RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

(AUTONOMOUS),

DEPARTMENT OF BOTANY

Report of BoS in Botany

Date: 25.04.2019

A meeting of Board of Studies in Botany was held on 11.04.2019 at 10:00 am in the Department of Botany, Rajarshi shahu Mahavidyalaya (Autonomous), Latur. The following agenda items were discussed and resolved in presence of Honorable members of Board of Studies in Botany.

Agenda of the meeting:

1. Revision of the Curriculum of UG and PG.
2. Designing of Curriculum of B.Sc III according to CBCS.
3. Short and long Excursions for UG and PG.
4. Designing of Practicals of all the PG courses as Separate Laboratory Courses.

S.N.Shinde
Chairman
Board of studies in Botany
Rajarshi Shahu Mahavidyalaya, Latur.
(Autonomous)

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR (AUTONOMOUS)

AFFILIATED TO

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

M. Sc. FRIST YEAR (GENERAL SEMESTER PATTERN) (CBCS)

BOTANY – CURRICULUM

(MCQ + THEORY PATTERN)

w. e. f. JUNE, 2019

ACKNOWLEDGEMENT

The Chairman , Board of Studies in Botany (PG) acknowledges the contributions of the members, Board of Studies in Botany, in structuring the Postgraduate Curricula. The abundant support and recommendations from the members for designing different courses have shaped this curriculum to this present nature.

Thanks to all the esteemed.

S. N. Shinde
Chairman

Board of Studies in Botany

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

(AUTONOMOUS)

BOARD OF STUDIES IN BOTANY

2018-19 to 2020-21

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14.	Dr. D. V. Vedpathak Rajarshi Shahu Mahavidyalaya (Auto), Latur	Member (From same Faculty)

S. N. Shinde
Chairman
BoS in Botany

INTRODUCTION

The Board of Studies in Botany (PG) recognizes that curriculum, course content and assessment of scholastic achievement play complementary roles in shaping education. The structured Curriculum for Postgraduate Programme of Botany envisages postgraduate education as a specialized education, simultaneously introducing the concepts of breadth and depth in learning .It also stresses learning to learn rather than learning of specific lessons. The attempt is to prepare the students for life long learning by drawing attention to the vast world of knowledge of plants and introducing him to the methodology of systematic academic enquiry. With this in mind, we aim to provide a firm foundation in every aspect of Botany and to explain a broad spectrum of modern trends in Botany and to develop experimental, observational, computational skills also which lead him / her as an ambassador of sustainable development of our country.

OBJECTIVES

1. To know the importance and scope of the discipline.

2. To Inculcate interest in and love of nature with its myriad living forms.

3. To Impart knowledge of Science as the basic objective of Education.

4. To develop a scientific attitude to make students open minded, critical and curious.

5. To develop an ability to work on their own and to make them fit for the society.

6. To expose themselves to the diversity amongst life forms.

7. To develop skill in practical work, experiments, equipments and laboratory use along with collection and interpretation of biological materials and data.

8. To Make aware of natural resources and environment and the importance of conserving it.

9. To develop ability for the application of the acquired knowledge in the fields of life so as to make our country self reliant and self sufficient.

10. To Appreciate and apply ethical principles to biological science research and studies.

11. To enable the students to face NET, SET examinations.

12. To enable the students to face MPSC, UPSC and other competitive examinations

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR
DEPARTMENT OF BOTANY
Course Structure of M.Sc.I &II Botany Syllabus (CBCS)
To be implemented from June 2019
M.Sc.-I (New Pattern)

Semester	Course No.	Course Title	L/P	Marks			Credits
				Internal	External	Total	
		SEMESTER I					
I	**BO 1.1**	Instrumentation and Biostatistics	60	40	60	100	04
	BO 1.2	Diversity of Microbes and Cryptogams.	60	40	60	100	04
	BO 1.3	'Plant Biochemistry	60	40	60	100	04
	BO 1.4	Plant Ecology and Evolution	60	40	60	100	04
	BOLC-I	Lab course I (Based on BO 1.1)	15	20	30	50	02
	BOLC-II	Lab course II (Based on BO 1.2)	15	20	30	50	02
	BOLC-III	Lab course III (Based on BO 1.3)	15	20	30	50	02
	BOLC-IV	Lab course IV (Based on BO 1.4)	15	20	30	50	02
		Students Seminars-I				25	01
					Total	**625**	**25**
		SEMESTER II					
II	**BO 2.1**	Diversity of Pteridophytes, Gymnosperms and Fossil Plants.	60	40	60	100	04
	BO 2.2	Cell Biology	60	40	60	100	04
	BO 2.3	Plant Physiology and Metabolism	60	40	60	100	04
	BO 2.4	Plant Structure Development &Reproduction in Angiosperms	60	40	60	100	04
	BOLC-V	Lab course V (Based on BO 2.1)	15	20	30	50	02
	BOLC-VI	Lab course VI (Based on BO 2.2)	15	20	30	50	02
	BOLC-VII	Lab course VII (Based on BO 2.3)	15	20	30	50	02
	BOLC-VIII	Lab course VIII (Based on BO 2.4)	15	20	30	50	02
		Students Seminars				25	01
					Total	**625**	**25**
					Total of Marks and Credits of Semester I and II	**1250**	**50**

BO=Botany, BOLC=Botany Laboratory Course, L/P=Lectures / Practicals

S.N.Shinde

Chairman

BOS in Botany

M.Sc.-II (New Pattern)

Semester	Course No.	Course Title	L/ P	Marks Internal	Marks External	Total	Credits
		SEMESTER III &IV					
III	**BO 3.1**	Angiosperms Systematics	60	40	60	100	04
	BO 3.2	Molecular Biology	60	40	60	100	04
	BO 3.3	Immunology, Plant Nanotechnology and Forensic Botany	60	40	60	100	04
	BO 3.4	Plant Pathology-I/Genetics-I/Plant Biotechnology- I	60	40	60	100	04
	BOLC-IX	Lab course IX(Based on BO 3.1)	15	20	30	50	02
	BOLC-X	Lab course X(Based on BO 3.2)	15	20	30	50	02
	BOLC-XI	Lab course XI(Based on BO 3.3)	15	20	30	50	02
	BOLC-XII	Lab course XII(Based on BO 3.4)	15	20	30	50	02
		Students Seminars				25	01
					Total	**625**	**25**
IV	**BO 4.1**	Cytogenetics and Plant Breeding	60	40	60	100	04
	BO 4.2	Plant Biotechnology and Genetic Engineering	60	40	60	100	04
	BO 4.3	Plant Pathology-II / Genetics-II / Plant Biotechnology-II	60	40	60	100	04
	BO 4.4	Plant Pathology-III / Genetics -III/ Plant Biotechnology-III	60	40	60	100	04
	BOLC-XIII	Lab course XIII Based on (BO3.1&3.2)	15	20	30	50	02
	BOLC-XIV	Lab course XIV (Based on BO3.3&3.4)	15	20	30	50	02
	PROJECT	Project / Dissertation				100	04
		Students Seminars				25	01
					Total	**625**	**25**
					Total of Marks and Credits of Semester III and IV	**1250**	**50**
					Grand Total Marks and Credits of all Semester	**2500**	**100**

BO=Botany, BOLC=Botany Laboratory Course, L/P=Lectures / Practicals

S.N.Shinde

Chairman

BOS in Botany

Course Objectives

1. To encourage a clear comprehensive and advanced mastery in the field of Botany.
2. To provide basic principles of biological sciences with special reference to Botany and its applied branches.
3. To enable the students to explore the intricacies of life forms at ellutar, molecular and nano level.
4. To sustain students motivation and enthusiasm and to help them not only to appreciate the beauty of different life forms but also to inspire them in the dissemination of the concept of biodiversity conservation.
5. To develop problem solving skills in students and encourage them to carry out innovative research projects there by enkindling in them the spirit of knowledge creation.
6. To demonstrate knowledge and understanding of the molecular machinery of living cells.
7. To demonstrate knowledge and understanding of the principles that governs the structures of macromolecules and their participation in molecular recognition.
8. To demonstrate knowledge and understanding of the principles and basic mechanisms of metabolic control and molecular signaling.
9. To use basic laboratory skills and apparatus to obtain reproducible data from biochemical experiments.
10. To implement experimental protocols and adapt them to plan and carry out simple investigations.
11. To analyze, interpret, and participate in reporting to their peers on the results of their laboratory experiments.
12. To participate in and report orally on team work investigations of problem-based assignments.
13. To build on their knowledge and understanding in tackling more advanced and specialized courses, and more widely to pursue independent, self-directed and critical learning.
14. The aim of this course is to ensure that you can achieve an up-to-date level of understanding and competence that will serve as a lasting and practical basis for a

career, for example, in research - whether industry, pure or applied biology as well as teaching.

15. Our objective is to provide training in scientific and transferable skills through modular lecture courses, research projects, written work, seminars and supervisions.
16. At the end of the course you should have increased: Your capacity to think critically; your ability to design and execute an experiment; your confidence and ability in communicating ideas.

A Good education is like a savings account, the more you put into it, the richer you are.

- Unknown.

SEMESTER I

BO1.1 Instrumentation and Biostatistics

Credits : 4 **Lecture : 60**

Objectives

1. To focus on application of instruments in research.
2. To understand the complex optical devices, key concept and application.
3. To obtain most conclusive results.
4. To know that mixtures are composed of constituents which are not combined
5. To apply methods of distillation, filtration, evaporation, sieving to separate mixture.
6. To store and process biological data.
7. To provide platform to develop computational biological methods.
8. To use the exact methods used to calculate the relation between biological data.

Credit-I: Microscopy (15L)

1. **Microscopy :** Introduction, Principle and working of the light microscope, Compound microscope, Stereo microscope, Phase contrast microscope, Fluorescence microscope, TEM, SEM, (image processing method and staining technique) Electron confocal microscopy& Flow cytometry .
2. **Spectroscopic Techniques:** UV visible and IR spectrophotometry, NMR, Circular dichrorism, Atomic absorption & mass spectrometry, MALDITOF.

Credit-II: Separation Techniques (15L)

1. **Separation Techniques:** Centrifugation: Basic principles of centrifugation, types, care and safety aspects of centrifuges, preparative and analytical centrifugation.
2. **Chromatographic Techniques:** Principles, paper, thin layer (TLC) Column, HPTLC, HPLC, GC,Gel filtration, Affinity and ion exchange.
3. **Electrophoretic Techniques:** General principles Support media, Electrophoresis of proteins and nucleic acids, Capillary, Microchip electrophoresis.
4. **Culture Techniques**: Principles, types (bacterial, fungal, algal, plant) media preparation, Sterilization, Inoculation.

Credit-III: Computers in Biology (18L)

1. **Computers in Biology:** Modern computers, its use in Biological science, Internet.
2. **Biochemistry Laboratory:** Laboratory discipline, safety and care, experimental report. SI unit, pH and Buffers.
3. **Microtomy:** Principle of tissue fixation for microtomy, types of microtome, serial sectioning and staining.
4. **Radioactive Techniques:** Isotopes and their half-life and biological half-life, Specific activity of radioisotopes, making radioisotope solutions, detection and measurement of radioactivity - radiation counters, Liquid scintillation counters, Autoradiography, Biosafety aspects.

Credit-IV: Biostatistics (12L)

1. **Statistical Methods:** Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence interval; Errors; Levels of significance.
2. Regression and Correlation; t-test; Analysis of variance; X^2 test.

REFRENCES

1. Practical cytology, applied genetics and Bio-statistics Goswami H. K. and R. Goswami, Himalayan Publ. House, Bombay (1993)
2. Methods in plant molecular biology – M. A. Schwer and Zeclinskin publ. Academic Press New York (1989)
3. Plant histochemistry – Jensen.
4. Photosynthesis and production in a changing environment. A field and laboratory manual- Hall, Scurlik, Bolhar Nordenkampt, Leagood and Long Chapman and Hall Publ. (1993)
5. Experimental plant physiology – J. Ardittiand Dunn, Publ. Academic Press (1970).
6. Techniques in Bioproductivity and photosynthesis by – Coombs, Hall, Long and Sourlock, Pergamon press Oxford (1985)
7. Methods in enzymology- Colowick and Kaplan Academic Press.
8. Handbook of field and herbarium techniques S. K. Jain and R. R. Rao.

9. Practical Biochemistry: Principles and Techniques. Ed. E. Wilson and J. Walker (2000) Cambridge Publ.
10. Studies in Paleobotany-Andrews, H. N. (1961)
11. Modern Experimental Biochemistry-Boyer, R.(2005). Pearsa, Education, Singapore.
12. Methods in Experimental Biology.-Ralph, R. (1975). Blakie, London
13. An Introduction to Biometry- Mungikar, A. M. (1997), Saraswati Printing Press Aurangabad.
14. Methods in Cell Research- Ruthmann August
15. Analytical quantitative methods in microscopy – G. A. Meek and H. Y. Elder
16. Microscope photometry – Horst Piller
17. Biological Ultrastructure – A. Engstrom and J. B. Finean
18. Techniques in Photomicrography – Brain and Ten Cate
19. Photomicrography: A comprehensive treatise – Roger P. Loveland.
20. Laboratory techniques in Botany – M. J. Purvis and D. C. Collier and D. Walli

BO1.2 Diversity of Microbes and Cryptogams

Credits: 4 **Lecture: 60**

Objectives:

1. To support and promote research development.
2. To investigate the ecological impact of antibiotic administration on the cultivable indigenous microbiota.
3. To provide training in scientific and transferable skills through modular lecture courses, research projects.
4. To understand and competence that will serve as a lasting and practical basis for a career.
5. Study of morphology, reproduction, structure and anatomy of cryptogams.

Credit-I: Viruses, Bacteria and Mycoplasma (15L)

1. **Viruses:** General characters, Chemical composition, Ultra structure of plant viruses (TMV), Virus multiplication, transmission of plant viruses, Symptoms of viral diseases of plants and Economic importance of viruses.
2. **Bacteria**: General characters, Ultra Structure, Nutrition (Autotrophic, Heterotrophic and Symbiotic), Reproduction (Binary fission, Transformation, Transduction and Conjugation), Symptoms of Bacterial diseases of plants, Economic Importance of Bacteria.
3. **Mycoplasma:** General characters, Ultra structure, Symptoms of Mycoplasma diseases of plants, Economic importance of Mycoplasma.

Credit-II: Algae. (15L)

1. Algae in diversified habitats.

2. Thallus organization

3. Cell structure, Reproduction, Pigments, Reserve food, Flagella.

4. Classification

5. Salient Features of Chlorophyta (Chara), Xanthophyta (Voucheria), Bacillariophya (Pinnularia), Pheophyta (Sargasum) and Rhodophyta (Batrachosperm), Algal blooms;

6. Economic importance of Algae.

Credit-III: Fungi- (15L)

1. General characters of Fungi.
2. Classification of Fungi by Hawksworthet al. (1995)
3. Biodiversity and Taxonomy of the Phyla Zygomycota (Rhizopus), Ascomycota (Aspergillus), Basidiomycota (Polyporus), Oomycota (Saprolgniea) , Myxomycota (Steminitis), Dueteromycota.
4. Economic importance of Fungi.

Credit- IV: Bryophytes (12L)

1. Classification of Bryophytes, Origin of Bryophytes
2. Distribution, Habit, Morphology, Reproduction, Phylogeny, and Inter -relationship of the orders Marchentiales (Riccia), Anthocerotales (Antheceros), Jungermanniales (Porella), Sphagnales (Sphagnum), Polytracheales (Polytrichum)
3. Economic importance of Bryophytes.
4. Bryophytes as indicators of pollution.

REFRENCES

1. Textbook of Algae Kumar, H.D. and H. N. Singh (1971)
2. Textbook of Algae Sharma, O.P. (1986)
3. Textbook of Botany – Algae Pandey, B. P. (1994)
4. Botany for degree students-Algae Vashista, B. R. (1995)
5. College Botany Vol. III Gangulee, H.C. and A.K.Kar(1992)
6. Taxonomy and Biology of Blue green algae Desikachary, T.V.(1)
7. Structure and Reproduction of Algae Fritsch, F. E. (1965)
8. Algae-Form and Function Venkataraman et al. (1974)
9. Textbook of Fungi Sharma, O.O. (1989)
10. Morphology and Taxonomy of Fungi Bessey, E. A.(1967)
11. College Botany Vol. I . Gangulee, H.S.andA.K.Kar(1992)
12. The Myxomycetes of India. Thind K. S. (1977)
13. Aquatic Fungi of India Dayal (1995):
14. Inter-relationship of Bryophytes Cavers, R. (1964):
15. Liverworts of Western Himalayas and the Punjab Plains PartI
16. An introduction to Embryophyta. Vol-I Bryophyta Parihar
17. Bryology in India Ram Udar (1976):
18. Cryptogamic Botany Bol. II. Smith, G. M. (1955)

19. The Structure and life of Bryopytes. Watson, E.V, (1964)

20. Botany for degree students -Bryophyta.Vashista, B.R (1996):

21. Biology of Bryophytes Chopra, R.N. and P. K. Kumra (1988).

BO 1.3 Plant Biochemistry

Credits: 4 **Lecture : 60**

Objectives:

1. To study biomolecules and its interaction with living organism.
2. To study biomolecules and energetics.
3. To provide the students with analytical and presentation skills.
4. The course aims to provide students with a basic understanding of the molecular architecture of eukaryotic cells and organelles, including membrane structure and dynamics;
5. The chemical nature of biological macromolecules, their three-dimensional construction, and the principles of molecular recognition;
6. The metabolism of dietary and endogenous carbohydrate, lipid, and protein;
7. The principles and major mechanisms of metabolic control and of molecular signaling by hormones;
8. The significance for clinical and veterinary practice of the molecular approach to medical science;
9.

Credit-I: Molecules and their Interaction (15L)

1. Structure of atoms, molecules and chemical bonds. (Covalent and Non covalent bonds)
2. Stabilizing interactions (H-bonding, hydrophobic interactions,electrostatic interactions Van der Waals interactions etc.)
3. Principles of biophysical chemistry (Solution (Percentage, Molar, Normal, PPM and PPB) pH, buffer, Reaction kinetics,
4. Thermodynamics laws (Concept of entropy, Enthalpy, standard free energy, Colligative properties (osmotic pressure freezing point and boiling point)

Credit-II: Structure and Functions of Biomolecules (15L)

1. Composition, structure and function of biomolecules (carbohydrates, lipids, Amino acids, peptide Bonds,

2., Proteins (Primary, secondary tertiary and quaternary structure) Conformation of proteins (Ramchandran plot, secondary structure, domains, motif and folds.) ,

3. Nucleic acids. Nucleotides Conformation of nucleic acids ((A, B, Z DNA), RNA.

Credit III: Enzymology (15L)

1. Introduction, Properties, Enzymes classification, vitamins as coenzymes, .Principles of catalysis and enzyme kinetics (MM equation,)

2. Types of Enzyme inhibition, (Competitive, noncompetitive and uncompetitive)allosteric enzyme regulation,

3. Types of Enzymes (Alloenzymes, isoenzymes, Apo enzymes, Ribozymes)

Credit – IV: Metabolism (15L)

1. Bioenergetics, glycolysis, Krebs cycle, oxidative phosphorylation (ETC). HMP pathway

2 .Metabolism of carbohydrates (Gluconeogenesis), nucleotides Biosynthesis (De novo and salvage pathway)

3. General pathway of Lipid metabolism

4. General pathway of Amino acid metabolism

REFRENCES

1. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologistsm Maryland, USA Buchanan B.B, Gruissem W. and Jones R.L 2000.
2. Plant Metabolism (Second Edition) Longman, Essex, England. Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds)1997.
3. Life processes in Plants. Scientific American Library, Springer Verlag, New York, USA.. Galstone A.W. 1989.
4. Biochemistry and Physiology of Plant Hormones Springer – Verlag, New York, USA. Moore T.C.1989.
5. Physiochemical and Environmental Plant Physiology (Second Edition) Academic Press, San Diego, USA. Nobel P.S1999.
6. Plant physiology (Fourth Edition) Wadsworth Publishing Company, California,USA. Salibury F.B and Ross C.W 1992.
7. Plant Physiology (Second Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA. Taiz L. and Zeiger E. 1998.
8. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S.Chand Publications. Verma S.K. and Verma Mohit 2007.
9. Principles of Biochmistry, CBS Publishers and Distributers (Indian Reprint) Leninger

BO 1.4 Plant Ecology and Evolution

Credit: 4 **Lecture: 60**

Objectives:

1. To create awareness among students about bio resource conservation.
2. To provide scientific basis for aims of environmentalism.
3. To understand dynamics of our surrounding and conserve it.
4. To understand trend of evolution among living organism.
5. To provide students with an understanding of the basics of plant-environment and plant-plant/plant-microbe/plant-animal interactions, and what influences plant abundance and diversity. While most areas of plant ecology will be mentioned, some areas will receive more attention (e.g. plant-resource interactions, diversity).

Credit-I: Environmental Ecology (15L)

1. **The Environment:** Physical environment, biotic environment, biotic and abiotic interactions.
2. **Habitat and Niche:** Concept of habitat and niche; (niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.)
3. **Ecosystem types:** Plant interaction with abiotic factors such as climatic, edaphic, and topographic factors Plant-plant interaction concept of allelopathy, parasitism**.** Species nteraction: mutualism, commensalism, competition and predation
4. **Conservation Biology:**

1. Principles of conservation, major approach to management, Indian case studies in conservation/ management strategy (Project tiger, biosphere reserves)
2. Organisms of conservation concern: Rare, endangered species.

Credit-II: Population and Community Ecology (15L)

1. **Population Ecology:** Characteristics of a population; population growth curves; population regulation, life history strategies (r and K selection); concept of metapopulation - demes and dispersal, interdemic extinctions, age structured populations.
2. **Community Ecology:** Nature of communities; community structure and attributes; level of species diversity and its measurement, edges and ecotones.
3. **Diversity types and levels:** Alpha, Beta, Gamma, Delta , Omega.
4. **Ecological Succession:** Types; mechanisms; changes involved in succession, concept of climax.
5. **Biogeography:** Major terrestrial biomes; theory of island biogeography, bio geographical zones of India.

Credit- III: Evolutionary Biology (18L)

1. **Emergence of evolutionary thoughts:** Lamarck; Darwin-concepts of variation, adaptation struggle, fitness and natural selection; Spontaneity of mutations; the evolutionary synthesis.
2. **Origin of cells and unicellular evolution :** Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparane and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.
3. **Paleontology and Evolutionary History:** The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms. Major groups of plants.

Credit-IV Molecular evolutionary Biology (12L)

1. **Molecular Evolution:** Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.
2. **The Mechanisms:** Population genetics - Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection, Co-evolution.

REFRENCES

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2. Fundamentals of Ecology. Agarwal S. K. (1992).
3. The Biosphere. Bradbury I. K. (1990)
4. Handbook of Limnology and water pollution with practical methodology Das S. M. (1989).
5. Environment and Plant Ecology. Etherington J. R. (1975).
6. Deterministic mathematical models in population ecology. Freedman H. I.(1980).
7. Quantitative Plant Ecology. Greig Smith P. (1983).
8. Comparative Plant Ecology. Grisms J. P. et .al (1988).
9. Quantitative and dynamic ecology. Kershaw K. S. (1964).

10. Concept of ecology. Kormondy E. J. (1966).
11. Ecology. Krebs C. J. (1978).
12. Manual of plant Ecology. Misra K. C. (1989).
13. Proceedings of the school of plant ecology. Misra R. and Das R. R. (1971).
14. Ecology. Odum E. P. (1971).
15. Fundamentals of Ecology. Odum E. P. (3rd ed. 1996).
16. Fundamentals of Ecology. Odum E. P. and Gary W. Barrett (6th ed. 2010).
17. Principles of Environment Sciences. Pandeya S. C. eta .l (1963).
18. on the Origin of Species. London: John Murray (always seek out the first edition, facsimile version, and avoid later editions). Darwin, C. 1859
19. Genetics and the Origin of Species. New York: Columbia Univ. Press (there are several later editions, and the title changed in the last). Dobzhansky, T. 1937.
20. The Genetical Theory of Natural Selection. Oxford: Oxford Univ. Press (there is a later edition). Fisher, R. A. 1930.
21. Phylogenetic Systematics. Urbana: Univ. Illinois Press (an English translation of a book published earlier in German). Hennig, W. 1966.
22. Systematics and the Origin of Species. New York: Columbia Univ. Press (there is a later edition, with a different title). Mayr, E. 1942.
23. Factors of Evolution. Philadelphia: Blakiston (publication of this book, written in the early 1940's, was delayed because of war, and then the translation from Russian to English was also delayed; it has been reprinted by Univ. Chicago Press). Schmalhausen, I. I. 1949
24. Tempo and Mode of Evolution. New York: Columbia Univ. Press (again, there is a later edition, with a different title). Simpson, G. G. 1944.

Botany Lab. Course-I (2C)

(Based on Theory paper BO – 1.1 Instrumentation and Biostatistics)

1) Preparation of Standard solutions, %, M, N, PPM, PPB
2) Determination of Absorption spectra using UV-VIS spectrophotometer. (Protein / Nucleic acid)
3) Separation of Nucleic acid using Agarose gel Electrophoresis.
4) Separation of Amino acid using paper Chromatography.
5) Separation of plant pigments using thin layer chromatography.
6) Separation of proteins using SDS-PAGE (Demonstration)
7) Demonstration and working of HPTLC.
8) Study the principle and working of compound Microscope.
9) Study the principle and working of pH meter / colorimeter / spectrophotometer and centrifuge.
10) Preparation of permanent double stained slides of plant material with the help of microtomy
11) Problems based on X^2 – Test
12) ANOVA use of computers.
13) pH – measurements and preparation of buffers.
14) Verification of Beer and Lamberts law
15) Micrometry
16) Study of instruments – Radioactive counters, X-ray diffraction, NMR, GC, HPLC, SEM, TEM, Fluorescence microscopy.
17) Accessing biological data bases / Email operation.

N.B: 1) Any ten Practicals
2) Several Short Excursions and at least one Long Excursion

Botany Lab. Course-II (2C)

(Based on Theory paper BO – 1.2 Diversity of Algae, Fungi and Bryophytes)

1. Isolation of Algae from soil and water.
2. Study of Algae: - Chlorophyta: Chara.
3. Study of Algae: - Pheophyta: Sargasum.
4. Study of Algae: - Bacillariophyta: Pillularia
5. Study of Algae: - Rhodophyta: Batrachospermum.
6. Study of Bryophytes: Marchantiales: Riccia.
7. Study of Bryophytes: Anthocerotales: Anthoceros.
8. Study of Bryophytes: Polytrichales: Polytricum
9. Study of Bryophytes: Jungermanniales: Porella
10. Study of Bryophytes: Sphagnales: Sphagnum
11. Study of Fungi: Zygomycota : *Rhizopus*
12. Study of Fungi: Ascomycota : *Aspergillus*
13. Study of Fungi:Basidiomycotsa: *Polyporus*
14. Study of Fungi: Oomycota : *Saprolegniea*
15. Study of Fungi: Myxomycota: *Steminitis*

16-17. Preparation of culture media: PDA, Czapek, Dox Agar medium.

18-19. Isolation of Fungi from soil, air, water, and host, their inoculation on culture media.

Several Short Excursions- Submission of collected specimens and Excursion Report.

N.B: 1) Any ten Practicals
2) Several Short Excursions and at least one Long Excursion

Botany Lab. Course-III (2C)

(Based on Theory paper BO – 1.3 Plant Biochemistry)

1. Quantitative estimation of protein by Foline -Lowry method.
2. Quantitative estimation of protein by Bradford reagent method.
3. Isolation of DNA From various sources.
4. Isolation of RNA from yeast tablets.
5. Estimation of DNA using Diphenyl Amine reagent.
6. Estimation of RNA by orcinol reagent.
8. Estimation of total Amino acid in Germinating and Non-germinating seeds.
9. Qualitative detection of Amino acid.
10. Estimation of total soluble sugars
11. Effect of substrate concentration pH on enzyme activity.
12. Effect of pH on enzyme activity.
13. Estimation of Ascorbic acid in ripe and unripe fruits.

N.B: 1) Any ten Practicals
2) Several Short Excursions and at least one Long Excursion

Botany Lab. Course-IV (2C)

(Based on Theory paper BO – 1.4 Plant Ecology and Evolution)

1. Study of Phytoplankton
2. Evaluation of Abiotic components of Aquatic ecosystem (pH, temperature, Transparency).
3. Determination of Phytomass
4. Study of species diversity index.
5. Study of Population dynamics
6. Determination of field capacity of Soil
7. Estimation of primary productivity of an Aquatic reosysten.
8. Determination of residual chlorine from water sample.
9. Determination of frequency, Density, Abundance, Dominance and IVI of the plant community.
10. Estimation of DO and free CO_2
11. Study of morphological and anatomical characteristics of plants under pollution stages.
12. Allelopathic analysis of the plants.
13. Determination of Palmers algal index.
14. Ecological reports based on tour or analysis.

N.B: 1) Any ten Practicals
2) Several Short Excursions and at least one Long Excursion

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR
DEPARTMENT OF BOTANY
Course Structure of M.Sc.I &II Botany Syllabus (CBCS)
To be implemented from June 2019
M.Sc.-I (New Pattern)

Semester	Course No.	Course Title	L/P	Marks			Credits
				Internal	External	Total	
		SEMESTER I					
I	**BO 1.1**	Instrumentation and Biostatistics	60	40	60	100	04
	BO 1.2	Diversity of Microbes and Cryptogams.	60	40	60	100	04
	BO 1.3	'Plant Biochemistry	60	40	60	100	04
	BO 1.4	Plant Ecology and Evolution	60	40	60	100	04
	BOLC-I	Lab course I	15	20	30	50	02
	BOLC-II	Lab course II	15	20	30	50	02
	BOLC-III	Lab course III	15	20	30	50	02
	BOLC-IV	Lab course IV	15	20	30	50	02
		Students Seminars				25	01
					Total	**625**	**25**
		SEMESTER II					
II	**BO 2.1**	Diversity of Pteridophytes, Gymnosperms and Fossil Plants.	60	40	60	100	04
	BO 2.2	Cell Biology	60	40	60	100	04
	BO 2.3	Plant Physiology and Metabolism	60	40	60	100	04
	BO 2.4	Plant Structure Development &Reproduction in Angiosperms	60	40	60	100	04
	BOLC-V	Lab course V	15	20	30	50	02
	BOLC-VI	Lab course VI	15	20	30	50	02
	BOLC-VII	Lab course VII	15	20	30	50	02
	BOLC-VIII	Lab course VIII	15	20	30	50	02
		Students Seminars				25	01
					Total	**625**	**25**
					Total of Marks and Credits of Semester I and II	**1250**	**50**

BO=Botany, BOLC=Botany Laboratory Course, L/P=Lectures / Practicals

SEMESTER II

BO 2.1 Diversity of Pteridophytes, Gymnosperms, and Fossil Plants

Credits: 4 **Lectures: 60**

Objectives:

1. To provide training in scientific and transferable skills through modular lecture course, research projects, written work, and seminars.
2. To know earlier plants, their vegetative and reproductive structures and their importance.
3. To acquaint the students about the morphology, biology and importance of Pteridophytes& gymnosperms.
4. To demonstrate sufficient knowledge of the concept of the fossil plants.
5. To apply biological principle and concept to everyday life, especially to matters affecting living things, the environment and economy.
6. Student should be able to differentiate between the characteristics of Pteridophytes & Gymnosperms.
7. Student should be able to differentiate between male and female reproductive organs and relate their structure and function to the production of new plants.
8. Student should be able to trace the evolution from fossil plants.

Credit: I Pteridophytes-I (15L)

1. Introduction and characteristic features. Diversity of Pteridophytes in India and their migration to land. Affinities of Pteridophyte with Bryophyte and Algae.
2. Recent systems of classification of Pteridophytes.
3. Comparative morphology, reproduction and phylogeny of following orders with reference to the forms mentioned against each**:** Psilotales (Tmesipteris), Lycopodiales (*Lycopodium*), Filicales (*Adiantum*), Equisitales (*Equisetum*), Salviniales (*Salvinia*)

Credit: II Pteridophytes-II (15L)

1. Apogamy and Apospory.
2. Telome concept.
3. Stelar evolution.
4. Soral evolution.
5. Gamatophyte evolution.
6. Heterospory and seed habit.
7. Economic importance of Pteridophytes.

Credit: III Gymnosperms (15L)

1. Characteristic features of Gymnosperms.
2. Recent system of classification (S.P. Bhatnagar and Alok Moitra).
3. Study of morphology and reproduction Cycadales (Zamia), Coniferales (Pinus), Gnetales (Gnetum), Ephedrales (Ephedra).
4. Gymnosperms as prospective ancestor of Angiosperms.
5. Economic importance of gymnosperms.

Credit: IV Paleobotany (15L)

1. Introduction ,Evolution time scale
2. Principles of Paleobotany: Petrification, Impression and Compression.
3. Indian fossil flora –Glossopteris flora, Rajmahal hill flora and Deccan Intertrappean flora.
4. Paleopalynological techniques- Coal maceration and Lignite maceration
5. Study of morphology and evolutionary trends of:
    - Bennettitales
    - Cycadales
    - Coniferales
6. Economic importance.

Reference Books:

1. Trivedi, A. N. (2002) - Advances in Pteridology
2. Bierhorst, D.W. (1971) - Morphology of Vascular plants
3. Eames, A. J. and E. M. Giffard (1950) - Comparative morphology of vascular plants.
4. Rashid, A. (1978) - An introduction to Pteridophytes.
5. Sporne, K.R. (1966) - Morphology of Pteridophytes.
6. Bower, F. O. (1963) - The Ferns.
7. Jermy, A. G. (1973) - The Phylogeny and Classification of ferns.
8. Vashishta, B.R. (1996) - Botany for degree students – Pteridophytes.
9. Parihar, N.S. (1959) - An Introduction to Pteridophyta.
10. Arnold, C.A. (1972) - An introduction to paleobotany.
11. Darroh, W.C. (1968) - Principles of paleobotany.
12. Surange, K.R. (1968) - Indian Fossil Pteridophytes.
13. Arnold, C.A. (1947): Introduction to Palaeobotany, Mc-Graw Hill Book Co. Inc., New York and London.
14. Pteridophytes and Gymnosperms, springer Verlag, New York
15. Agashe, S.N. (1995), Palaeobotany, Oxford & IBH, New Delhi.
16. Biswas, C & Johri, B.N. (2004), The Gymnosperms, Narosa Publishing House, New Delhi.Coulter J.M. & Chamberlain C.J.(1978): Morphology of
17. Gymnosperms, Central Book Depot, Allahabad.
18. Kakkar, R.K.and Kakkar, B.R. (1995), The Gymnosperms (Fossils & Living), Central Publishing House, Allahabad.
19. Sharma O.P. (2002) Gymnosperms, Pragati Prakashan, Meerut.
20. Vashishta P.C., A.R. Sinha, Anil Kumar. 2006. Gymnosperms. S.Chand.
21. Vashishta P.C. 2006. Pteridophytes. S. Chand.
22. Parihar N.S. 1996. Biology and Morphology of Pteridophytes. Central Book Depot,Allahabad.

Journals

1. American Fern Journal.
2. International Journal of plant sciences.
3. Bierhorst, D.W. (1971) – Morphology of vascular plants
4. Chamberlein, C.J. (1966) - Gymnosperms, Structure and Evolution.
5. Coulter and Chumberlein, J. M. - Morphology of Gymnosperms.

6. Foster, A. S. and Gifford, E. M. (1959)- Comparative morphology of vascular plants.
7. Ramanujan, C.G.K. (1979) - Indian Gymnosperms in Time and Space.
8. Sporne, K.R. (1967) - Morphology of Gymosperms.
9. Vashistha, P.C. (1976) - The Gymnosperms.
10. Bhatnagar, S.P. and MoitraAlok (1996)- The Gymnosperms.
11. Arnold, C. A. (1972) - An Introduction to Paleobotany
12. Andrews, H.N. (1961) - Studies in Paleobotany.
13. Darroh, W.C. (1960) - Principles of Paleobotany.
14. Surange, K. R. (1968) - Indian Fossil Pteridophytes.
15. Shukla, A.C. and Mishra, S.D. (1975)- Essentiales of Paleobotany.
16. Bhatnagar, S.P. and MoitraAlok (1975) - The Gymnosperms.
17. Stewart, W. N. (1983) - Paleobotany and the evolution of plants,Cambridge U.S.

BO 2.2 Cell Biology

Credits: 4 **Lectures: 60**

Objectives

1. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
2. Students will understand how these cellular components are used to generate and utilize energy in cells
3. Students will understand the cellular components underlying mitotic cell division.
4. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.
5. All cell biology sections will cover the following topics.

Credit I: Cell organelles (I) (15L)

1. **Introduction**
2. Cell wall - biogenesis, ultra structure and functions. Growth- primary and secondary wall.
3. Cell membranes - molecular organization, Fluid mosaic model, membrane protein diffusion, transport across membranes- facilitated diffusion, carrier & channel proteins, transporters, active transport, transport of ions and solutes
4. Biogenesis of chloroplasts and mitochondria.
5. Molecular organization of chloroplast and mitochondrial membranes.
6. Plasmodesmata –Structure and role in movement of molecules.
7. Vacuoles –Tonoplast membrane biogenesis, transporters, role as storage organelle, transport across vacuolar membrane

Credit II: Cell organelles (II) (15L)

1. Nucleus - Structure, organization and regulation of nuclear pore complex. Transport across nuclear membrane.
2. Endoplasmic reticulum-Role in synthesis and transport of secretary proteins
3. Golgi complex –Role in sorting, storage and secretion,

4. Lysosomes, membrane integrity and role Glyoxysomes and Peroxisomes structure and functions.
5. Ribosome –Structure, assembly and dissociation of subunits, functions.
6. Structure and function of Cytoskeleton**:** Composition and organization of microtubules, microfilaments. Tread milling, role in cell division, signaling and intracellular traffic. Role in motility. Flagella-Structure and organization.

Credit III: Cell signaling and communication. (15L)

A) **Cell signaling :**

1. Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors.
2. Signal transduction pathways, secondary Messengers.
3. Regulation of signaling pathways,
4. Bacterial and plant two component systems.
5. Light signaling in plants.

B) Cellular communication:

1. Regulation of hematopoiesis.
2. General principles of cell communication.
3. Cell adhesion and roles of different adhesion molecules.
4. Gap junctions.
5. Extracellular matrix and integrins.
6. Neurotransmission and its regulation.

Credit IV: Cell cycle (15L)

Cell Cycle

1. Phases of Cell Cycle.
2. Functional importance of each phase.
3. Molecular events during cell cycle.
4. Regulation of cell cycle.
5. Cyclins and protein kinases.
6. MPF (maturation promoting factor)

Cell aging and cell senescence:

1. Programmed cell death and its molecular aspects.
2. Regulation of cell death.
3. PCD in response to stress.

Apoptosis:

1. Role of different genes.
2. Cell organelles during apoptosis.
3. Genetic control of apoptosis.

Cancer:

1. Cancer and the cell cycle.
2. Interaction of cancer cell with normal cell.
3. Metastasis.

Reference Books:

1. Albert's B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. 1989
2. Molecular biology of the Cell (2ndedition). Garland Pub. Inc., New York.
3. Karp, G. 1999. Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc., USA.
4. Lodish S, Baltimore B , Berk, C and Lawrence K, 1995 , Molecular Cell Biology ,3rd editions, Scientific American Books, N.Y
5. De Robertis and De Robertis, 1988, Cell and Molecular Biology, 8 edition, Info-Med, Hongkong.
6. Buchanan, Grissem and Jones, 2000, Biochemistry and Molecular Biology of Plants, American Soc. Plant Biologists, Waldorf
7. Lewin, B. 2000. GENE VII. Oxford University Press, New York, USA Cooper G M and Hausman R E,2007 , The Cell: Molecular Approach 4thEdn, Sinauer Associates, USA. Johnson Lewys – 2004: Cell Biology; Sarup and sons, New Delhi
8. E.J. Dupraw – 1970 : Cell and Molecular Biology; Academic Press, London
9. De Robertis and De Robertis – 1997: Cell and Molecular Biology (VIII); B.I. Waverly Pvt. Ltd., New Delhi
10. C. P. Swanson, T. Merz, and W.J. Young – 1982 : Cytogenetics ; Prentice – Hall of India Pvt. Ltd., New Delhi India
11. C. B. Powar – 1992: Cell Biology; Himalaya Publishing House.

BO 2.3 Plant Physiology and Metabolism

Credits: 4 **Lectures: 60**

Objectives

1. To increase awareness and appreciation for plants in your environment, as well as to understand their diverse physiological functions.
2. To help you understand the role of plant physiology in the botanical sciences.
3. To introduce you to some methods and techniques used in plant physiological research.
4. To give you the opportunity to develop useful research skills and to improve your scientific writing skills.
5. To help you develop the knowledge and confidence to pursue advanced courses in plant biology, and to conduct your own plant physiology research.
6. Demonstrate ways to measure environmental services accomplished by plants.
7. Propose ways of using plants to preserve and improve urban, agricultural, rural, and wilderness environments.
8. Explain and provide examples of how plants interact with light, water, soil and
9. Other organisms and how humans can optimize those interactions.
10. Evaluate the idea that plants such as wheat, corn, tea and tomato have exploited

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Credit: I Transport and translocation mechanism: (15L)

1. Solute transport and photoassimilate translocation

Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, hrough cells, across membranes, through xylem and phloem, nutrient uptake through root microbe interaction; membrane transport proteins.

2. Nitrogen metabolism:,

1. Root nodulation and nitrogen fixation.
2. Nitrogen uptake
3. NOD factor

Credit: II Stress physiology and Senescence (15L)

1. **Stress physiology**: – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.
2. **Senescence: Mechanism**, physiology of senescence; role of hormones, biochemical aspects, significance in fruit ripening.

Credit: III Photosynthesis (15L)

1. **Photosynthesis**: Evolution of photosynthetic apparatus, photoxidation of water, Hills reaction, two-pigment system, mechanism of electron and proton H+ transport.
2. **Carbon assimilation pathways** in C3, C4 and CAM plants. Photosynthetic productivity in these plants, and significance.
3. **Photorespiration:** Glycolate pathway, Glyoxylate pathway, biochemical basis of photorespiration, significance.

Credit: IV Plant Metabolism (15L)

1. **Secondary metabolites** - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.
2. **Phytohormones:** Biosynthesis and mechanism of action of Phytohormones auxin, gibberellin, cytokinin,ethylene and ABA. Brassinosteriods, Jasmonic acids, Polyamines, salicylic acid.

Suggested Reading:

1. Buchanan B.B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.
2. Galston, A.W. 1989. Life Processes in Plants. Scientific American Libray, Springer-Verlag, New York,USA.
3. Hooykaas, P.J.J., Hall, M.A. and Libbenga, K.R. (eds) 1999.Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amesterdam, The Netherilands.
4. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley& Sons, Inc., New York, USA.
5. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D.,and Darnell, J. 2000. Molecular Cell Biology (fourth edition).W.H. Freeman and Company, New York, USA.

6. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones(second edition). Springer-Verlag, New York, USA.
7. Nobel, P.S., 1999. Physiochemical and Environmental PlantPhysiology (second edition), Academic Press, San Diego, USA.
8. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th edition).Wadsworth Publishing Co., California, USA.
9. Singhal, G.S., Renger, G., Sopory. S.K., Irrgang, K.D. and Govindejee 1999. Concepts in Photobiology. Photosynthesis andPhotomorphogenesis, Narosa Publishing House, New Delhi.
10. Taiz, L. and Zeiger, E. 1998. Plant Physiology (2nd edition). Academic Press, San Diego, U.S.A. Westhoff, P. (1998) Molecular Plant Development: from Gene to Plant. Oxford University Press, Oxford, UK.
11. Plummer, D.T. 1988. An Introduction to practical Biochemistry. TataMcGraw Hill Publishing Co.Ltd.New Delhi.
12. Wilson,K. and Goulding, K.H. (Eds), 1992. A Biologist Guide to Principles and Techniques.
13. Practical Biochemistry (3rd Edition). ManasSaikia for Foundation Books, New Delhi.
14. Sadasivam, S. and Manickam A., 1996. Biochemical methods (2ndEdition). New Age International Publishers New Delhi.

BO 2.4 Plant Structure, Development & Reproduction in Angiosperms

Credits: 4 **Lectures: 60**

Objectives:

1. Student should able to describe reproductive structure of a plant and compare male and female gametophytes and explain how they form in Angiosperms.
2. To describe the components of a complete flower.
3. To compare and contrast life cycles of angiosperms, gymnosperms.
4. To describe the structure and function of the flower within the angiosperm life cycle.
5. To list and explain significance of steps in angiosperm gametogenesis and fertilization, including double fertilization.
6. To explain significance of features or steps of seed maturation, dormancy, and germination.
7. To predict mechanisms of pollination or dispersal based on flower or fruit characteristics.
8. To study structure and development of angiosperms.

Credit: I: Process of Plant Development (15L)

1. Plant development- concept, definitions and unique features.
2. Processes of development, cell growth, organization of cells, tissues and tissue system to whole plant. Cell- cell interaction.
3. Factors for development- intrinsic and extrinsic.
4. Vegetative development – structure and organization of seed embryo.
5. Seed formation and germination – Embryonal axis- meristems, establishment of seedling organ.
6. Phenomenon of development, meristems as dynamic centers of cell regeneration, organ development, primordium to organ, juvenility – characteristics, transition to adult phase.Coordinated development.

Credit: II: Embryological Aspects of Development (15L)

1. Transition - vegetative to reproductive phase, morphological and histochemical changes in vegetative plant body.
2. Gametophyte development, microsporogenesis and male gametophyte megasporogenesis and female gametophyte
3. Fertilization – process and its significance abnormalities in fertilization .
4. Embryo development - Development of embryo in dicots and monocot, unclassified or abnormal embryos, unorganized or reduced embryo.
5. Polyembryony – concept and classification of polyembryony, special cases and causes of polyembryony, apomixis- concept, categories- agamospermy and vegetative reproduction apospory, parthenogenesis .

Credit III: Molecular basis of plant development[15L]

1. Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.
2. Organization of shoot and root apical meristem , shoot and root development , leaf development and phylotaxi .
3. Molecular basis of plant development - Embryogenesis and seedling development, root, shoot and leaf development, gene expression during transition to flowering and flower development molecular genetics of gametophytes development, expression of cell incompatibility.
4. Transition to flowering and flower development-ABCE Model.

Credit IV: Palynology[15L]

1. Palynology**:** Scope and branches with special suggested readings
2. Palynotaxonomy**:** Pollen morphology and plant taxonomy with suggested readings: to Gymnosperms and Angiosperms.
3. Paleopalynology: Principles, microfossil recovery theory and techniques, microfossilgroups and oil exploration.
4. Aeropalynology**:** Principles, techniques, pollen analysis, pollen and spore allergy,
5. allergicproperties of pollen, pollen calendar and importance.
6. Agropalynology**:** Pollen viability, pollen germination, pollen storage and their
7. Significance.
8. Melittopalynology**:** Bee colony, foraging behavior of bees unifloral multifloral honey,aplication in crop productivity.

References:

1. Bhojwani S. S. and Bhatnagar S. P. (1999). The embryology of angiosperms. VikasPub.House.
2. Bhojwani S.S. and Soh W.Y. (2001). Current Trends in Embryology of Angiosperms.
3. Kluwer Academic Publishers.
4. Fahn A (1989) plant anatomy (Third edn) Pergamon Press.
5. Gilbert (2006). Developmental biology (8thEdition). Sinauer Associates, Inc., Publishers,Sunderland, Massachusetts, USA.
6. Graham C.F. and Wareing P.F. (1984). Developmental Controls in Animals and Plants.
7. Blackwell Scientific Publications.
8. Jermy Burgess (1985) An Introduction to Plant Cell Development. Cambridge University Press.
9. Johri B. M. and Srivastava P. S. (2001). Reproductive biology of plants. Narosa Pub. House,New Delhi.
10. KrishnamurthyK.V. (1988) Methods in Plant Histochemistry.
11. Lewis Wolpert(2002), Principles of Development (2ndedition). Oxford University Press.
12. Lyndon R.F. (1990) Plant Development The Cellular Basis. UNWIN HYMAN.
13. Raghavan V. (2000) Developmental Biology of Flowering Plants.SpringerVerlag.
14. Razdan M.K. (2003) Plant Tissue Culture, Oxford IBH.
15. Wareing P. F. and Philips I. D. J. (1981) Growth and Differentiation in plants. Pergamon Press
16. Wada M., Shimazaki K., Iino M. (2005). Light sensing in plants. Springer.
17. Davies P. J. (2004) Plant hormones. Kluwer.
18. Buchanan B. B., Gruissem W. and Jones R. L. (2000) Biochemistry and Molecular Biology of Plants. Americal Society of Plant Physiology, Marylan

Botany Lab. Course-V (2C)

(Based on Theory paper BO – 2.1) Diversity of Pteridophytes, Gymnosperms, and Fossil Plants

1-5 Morphological, anatomical and reproductive studies of the following members (available specimens / slides)

- Psilotales: Tmesipteris
- Lycopodiales: Lycopodium /Selaginella
- Filicales :Adianntum
- Equisitales: :Equisetum
- Salviniales :Salvinia
- Prepration of double stained slidepermnant slide of above mentioned plant material.

6-10 Study of the morphology and anatomy of the vegetative and reproductive parts of Zamia, Pinus, Gnetum, and Ephedra from available specimens / slides.

11-12 Study of following specimens (Any two as per available material)

Any Ten Practicals

N.B: 1) Any ten Practicals
2) Several Short Excursions and at least one Long Excursion

Botany Lab. Course-VI (2C)

(Based on Theory paper BO – 2.2 CELL BIOLOGY)

1 Isolation of chloroplast.

1. Demonstration of SEM and TEM.(photocopy)
2. Isolation of mitochondria. .
3. Comparative study of normal and banded karyotype.
4. Determination of mitotic index in any plant species

7. Differential centrifugation for isolation of cell fractions –Nuclear fraction

8. Determination of permeability of living cells to acids and bases

9-10.Identification of different stages of mitosis from Onion root meristem

11-12. Identification of different stages of meiosis from suitable plant material.

1. To study cell diversity.
2. Study of electron micrographs of cell organelles

Botany Lab. Course-VII (2C)

(Based on Theory paper BO 2.3)Practicals based on Plant physiology and metabolism

1. Estimation of soluble proteins in germinating and non-germinating seeds by Lowry /Bradford'smethod
2. Estimation of total amino acids in germinating and non germinating seeds
3. The identification of sugar in Fruit juices by TLC.
4. Isolation of Chloroplast from spinach leaves.
5. To study biochemical changes during leaf senescence.
6. Effect of time and enzyme concentration on the rate of enzyme action(Any one)
7. Estimation of stress induced amino acid (Proline)
8. Estimation of total fats in fatty seeds.
9. Separation of Alkaloids/Phenols by TLC.
10. Estimation of Phenols by chemical method.
11. Qualitative analysis of secondary metabolites.
12. Sugar/ amino acids analysis with paper chromatography.
13. Estimation of Chlorophylls

Any Ten Practicals

N.B: 1) Any ten Practicals
2) Several Short Excursions and at least one Long Excursion

Botany Lab. Course-VIII (2C)

Practicals Based on BO 2.4 Plant Structure, Development & Reproduction in Angiosperms

1. Isolation of vegetative and reproductive apical meristems.
2. Tracing the course of stomatal development and observations on stomatal types.
3. Anatomical studies on secondary growth (wood).
4. Origin and development of epidermal structures (trichomes, glands and lenticels) and study of secretory structures (nectaries and laticifers).
5. Histochemical comparison between vegetative SA and reproductively induced SA.
6. Observations on Microsporogenesis and development of male gametophyte (pollen).
7. Observations on.Megasporogenesis and development of female gametophyte.
8. Observations on types of endosperm, dissection and isolation of endosperm.
9. Observations on stages of embryo development, dissection and isolation of developing embryo (3 stages) .

10. In vitro germination of spore/pollen, Correlation between fertility (stainability), viability (TTC and FDA staining) and germinability (in vitro) of pollen grains.
11. Histological analysis of secondary growth (Primary or secondary axis).
12. Dissection of haustorial endosperm.
13. Dissection of an embryo of dicot and monocot.

SKELETON OF THEORYQUESTION PAPER
M. Sc. I and II Year
Semester – I, II, III & IV
Question Paper pattern

Time*: 2.30 hours* ***Maximum Marks: 60***

Note: (i) Attempt all questions
(ii) All questions carry equal marks
(iii) Draw neat and well labeled diagrams wherever necessary

Q1. Long answer type question. **15**

Or

a) Short answer type question **07**
b) Short answer type question **08**

Q2. Long answer type question. **15**

Or

a) Short answer type question **07**
b) Short answer type question **08**

Q3. Long answer type question. **15**

Or

a) Short answer type question **07**
b) Short answer type question **08**

Q4. Long answer type question. **15**

Or

a) Short answer type question **07**
b) Short answer type question **08**

S. N. Shinde
Chairman

BoSin Botany

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

(Autonomous)

M.Sc. I and II

PRACTICAL EXAMINATION IN BOTANY

SEE WINTER/SUMMER

Time: Four Hours ***Maximum Marks: 30***

Note: - (i) Attempt all questions.

(ii) Draw neat and well labeled diagrams wherever necessary

Q.1) a) Long answer type question. 15

b) Long answer type question.

Q.2) a) Short answer type question 10

b) Short answer type question

Q.3) Viva-voce. 05