000, Genes VII, Oxford University Press, New York.
2. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D.I 1999. Molecular Biology of the cell. Garland Publishing, Inc. New York.
3. Wolfe, S.L. 1993. Molecular and cellular biology. Wodsworth Publishing Company, California, U.S. A.
4. De, D.N. 2000. Plant cell vacuoles. An introduction. CSIRO Publication, Collingwood, Australia.
5. Kleinsmith, I.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (End Edition). Harper Collins College publishers, New York, U.S.A.
6. Lpdish, H., Berk, A., Zipursky, S.Z., Matsudaira, P., Baltimore, D. and Darnell, J., 2000. Molecular Cell Biology. (4th Edition). W.H. Freeman and company, New York, U.S.A.

7. Click, B. R. and Thompson, J.E. 1998. Methods in Plant Molecular biology and biotechnology. CRC Press, BOCA RBTON Florida.
8. Gilmartin P. M. and C. Bowler (2002) Molecular Plant Biology, Vol. I & II Oxford University Press, New Delhi.
9. Glover, D.M. and Hames, B.D. (Eds.) 1995. DNA cloning I: A practical approach, Core techniques, first edition, TASIRL Press at Oxford University Press, Oxford.
10. Gunning B.E.S. and Steer, M.W. 1996. Plant cell biology, structure and function. Jones and Bartlet Publishers, Boston, Massachusetts.
11. Hackett, P.B., Funchs, J.A. and Messing, J.W. 1998. An Introduction to recombinant DNA techniques: Basic experiments in gene manipulation. The Benjamin Cummings Publishing Company, Inc. Memno Park, California.
12. Hall, J.L. and Moore, A.L. 1983. Isolation of membranes and organelles from plant cells. Academic Press, London, U.K,
13. Harris, N. and Opataks, K. J. 1994. Plant Cell Biology: A practical approach. IRL Press at Oxford University Press, Oxford, U.K.
14. Shaw, C.H. (Ed.) 1988. Plant Molecular Biology: A Practical Approach. IRL Press, Oxford.

Review Journals

1. Annual review of plant physiology and molecular biology.
2. Current advances in Plant Sciences.
3. Trends in Plant Sciences.
4. Nature reviews: Molecular and Cell Biology.

BOT-402

Plant Biotechnology

- Unit I. Biotechnology:** Basic concept, Historical, principles of tissue culture, Cellular totipotency, Discoveries of Plant Growth hormones in brief review, Contribution of Sir Gottlieb Haberlandt, Development of Tissue culture as a technique, Scope and Importance.
- Unit II. Introduction to tissue culture:** Tissue culture laboratory, Equipment's in Tissue culture laboratory, Preparation of Media, Media composition, Plant Growth Regulators and their Role, selection of media for specified applications, Selection of explant, Sterilization, Sterilizing agents, initiation of tissue culture
- Unit III. Cellular totipotency:** Media for initiation of callus, dynamics of callus growth, measurement of growth, organogenesis and factors controlling it, genome instability in reaction to morphogenesis, somaclonal variation and its applications.
- Unit IV. Cell and organ culture:** Plant organ culture; shoot tip, shoot apical meristem, root, leaf, flower and ovary culture, embryo rescue, factors influencing embryogenesis, suspension culture in stationary and stirred tank reactors, isolation of single cells and their culture, measurement of growth,
- Unit V. Practical approaches of single cell culture:** Somatic embryogenesis, protoplast isolation, regeneration of protoplasts and protoplasts fusion, Synthetic seeds, generation of cybrid and hybrids, cryopreservation of plant cells.
- Unit VI. Applications of tissue culture:** Applications in agriculture and Horticulture, Application in Forestry, Application of Tissue culture in pharmaceutical industry. *In situ* and *ex-situ* conservation. *In vitro* mutagenesis and its application. Production of transgenic plants
- Unit. VII. Recombinant DNA technology:** Gene cloning, Vectors, Role of *Agrobacterium*, Gene cloning techniques - Gene gun, Electroporation, Microinjection, Liposome mediated gene transfer, Ultra sonication and Pollen Mediated gene transfer.

Practicals based on 402

1. Equipment's required in Tissue culture Lab
2. Media preparation
3. Sterilization of media
4. Sterilization of explant.
5. Explant Culture.
6. Anther culture
7. Pollen culture,
8. Micropropagation.
9. Embryo rescue technique.
10. Somaclonal variation.
11. *In vitro* mutation.
12. Isolation of plant protoplasts and viability testing.
13. Protoplast fusion by PEG.
14. Tissue culture of Horticultural plant Banana.
15. Tissue culture of Medicinal plant.

Suggested readings:

1. Henry, R.J. Practical application of plant molecular Biology, Chapman and Hall
2. Kalyankumar De. Introduction to Plant Tissue culture,
3. Bhojwani, Plant Tissue Culture.
4. Montell S.H. Mathews, J.A., Meker, R.A. Principles of Plant Biotechnology.
5. Glover, D.M. and Hanes, B.D. (eds.) 1995. DNA cloning 1: A practical approach, core techniques, 2nd edition, PAS, IRL press at Oxford University Press.
6. Plant cell culture protocols. Humana Press, Inc. New Jersey, USA.
7. Shaw, C.H. (ed.) 1998, Plant Molecular Biology. A practical approach IRI Press, Oxford.
8. Smith, R.H. 2000. Plant Tissue culture: Techniques and Experiments. Academic Press, New York.
10. Susan R. Barnum (1998). *Biotechnology: an introduction*. Thomson Brooks/cole.
11. George Acquaah (2005). *Understanding biotechnology*. Pearson.
12. Biotechnology; P.K. Gupta
13. Chawla H. S. (2005) Plant Biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd.
14. Singh B. D. (2015) Biotechnology, Kalyani Publishers, New Delhi
15. Dubey R. C. (2020) A text Book of Biotechnology, S. Chand Pub. New Delhi

BOT-403

Biology & Diversity of Algae and Bryophytes

Theory:

Unit I.i. Introduction and history of phycology with special reference to Indian work.

- ii. Algae in diversified habitats (Terrestrial, fresh water, marine). Algal blooms.
- ii. Criteria used in classification of algae, pigments, reserve food and flagella; and important systems of classification of algae.

Unit II. A general account of thallus organization, reproduction and life history of algae.

Study of important groups of algae with reference to General account, cell structure and method of reproduction and their economic importance -

- a) **Cyanophyta** – *Nostoc*, *Oscillatoria*, *Rivularia* and *Spirulina*
- b) **Chlorophyta**– Volvocales (*Chlamydomonas*, *Volvox*), Oedogonials (*Oedogonium*, *Cladophora*), Zygnematales (*Spirogyra*, *Zygnema* and *Cosmarium*)
- c) **Xanthophyta**- *Botrydium* and *Vaucheria*.
- d) **Bacillariophyta**- *Pinularia* and *Navicula*
- e) **Phaeophyta**–*Ectocarpus* and *Sargassum*.
- f) **Rhodophyta**: *Batrachospermum* and *Polysiphonia*
- g) **Unit III Bioprospecting of Algae**: BGA bio-fertilizers, Freshwater and Marine algae as food and fodder, Algae in industry. Role of algae in human welfare.

Bryophytes:

Unit IV. General account of classification, distribution, Habit, Habitat and Economic importance.

Unit IV. External and internal morphology, reproduction, gametophytes and sporophytes, phylogeny and interrelationships of the orders:

- Sphaerocarpaceae,
- Takakiales,
- Marchantiales,
- Jungermanniales,
- Anthocerotales,
- Sphagnales,
- Andreales
- Bryales.

Practical's: Based On BOT- 403

Biology & Diversity of Algae and Bryophytes

Algae :

1. Morphological study of algal forms: *Microsystis*, *Oscillatoria*, *Nostoc*, *Anabaena*, *Scytonema*, *Rivularia*, *Calothrix*, *Chlamydomonas*, *Pandorina*, *Eudorina*, *Volvox*, *Hydrodictyon*, *Ulothrix*, *Ulva*, *Odeogonium*, *Cladophora*, *Coleochaete*, *Cosmarium*, *Caulerpa*, *Acetabularia*, *Chara*, *Nitella*, *Botrydium*, *Vaucheria*, *Pinnularia*, *Navicula*, *Ectocarpus*, *Sargassum*, *Batrachospermum* and *Polysiphonia*.
2. Collection and submission of algae.

Bryophytes:

- i. Vegetative and anatomical Organization- *Marchantia*, *Riccia*, *Anthoceros*, *Porella*, *Sphagnum*, *Polytrichum*.
- ii. Reproductive structure of - *Riccia*, *Marchantia*, *Porella*, *Anthoceros*, *Sphagnum*.
- iii. Sporophytes: *Riccia*, *Marchantia*, *Porella*, *Anthoceros*, *Funaria*, *Sphagnum*, *Polytrichum*.
- iv. Collection and submission of Bryophytes.

Note: Students have to undergo several local excursions and at least one long excursion and submit excursion report.

Suggested Readings on BOT- 403 (Biology & Diversity of Algae and Bryophytes)

Algae:

1. Chapman V.J. & D. J. Chapman (1983). The Algae, The MacMillan Press Ltd., London.
2. Desikachary T.V. (1959) Cyanophyta, ICAR, New Delhi.
3. Fritsch F.E. (1961). The Structure and Reproduction of the Algae, Vol.I & H, Cambridge University Press, London.
4. Kumar H.D. (1988) Introductory Phycology, Affiliated East-West Press Pvt. Ltd., New Delhi.
5. Prescott G. W. (1969). The Algae: A Review, Thomas Nelson .and Sons Ltd., Melbourne.
6. Round F.E. (1981). The Ecology of Algae, Cambridge University Press, London.
7. Smith G.M. (1950). The fresh water algae of the United states, McGrawHill Hoc Co., New York.
8. Vijayraghavan & Sunita Kumari (1995). Chlorophyta, Bisen Singh Mahendra P. Singh, Dehra Dun.
9. Sharma O. P. (2018), A text Book of Algae, Tata Mc Graw Hill, New Delhi
10. Bilgrami, K. S. (2020), A text Book of Algae,
11. Arunnam N., Ragland Anita and Kumarion N, (2018), Fundamentals of Algae and Bryophytes, Saras Publication, Tamil Nadu
12. Samba Murty A. V. S. S. (2020), A text book of Algae, Wiley Publication, New Delhi

Bryophytes:

1. Smith (1955) Cryptogamic Botany I & II, McGraw-Hill, New York.
2. Prem Puri (1980) Bryophytes, Atmaram & Sons, Delhi.
3. Parihar N. S. (1991) Bryophytes, Central Book Dept., Allahabad.
4. Verdon - (1932) Manual of Bryology, The Hague.
5. Bower P.O. (1935) Primitive; land Plants, Macmillan and Co., London.
6. Campbell (1940) Evolution of land Plants, Stanford University Press.
7. Kashyap S.R. (1929, 1932), Liverworts of Western Himalays and the Pan); plain, Vol. I & II, The University of Punjab, Lahore.
8. Tewari, Shiv Datt and Giri Bala Pant (2005) Bryophytes of Kumaun Himalaya. Publisher- Bhishan Singh Mahendra Pal Singh- Dehradun.

BOT 404

(Taxonomy of Angiosperms)

- UNIT- I:** Angiosperms: Definition, its characteristic features and probable causes of their evolutionary success. Taxonomy: Definition, scope, principles, aims and objectives and functions of taxonomy. History of Botanical Explorations in Maharashtra with special reference to Marathwada.
- UNIT- II:** Phylogeny of Angiosperms: A general account of origin of Angiosperms with reference to time and place and possible ancestors: Euanthial theory (Bennettitales, Caytoniales, Gnetales, Cycadales) and Pseudanthial theory (Pentoxylales, Pteridospermales, Glossopteridales).
- UNIT- III:** Criteria used for classification; Categories of classification – Major, Minor and Infra-specific; phases of plant classification and brief history on account of artificial, natural, phylogenetic systems of classifications with special reference to Bentham and Hooker, Cronquist's system, Takhtajan's system and Broad outline of APG IV (2016) system of classification and its merits and demerits.
- UNIT-IV:** Botanical Nomenclature: Concept of nomenclature, Binomial nomenclature and its advantages, formation of code, Melbourne Code 2012, Shenzhen Code 2018, Principles of International Code of Nomenclature of Algae, Fungi and Plants (ICN), ending of taxa names, Typification. Taxonomic literature: Keys, Flora, Manuals, Monographs, Periodicals, Dictionaries, indices, journals, pictorial encyclopaedias and books.
- UNIT-V:** Taxonomic evidences: Morphology, anatomy, embryology, palynology, cytology, phyto-chemistry and numerical taxonomy. Taxonomic tools: Serological and molecular techniques, GIS, GPS, Use of computers in angiosperms taxonomy (Use of computer and data bases for identification of plants with the help of website). Herbarium Techniques, Major herbaria of the World and India. Contributions of Herbarium BAMU.
- UNIT-VI:** Causes of variations in population; Speciation, Species Concepts; Taxonomic Hierarchy.
- UNIT-VII:** Angiosperm Families: Nymphaeaceae, Hydatellaceae, Magnoliaceae, Papaveraceae, Malvaceae, Leguminaceae, Sapotaceae, Apiaceae, Asteraceae, Rutaceae, Apocynaceae, Solanaceae, Liliaceae, Arecaceae and Poaceae.

Practicals Based on BOT-404

TAXONOMY OF ANGIOSPERMS

1. Morphology: Terminologies related to Habit and life span, root, stem, leaves, inflorescence, Flower, fruits.
2. Phytography: Preparation of scientific botanical description of a plant specimen.
3. Study of at least 20 locally available families of flowering plants.
4. Identification of genus and species of locally available wild plants.
5. Preparation of botanical keys at generic level by locating key characters.
6. Knowledge of at least 10 medicinal plant species.
7. Demonstration of the utility for secondary metabolites in the taxonomy of some appropriate genera.
8. Local field excursions and compilation of field notes and preparation of herbarium sheets of plants.
9. Botanical excursion of about one week duration to any botanically rich location preferably outside the State and submission of Excursion report.

Note: Students have to undergo several local excursions and at least one long excursion and submit excursion report.

Suggested Readings

1. Cole, A.J. 1969. Numerical Taxonomy. Academic Press. London.
2. Davis, P.H. and Heywood, V.H. 1973. Principles of Angiosperms Taxonomy. Robert E. Krieger Pub. Co. New York.
3. Daniel Mammen (2009) Taxonomy, Evolution at work, Narosa Publication, New Delhi.
4. Grant, V. 1971. Plant Speciation, Columbia, University Press, New York.
5. Grant, W.F. 1984. Plant Biosystematics, Academic Press, London.
6. Harrison, H.J. 1971. New concepts in Flowering Plant Taxonomy. Hieman Educational Book Ltd., London.
7. Heslop-Harrison, J. 1967. Plant Taxonomy. English Language Book Soc. & Edward Arnold Pub. Ltd. U.K.
8. Heywood, V.H. and Moore, D.M. 1984. Current Concepts in Plant Taxonomy, Academic Press, London.
9. Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptions in Plant species. Hieman & Co. Educational Ltd. London.

10. Jones S.B. Jr. & Luchsinger, A.E. 1986. Plant Systematics, (2nd Edition) McGraw-Hill Book Co. New York.
11. Naik V. N. (1989) Taxonomy of angiosperms, Tata Mc Graw Hill Co. Ltd. New Delhi
12. Naik V. N. (1998) Flora of Marathwada, Amrut Prakashan, Aurangabad
13. Radford, A.E. 1986 Fundamentals of Plant Systematics. Harper & Row Publications, U.S.A.
14. Solbrig, O.T. & Solbrig D.J. 1979. Population Biology and Evolution. Addison Wesley Publication Co. Inc. U.S.A.
15. Stebbins, G.L. 1974 Flowering Plant- Evolution above Species Level. Edward Arnold Ltd., London.
16. Stace, C.A. 1989. Plant Taxonomy and Biosystematics. (2nd Edition) Edward Arnold, London.
17. Takhtajan A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.
18. Woodland D.W. 1991. Contemporary Plant Systematics. Prentice Hall, New Jersey 1

IC -001

Indian Constitution

BOT 406

Cytology and Genetics

Unit I. Chromatin organization:

- i. Chromosome structure and packaging of DNA.
- ii. Nucleosome organization, DNA Structure (A, B and Z forms)
- iii. Organization of centromere and telomere.
- iv. Karyotype analysis and the banding patterns.
- v. Special types of chromosomes- Polytene, Lampbrush, B-chromosome and sex chromosomes.
- vi. Molecular basis of chromosome pairing.

Unit II. Structural and Numerical alterations in chromosomes:

- i. The origin, meiosis and breeding behavior of duplication, deficiency, inversion, translocation heterozygotes, haploids, aneuploids and autopolyploids.
- ii. The allopolyploids and evolution of major crop plants.
- iii. Agro-biotechnological applications of Cytology and Genetics

Unit III. Mutation:

- i. Spontaneous and induced mutations.
- ii. Physical and chemical mutagens.
- iii. Molecular basis of gene mutations.
- iv. Transposable elements and mutation induced by transposons.
- v. Site directed mutagenesis.
- vi. Applications of various Mutation techniques.

Unit IV. DNA damage and repair mechanism.

- i. Gene fine structure. Cis-trans test, introns and their significance, RNA splicing.
- ii. DNA damage and repair mechanism.
- iii. Initiation of cancer at cellular level. Proto-oncogenes and oncogenes.

Unit V. Cytogenetics of aneuploids and structural heterozygotes:

- i. Effect of aneuploids on plant phenotypes.
- ii. The use of monosomics and trisomics in chromosome mapping of diploid and polyploid species.
- iii. The breeding behavior and genetics of structural heterozygotes.
- iv. The complex translocation heterozygotes.
- v. Robertsonian translocation.
- vi. B-A translocation.

Unit VI. Genetics of prokaryotic and eukaryotic organelles:

- i. Phage and Bacterial Genetics—mapping of the bacteriophage genome, genetic recombination in phage, transformation, transduction and conjugation in bacteria
- ii. Genetics of mitochondria and chloroplast, cytoplasmic male sterility.
- iii. Regulation of gene expression in prokaryotes and eukaryotes.

Unit VII. Cell signaling: Signal transduction, signaling pathways, second messengers, cAMP, genetic disorders due to the G protein defect. Lipid derived second messengers. Receptor tyrosine kinase and signaling pathway. Molecular biology of signaling.

Practical Based on 406

1. Induction of polyploidy in plants using colchicine. Different methods of application of colchicine.
2. Isolation of biochemical mutants following physical and chemical mutagenic
3. Isolation of chlorophyll mutants following physical and chemical mutagenic treatments.
4. Isolation of morphological mutants following physical and chemical mutagenic treatments.
5. Karyotype analysis in any two plant species.
6. Meiosis of complex translocation heterozygotes.
7. Meiotic behavior of monosomy in plants & its effect.
8. Meiotic behavior of trisomy in plants and its effect.
9. Mitotic/ meiotic chromosomal behaviour in mutagen treated materials.
10. Orcein and Feulgen staining of the polytene chromosomes of *Chironomus*.
11. Study of chromosome pairing and disjunction in translocation heterozygote.
12. Utilization of banding technique for identification of chromosomes in karyotype.

Suggested Readings :

1. Alberts, B. Bray, D. Lewis, J. Raff, M. Roberts, K. and Watson, J. D. 1989. Molecular Biology (Ed.) Garland Publishing Inc. New York.
2. Atherly, A. G., Girton, J. R. and McDonald, J. F. 1999. The Science of Genetics. Saunders College USA.
3. Burnham, C. R. 1962. Discussions in Cytogenetics, Burgess Publishing Co., Minnesota.
4. Busch. H. and Rothblum, L. 1982 Volume X. The cell nucleus: DNA part A, Academic Press.
5. Hartl, D. L. and Jones E. W. 1998. Genetics: Principles and Analysis (4th Ed.) Jones and Baw Publishers, Massachusetts, USA.
6. Khush, G. S. 1973. Cytogenetics of Aneuploids, Academic Press, New York, London.
7. Karp, G. 1999. Cell and Molecular Biology; Concepts and Experiments, John Wiley and Sons Inc. USA.

8. Lewin, B. 2000. Genes VII. Oxford University Press, New York, USA. Lewis, R. 1997. Human Genetics: Concepts and applications (2nd Ed), WCB, McGraw Hill, USA.
9. Malacinski, G. M. and Friefelder, D. 1998. Essentials of Molecular Biology (3rd Ed.), John and Bartlet Publishers Inc. London. Russel, P. J. 1998. Genetics (5th Ed) The Benjamin / Cummings Publishing Company, Inc. USA.
10. Powar C. B. (2016) Essentials of Cytology, Himalaya Publishing House, New Delhi
11. Sen Sumitra, Dipak Kumar Kar and B. M. Johri (2005) Cytology and Genetics, Alpha Science Publications
12. Sharma A. K. and Sharma Archana (2016) Chromosome Techniques, Theory and Practice, Butterworth Publication
13. Snustad, D. P. and Simmons, M. J. 2000. Principles of Genetics (2nd Ed.), John Wiley and Sons Inc. USA.

BOT 407

Plant Development & Reproduction

Plant Development

- Unit I.** **i. Meristems:** Organization of shoot and root apical meristem, various theories, Cytological and Molecular analysis of SAM, control of tissue differentiation especially Xylem and Phloem.
- ii. Tissue systems:** Differentiation and functions of different tissue systems such as epidermis, parenchyma, chlorenchyma, sclerenchyma, laticifers and glands.
- iii. Organ determination:** Leaf, stem, root etc.
- Unit II.** **i. Vascular tissues:** Origin, structure and functions Xylem and Phloem elements and their taxonomic significance, Wood development in relation to Environment.
- Unit III.** **i. Leaf:** Growth and differentiation, differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.
- ii. Root:** Initiation and development; lateral roots, root hair, root microbe Interaction.

Plant Reproduction

- Unit IV.** **i. Flower:** Structure and development
- ii. Pollination:** Types of pollination, attractions and rewards of pollination, pollination mechanism and vectors, breeding systems, structure of pistil, pollen interaction and fertilization.
- Unit V.** **i. Male gametophyte:** Structure of anthers, micro-sporogenesis, role of tapetum, male sterility, pollen germination, pollen tube growth and development, pollen storage, pollen allergy, pollen embryos.
- ii. Female gametophyte:** Ovule development, megasporogenesis, organization of the embryo sac. Structure of the embryo sac.
- Unit VI.** **i. Seed development and fruit growth:** Double fertilization, Endosperm development, Embryogenesis, Ultra-structure and nuclear cytology; Development of dicot and monocot embryos, poly-embryony, apomixes, embryo culture.
- ii. Fruit development and seed dispersal mechanisms.**

Practicals Based on BOT-407

1. Dermatology - trichomes and stomata and leaf anatomy of *Nerium*, *Terminalia* etc.
2. Mechanical tissues (Collenchyma, Sclerenchyma, Stone cells and Xylem), Secretory tissues (Mucilage Canals, Resin canals, Nectaries, and oil glands), laticifers (Latex cells and Vessels).
3. Vascular tissues and its constituents by sections and maceration, wood anatomy, TS, TLS and RLS
4. Abnormal secondary growth in *Dracaena*, *Bignonia*, *Aristolochia*, *Achyranthus*, *Nyctanthus*, *Salvadora*, *Beta*, *Mirabilis*, *Tinospora*.
5. Study of microsporogenesis and gametogenesis in sections of anthers.
6. Examination of modes of anther dehiscence and collection of pollen grains for
7. Microscopic examination (maize, grasses, *Crotolaria*, *Tradescantia*, *Brassica*, *Petunia*, *Solanum* etc.)
8. Test for pollen viability using stains and *in vitro* pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
9. Estimation of percentage and average pollen tube length *in vitro*
10. Pollen storage, pollen pistil interaction, *in vitro* pollination.
11. Study of ovules and embryo sacs.
12. Field study of types of flowers and pollination mechanism. .
13. Study of nuclear and cellular endosperms.

Suggested readings

- Bhojwani and Bhatnagar (2000) The Embryology of Angiosperms, S. Chand Pub. New Delhi
- Burjes, J. (1985). "An Introduction to Plant cell development Cambridge University Press, Cambridge.
- Carlquist S (2001). Comparative Wood Anatomy, Springer-Verlag, Germany.
- Chopra, V.L. (2001), 'Plant Breeding, Field Crops', Oxford, BH Pvt. Ltd, New Delhi.
- Chopra, V.L. (2001), 'Plant Breeding; theory and practice', Oxford I BH Pvt. Ltd.
- Cutler DF (1978). Applied Plant Anatomy, Longman, United Kindom
- Cutter EG (1978) Plant Anatomy, Part I & II, Edward Arnold, United Kingdom.
- Cutter, E.G. 1978 Plant Anatomy - Experiments and interpretations' Part I and II, Edward Arnold
- Dickinson WC (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA.
- Esau, K, 1965. "Plant Anatomy" (Second edition; 7th reprint 1991), Wiley Eastern, New Delhi.
- Fahn A (1974) Plant Anatomy, Pergmon Press, USA & UK.
- Fahn, A. (1977). Plant Anatomy' (3rd edition, 1982). Pergamon Press, Oxford.
- Forster, A.S. 1960. 'Practical plant anatomy D.vanNostrandcompany.Inc.
- Fosket DE. (1994) Plant, Growth and Development: A Molecular Approach, Academic Press.
- Foskt D.E. 1994 'Plant growth and development' - A molecular approach Academic Press, Santiago.

- Fritsch FE (1935, 1945). The Structure and Reproduction of Algae Vols.I and II.Cambridge University Press, Cambridge, UK.
- FrugisGivoanna (2020) Plant Development and Organogenesis: From basi principles to advanced research, M D P I
- Hopkins WG. (2006). The Green World: Plant Development, Chelsea House Publication
- Howell SH. (1998) Molecular Genetics of Plant Development, Cambridge University Press.
- Howell, S.H. 1998, Molecular genetics of plant development, Cambridge University Press, Cambridge.
- Hyndon, R,F. 1990, Plant Development - The Cellular Basis Univ. Hyman, London.
- improvement Cambridge University Press. Cambridge.
- Leyser O and Day S (2003) Mechanism of Plant Development, Blackwell Press
- Maheshwari P. (2000) An introduction to the Embryology of Angiosperms,
- Mauseth JD (1988). Plant Anatomy, The Benjamin/ Cummings Publisher, USA
- Metcalf and Chalk (1950) Anatomy of Dictotyledons vol. I & II, Clarendon Press.
- Murphy, T.M. and Thompson, WF. 1988 'Molecular plant development Prentice Hall, New Jersey.
- Nair MNB (1998). Wood Anatomy and Major Uses of Wood, Faculty of Forestry, University of Putra Malaysia, Malaysia. 11
- Nels R. Lersten (2014) Flowering Plant Embryology, Wiley, New Delhi
- Pandey A. K. (2010) Introduction to Embryology of Angiosperms,
- Procton, M. and Yeo, P. (1973), 'The pollination of flowers', William Collins Sons, London.
- Raghavan V (1997). Molecular Embryology of Flowering Plants.Cambridge University Press.
- Raghavan V (2000) Developmental Biology of Flowering Plants, Springer, Netherlands
- Raghavan, V. (1999) Developmental Biology of flowering plants', Springier Verlag, New York.
- Reven, P.H., Evert, R.F. and Eicbhom, S.E. 1992 'Biology of Plants' (5th Edition), New York.
- Richards AJ (1986) Plant Breeding System, George Allen and Unwin.
- Roberts, L.W. 1976. Cyto-differentiation in plants, Cambridge University Press, Cambridge.
- Shivanna K. R. (2003) Pollen Biology and Biotechnology, Science Publishers.
- Shivanna, K.R. and John, B.M. (1985), 'The angiosperm pollen structure and function', Willey Eastern Ltd., New York.
- Shivanna, K.R. and Rangaswamy, N.S. (1992), 'Pollen Biology: A laboratory manual', Springer Verlag, Berlin.
- Shivanna, K.R. and V.K. Sarobney, (Ed) 'Pollen Biotechnology for crop production and
- Sleeves, T.A. and Sussex, LM.1989, 'Patterns in plant development (7thedition) Cambridge Press, Cambridge.

BOT - 408

Biology and Diversity in Fungi and Microbes.

Unit I. Fungi:

- a) Fungi - General characteristics in fungi. (Ultrastructure and Reproduction).
General account and outline of Classification (Ainsworth 1973)
- b) Economic importance of fungi –
Fungi in Agriculture (Biopesticides and Biofertilizers)
Fungi in medicine
Fungi in industry
Fungi as source of food (SCP, Mushrooms).

Unit II: Fungi as plant pathogens

- General account of different groups and type study of fungi as pathogen.
 - Mastigomycotina - *Phytophthora*, *Albugo*.
 - Zygomycotina - *Rhizopus*, *Mucor*.
 - Ascomycotina - *Claviceps*, *Erysiphe*.
 - Basidiomycotina - *Puccinia*, *Ustilago*.
 - Deuteromycotina - *Alternaria*, *Aspergillus*, *Penicillium*, *Fusarium*, *Cercospora*, *Helminthosporium*.

UNIT- III. Bacteria:

- a) General characters, ultrastructure, classification, Koch's postulates,
 - Archaeobacteria and Eubacteria.
 - Economic importance of Bacteria,
 - Role of bacteria in nitrogen fixation, Role of agrobacterium in GM crops.
- b) Bacteria as plant pathogens
 - Citrus canker.
 - Angular leaf spot of Cotton.
 - Soft rot of fruits.

UNIT –IV Phytoplasma :

- a) Phytoplasma: General Account, ultrastructure and economic importance
- b) Phytoplasma as plant pathogens
 - Grassy shoot of Sugarcane.
 - Little leaf of Brinjal.
 - Sesamum phyllody

UNIT- V Virus :

- a) General account, ultrastructure, Transmission and multiplication of viruses.
- b) Economic importance of viruses.
- c) Virus carrying human diseases (HIV, COVID-19, SARI).

UNIT- VI. a) Viruses as plant pathogens

- Tomato / Chilli leaf curl virus
- Papaya leaf mosaic virus.
- Yellow vein mosaic virus of Bhindi.

Practical's based on BOT - 408

Biology and Diversity in Fungi and Microbes.

1. Principal and working of instruments, Sterilization Methods.
2. Preparation of Media, stains and Isolation of Bacteria and Fungi from soil and infected plant tissues.
3. Gram staining of bacteria.
4. Morphology and Taxonomy of following fungi - *Albugo*, *Phytophthora*, *Mucor*, *Rhizopus*, *Plasmopara*, *Sclerospora*, *Taphrina*, *Claviceps*, *Chaetomium*, *Puccinia*, *Ustilago*, *Agaricus*, *Polyporus*, *Ganoderma*, *Cyathus*, *Lycoperdon*, *Geaster*, *Alternaria*, *Aspergillus*, *Penicillium*, *Helminthosporium*, *Cercospora*, *Curvularia*, *Fusarium*, *Rhizoctonia*, *Colletotrichum*.
5. Growth of Fungi on liquid and solid media — *Fusarium* and *Alternaria*.
6. Study of bacterial plant diseases - Citrus canker, Angular leaf spot of cotton, soft rot of fruits.
7. Study of Phytoplasma diseases - Little leaf of Brinjal, Sesamum phyllody, Grassy shoot of sugarcane.
8. Study of viral plant diseases - Papaya mosaic virus (PMV), Tomato leaf curl virus (TLCV), Yellow vein mosaic virus of Bhindi (YVMV), Tobacco Mosaic Virus (TMV).
9. Collection and submission of fungal, bacterial, phytoplasma and viral diseases of plants.

Suggested Reading BOT 408:

1. U. Sinha and Sheela Shrivastava (1985) An Introduction to Bacteria, Vikas Publishing House Pvt. Ltd., New Delhi.
2. Burgey's Manual of Systematic Bacteriology, Vol. 1-4(1986-1989) Williams & Wilkins, Baltimore.
3. J.P, Verma (1992) The Bacteria, Malhotra Publishing House, New Delhi,
4. A.J. Salle (1974) Fundamental Principles of Bacteriology, Tata McGraw Hill Publishing Co.Ltd., New Delhi.10.
5. K.G.Hardy (1987) Plasmids - a Practical Approach, IRL Press, Oxford, Washington D.C.
6. Bruce A. Voyles (2002) The Biology of Viruses, McGraw Hill, Boston.
7. Luria S.E., J.E. Darnell, D. Baltimore & A. Campbell (1978) General Virology, John Wiley & Sons, New York.
- 8) E.W. Mester, C.E. Roberts, M.M. Pearsall and B. J.Mc Carth- General Microbiology, Holt,

Renehart & Winston, New York.

9. Powar & Dagainawala (2004) General Microbiology Vol. II, Himalaya Publishing House, Mumbai.
10. R. F. Boyd (1984) General Microbiology, Times Mirror/Mosby College Publishing St. Louis.
11. S.B. Biswas & Amrita Biswas (1993) An Introduction to Viruses, Vikas Publishing House Pvt. Ltd., New Delhi.
12. V. K. Gupta & M. K. Behl (1994) Indian Plant Viruses & Mycoplasma, Kalyani Publishers, Ludhiana.
13. S.P. Raychoudhari & T. K. Nariani (1977) Virus & Mycoplasma Diseases of plants in India, Oxford & IBH Publishing Co., New Delhi.
14. K.B. Deshpande & P.B. Papadiwal (1979) A Laboratory course in Bacteriology, COSIP- ULP - Botany Publication, Marathwada University, Aurangabad.
15. P.B. Papdiwal (1980) Biotechniques, COSIP- ULP - Botany Publication, Marathwada University, Aurangabad.
16. Alexopoulos C.J., C.W. Mims & M. Blakwel (1996) - Introductory Mycology, John Wiley & Sons Inc.
17. Dube H.C. (1994) - An Introduction to Fungi, Vikas Publishing House, New Delhi.
18. Sharma P.O. (2000) - Microbiology and plant pathology, Rastogi Publication, New Delhi.
19. Mukadam D. S. (1997) The Illustrated Kingdom of Fungi, Aksharganga Publication, Aurangabad.
20. Mukadam D. S. (2004) - Modern Topics in Fungi, Saraswati Printing Press, Aurangabad.
21. Rangaswami G. & A. Mahadevan (2001) - Diseases of Crop Plants in India., Prentice Hall of India, New Delhi.

BOT 409

Plant Physiology and Metabolism

- Unit I. Plant water relations:** Water Potential, Absorption and Transpiration, Stomatal Physiology, Active and passive transport of solutes, Phloem loading and unloading, source-sink relationship, Physiology of plants under water stress.
- Unit II. Enzyme:** Nomenclature, Properties and classification of enzymes, Mechanism of Enzyme action, regulation of enzyme action, isoenzymes.
- Unit III. Photosynthesis:** Light and dark reactions, pigments and mechanism of light absorption, Photosystem I and II, Emerson enhancement effect, C_3 , C_4 and CAM pathways, significance of C_4 and CAM pathways, photorespiration, Photo synthetic productivity.
- Unit IV. Respiration:** Glycolysis, TCA cycle and its role in synthesis of bio-molecules Mitochondrial electron transport, oxidative phosphorylation, Pentose phosphate pathway, cyanide resistance, Bioenergetics principles.
- Unit V. Nitrogen Metabolism:** Nitrification and denitrification, Nitrate assimilation, Biological nitrogen fixation, Biosynthesis of amino acids - reductive amination and trans amination, Protein synthesis, classification of amino acids and proteins, amphoteric nature and zwitter ions, structure of proteins, protein denaturation, Isolation and purification of proteins.
- Unit VI. Lipid Metabolism:** Fatty acids, lipids, triglycerides, Saponification, oxidation of Fatty Acids, alpha and beta oxidation.
- Unit VII. Plant Growth regulators:** Growth curve, growth analysis, Plant Growth Regulating substance (PGRS), Gibberellins, Cytokinesis, Absciscic acid, Ethylene, role of PGRS in agriculture.
- Unit VIII. Plant Development and secondary metabolites:** Physiology of flowering, Phytochrome, flowers induction, Seed germination and dormancy, senescence and aging, stress physiology, vernalization, abscission and secondary metabolites.

Practicals Based On BOT- 409

1. Separation of chlorophyll pigments by paper and thin layer chromatography,
2. Spectrophotometry - Absorption spectrum for chlorophyll pigments extracted from green leaves.
3. Estimation of total chlorophyll, chlorophyll 'a' and chlorophyll b
4. Estimation of reducing sugars using Fehling's solution A and B.
5. Isolation of starch from potato.
6. Isolation of pectin from fruit rinds.
7. Hydrolysis of starch by acid and crude enzyme extract from germinating seeds.
7. Effect of temperature on permeability.
8. Difference between C3 and C4 plants- chlorophyll content and leaf anatomy.
9. Estimation of Ascorbic acid from fruit juice and germinating seeds.
10. Estimation of proline in normal and plants under stress.
11. Separation of amino acids by paper and thin layer chromatography.
12. Chemical tests for protein.
13. Estimation of protein by Lowry's method.
14. Estimation of protein by Biuret method.
15. Isoelectric point of casein.
16. Immobilization of enzymes using sodium alginate.
17. Preparation of leaf protein concentrate (LPC) by heat coagulation method.
18. Iodine number of fat.
19. Saponification number of fat.
20. Growth analysis - RGR, NAR and LAI.
21. Fermentation process by Kuhne's apparatus

Suggested Readings :

1. Salisbury F.N. and C.W. Ross, Plant physiology: CBS Publishers and Distributors, New Delhi.
2. Lehninger, A. L. Principles of Biochemistry, CBS Publishers and Distributors, New Delhi.
3. Bidwell R.G.S., Plant physiology: Mac Millan Publishers Co., New York.
4. Wilkins M.B., Advanced plant physiology, English Language Book Society, London.
5. Borner, J. and Galston, A.W., Principles of plant physiology,
6. Noggle G.R. and Fritz, G.S., Introductory plant physiology, Prentice Hall, USA.
7. Slyter, R.O. Plant Water Relationships, Academic Press, New York.
8. D. Hess, Plant physiology, Narosa Publishing House, New Delhi.
9. Mertz, E.T., Vakils, Elementary Biochemistry, Fetter and Simsons Pvt Ltd. Mumbai.

10. Fairley, J.L. and Kilgon, G.L., Essentials of Biological Chemistry, Earr west Press Pvt. Ltd., Delhi.
11. Devlin, R.M. and Hostan, F.H., Plant physiology, CBS Publishers and Distributors, New Delhi.
12. Datta,S.C., Plant Physiology, Willey Eastern Limited, Culcutta.
13. Mukharji S., A.K.Ghosh, Plant Physiology, New Central Book Agencies, Kolkatta.
14. Jayraman, J., Laboratory Manual in Biochemistry, New Age International Publishers, Mumbai.
15. Bajrachrys D. Experiment in Plant Physiology, Narosa Publishing House, New Delhi.
16. Pandey S. N. & Sinha B. K., Plant Physiology, Vikas Publishing House, New Delhi
17. Nels R. Lersten (2014) Flowering Plant Embryology, Wiley, New Delhi
18. Goodwin T. W. & E. I. Mercer (2003) Introduction to Plant Biochemistry, CBS, New Delhi

BOT 410
Research Methodology - I

- Unit I.:** **Microscopy:** Light Microscopy, Phase contrast Microscopy, SEM & TEM, The flow cytometry and confocal microscopy in karyotype analysis, Micrometry.
- Unit II.:** **Stains and Staining Procedures:** Preparation and use of various stains used in Botany- Saffranine, Crystle Violet, Light Green, Erythrosine, Acetocarmine, Fuelgen, Basic Fuchsin, Cotton Blue, Iodine, Sudan IV, Fluoroglucinol, Carboic acid etc. Sectioning and Maceration, Microtomy and its staining.
- Unit III.:** **Ethical and Legal issues of Research:** Legal permissions for collection of biological material from Local Biodiversity committees, Forest Department, State Biodiversity Board and National Biodiversity Authority.
- Unit IV.:** **Plant Collection and Preservation** — Plant collection, Voucher specimens, Herbarium techniques, Liquid preservation, Authentication of specimens, etc.
 Sampling of Plant materials for Phytochemistry, DNA finger printing, Tissue Culture, Cytological, pathological studies etc.
- Unit IV.:** **Biostatistics:** Biostatistics used in analysis of data - mean, variance, standard deviation, standard error, coefficient of variation and 't' test, lay out of field experiments.
- Unit V.:** **Laboratory Techniques:** Ultracentrifugation, TLC, fractionation, Biochemical analysis, Electrophoresis, PCR, GISH, FISH techniques. Tissue culture technique, Spectroscopy etc.
 Laboratory ethics: Storage and handling of corrosive, toxic and flammable hazardous chemicals, Safety measures, Disposal of wastes,

Suggested Readings :

1. David T. Plummer, An Introduction to Practical Biochemistry-Third Edition-. Tata MacGraw Hill
2. Chatwal G. R. & Anand S. K. (2008) Instrumental Methods of Chemical analysis, Himalaya Publishing House, New Delhi
3. Senger R. S. Gupta Shalini, Sharma A. K., 2011, Laboratory Manual On Bioechnology- Studium Press India PVT LTD, New Dehli-2000

4. Paterson, D. D. 2008, Statistical Techniques in Agricultural research, J.V. Publishing House Jodhpur.
5. Glick Bernard R. and John E. Thompson (2014) Methods in Plant Molecular Biology and Biotechnology, CRC Press
6. Kurt Weising, Hilde Nybom, Kirsten Wolff and Gunter Kahl, CRC Press
7. Jensen Wiliam A. 2015, Botanical Histochemistry- Principles and Practice-Agri-Horti Press New Dehli.
8. Krishnamurthy K. V. (1988) Methods in Plant Histochemistry, S. Vishwanathan Printers and publishers,
9. Mungikar, A. M. 2003. Biostatistical Analysis. Saraswati Printing Press. Aurangabad.
10. Mungikar A. M. (2008) An Introduction to Biometry, Saraswati Printing Press, Aurangabad.
11. Singh H. B. & Subramanian ((2008) Field Manual on Herbarium Techniques, NISCAIR, New Delhi



15/12/21.

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