RAJARSHI SHAHU MAHAVIDYALAYA, LATUR
(AUTONOMOUS)

AFFILIATED TO

SWAMIRAMANANDTEERTHMARATHWADAUNIVERSITY, NANDED

M. Sc. (SEMESTER PATTERN)

M. Sc. FIRST YEAR

BOTANY – CURRICULUM

w. e. f. JUNE, 2017

ACKNOWLEDGEMENT

The Chairman , Board of Studies in Botany (PG) acknowledges the contributions of the members, Board of Studies in Botany, in structuring the under graduate 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.

Chairman

Board of Studies in Botany

Programme 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.

BO1.1 Instrumentation and Biostatistics

Credit : 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.

COURSE OUT COME

I] Bioinstrumentation & Biostatistics

1) Prepared to interpret and participate in reporting to their peers on the result of their laboratory experiments.
2) Able to use basic laboratory skills and apparatus to obtain reproducible data from biochemical experiments.
3) Able to understanding of the principles that governs the structures of molecular recognition.

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&Micrometry.

2. Spectroscopic Techniques: UV visible and IR spectrophotometry, Spectrofluorimetry,

NMR and ESR spectroscopy, Circular dichrorism, Atomic absorption & massspectrometry,

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

Credit: 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.

COURSE OUT COME

1) Prepared them to achieve on up to date level of understanding and competence that will serve as a lasting and Practical basis for a carrier for that is in research – industry.

2) Developed ability to design and execute an experiment.

3) Provided students with a basic understanding of the molecular architecture of macromolecules.

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.

SalientFeaturesofProtochlorophyta,Chlorophyta,Charophyata,Xanthophyta,Bacillariophya pheophyta and Rhodophyta, 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 Chytridiomycota, Zygomycota Ascomycota, Basidiomycotsa Oomycota, Hypochytridiomycota, Labyrinthulomycota, Hemiascomycetes,

Plasmodiophoromycota, Dictyostelliomycota, Myxomycota.

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

Sphaerocarpales, Takakiales, Jungermanniales, Sphagnales, Buxbaumiales

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

Credit: 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. An awareness of the ethical aspects of molecular science.

COURSE OUT COME

1) Able to investigate the ecological impact of antibiotic administration on the cultivable indigenous micro biota.

2) Provided training in scientific and transferable skills through modular lecture courses.

3) Able to distinguish species on morphology and anatomy basis.

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, proteins (Primary, secondary tertiary and quaternary structure)
2. Conformation of proteins (Ramchandran plot, secondary structure, domains, motif and folds.), Nucleotides (ATP, GTP, TTP, CTP and UTP)
3. Nucleic acids. Conformation of nucleic acids (Watson and Crick Model 1953 (A, B, Z), RNA. Stability of proteins and nucleic acids.

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, allosteric enzyme regulation, mechanism of enzyme catalysis (Covalent catalysis)
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 (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. Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi. Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee 1999.
8. Plant Physiology (Second Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA. Taiz L. and Zeiger E. 1998.
9. Photoperiodism in Plants (Second Edition) Academic Press, San Diego, USA. Thomas B. and Vince-Prue D. 1997.
10. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S.Chand Publications. Verma S.K. and Verma Mohit 2007.
11. 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).

COURSE OUT COME

1) Created awareness among students about bio resource conservation.
2) Able to understand dynamics of our surrounding and conserve it.
3) Provided students with to understand trend of evolution among living organisms.

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 and gamma.
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

1. Patterns of primary production in the biosphere. H.F.W. Lieth (1978).
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 (4C)

(Based on Theory paper BO – 1.1 and BO – 1.2)

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.

NB: Any Ten Practicals

BO-1.2 Diversity of Algae, Fungi and Bryophytes

1. Isolation of Algae from soil and water, collection and preservation .
2. Handling of compound microscope and methods to study algae (use computational facility attached with microscope for observation.
3. **Algae: -** Chlorophyta : Volvox, Chlorella, Oedogonium, Spirogyra, Zygnema.
4. **Algae: -** Charophyta : Nostoc, Anabaena, Oscillatoria.
5. **Algae:-** Pheophyta : Ectocarpous.

6. **Algae:-** Bacillariophyta: Diatoms
7. **Algae: -** Xanthophyta : Botrydium, Vaucheria.
8. **Algae:-** Rhodophyta : Batrachospermum, Polysiphonia.

9-10. **Bryophytes :** Marchantiales, Anthocerotales, Polytrichales, Jungermanniales

11-12. Preparation of culture media: PDA, Czapek, Dox Agar medium.

13-15. Isolation of Fungi from soil, air, water, and host, their inoculation on culture media.

16. Study of the antimicrobial activity against fungi Trichoderma.

NB: Any Ten Practicals

Botany Lab Course –II (4C)

(Based on theory paper BO-1.3 and BO-1.4)

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. Quantitative estimation of Amino acid.
10. Estimation of Trypsine, Chymotrypsin .
11. Estimation of total soluble sugars
12. Estimation of cellulose from given plant material.
13. Effect of substrate concentration pH on enzyme activity.
14. Effect of pH on enzyme activity.
15. Estimation of Ascorbic acid in ripe and unripe fruits.

NB: Any Ten Practicals

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.

NB: Any Ten Practicals