

DEPARTMENT OF BOTANY

B. Sc.

(Semester System)

SYLLABUS

3 Year Programme

(2 Paper Pattern)

To be applicable from, July 2019

KUMAUN UNIVERSITY

NAINITAL

BOTANY
CURRICULA- SEMESTER SYSTEM

Three Years Programme

B. Sc. Course in Botany syllabus, Kumaun University, Nainital

Semester system with effect from July 2019

Total six semesters.

Each semester will be of 200 marks.

Semester system course structure:

1. The course work shall be divided into six semesters with two papers in each semester.
2. Each paper in semester will be of 80 marks out of which 60 marks for theory and 20 marks are allotted for internal assessment (one written test/assignment/both)
3. Each theory paper shall consists of section (A) will be of 8 questions and 5 questions to be attempted (45 marks) section (B) will be of 2 questions of 15 marks each (30 marks) with internal choice.
4. Students shall have to attempt in all 07 questions out of 10 questions in each paper. Both sections are compulsory.
5. Question paper shall be prepared from the whole syllabus proportionally.
6. Practical in each semester will be of total 40 marks, out of which 10 marks are assigned for internal assessment (Attendance, practical records and herbarium etc.).
7. Practical examination will be evaluated by both external and internal examiner.
8. The duration of theory and practical examination shall be 03 h and 04 h, respectively.

**B. Sc. Botany
I Semester**

Max. Marks: 200

Paper I: Algae and Bryophyta	80 (60+20)
Paper II: Fungi and El. Microbiology	80 (60+20)
Practical	40 (30+10)
Total	200

II Semester

Max. Marks: 200

Paper III: Pteridophyta and Gymnosperm	80 (60+20)
Paper IV: Ecology and Biostatistics	80 (60+20)
Practical	40 (30+10)
Total	200

III Semester

Max. Marks: 200

Paper V: Taxonomy of Angiosperms and Economic Botany	80 (60+20)
Paper VI: Embryology and Morphogenesis	80 (60+20)
Practical	40 (30+10)
Total	200

IV Semester

Max. Marks: 200

Paper VII: Plant Anatomy	80 (60+20)
Paper VIII: Genetics and Plant Breeding	80 (60+20)
Practical	40 (30+10)
Total	200

V Semester

Max. Marks: 200

Paper IX: Plant Physiology	80 (60+20)
Paper X: Biochemistry	80 (60+20)
Practical	40 (30+10)
Total	200

VI Semester

Max. Marks: 200

Paper XI: Cell and Molecular Biology	80 (60+20)
Paper XII: Biotechnology	80 (60+20)
Practical	40 (30+10)
Total	200

Semester-I

Bot. 101: PAPER-I ALGAE AND BRYOPHYTA

Max. Marks: 80

1. Introduction and salient features of algae and their place among the organism.
2. Classification of algae (Smith) up to class level and basis of classification.
3. Range of vegetative structure of algae. Cell structure of Prokaryotic and Eukaryotic algae.
4. Reproduction, types of life cycles (haplontic, diplontic, diplohaplontic, haplodiplontic and diplobiontic) and alternation of generation in algae.
5. Ecology of algae-brief idea of fresh water and marine, terrestrial, epiphytic, parasitic, symbiotic algae and phytoplanktons.
6. Economic importance of algae as food, fodder, in agriculture, industry and public health.
7. Structure, reproduction and life cycles of the following genera-
Nostoc, *Chlamydomonas*, *Volvox*, *Oedogonium*, *Chara*, *Vaucheria*, *Ectocarpus*,
Sargassum, *Polysiphonia*, Diatoms.
8. Introduction, salient features, distribution, habit and habitat and economic importance of Bryophyta.
9. A brief account of alternation of generation in Bryophyta.
10. Classification of Bryophyta (Rothmaler/Schuster) upto order level giving the characteristic features of each class.
11. Study the following genera on the basis of morphology and anatomy of gametophyte, vegetative, sexual reproduction and sporophyte: *Riccia*, *Marchantia*, *Pellia*, *Anthoceros* and *Funaria*

Bot. 102: Paper- II FUNGI AND ELEMENTARY MICROBIOLOGY

Max. Marks: 80

1. Introduction and salient features of Fungi. A brief history of the study of fungi and their place among the organisms.
2. A broad outline of classification of fungi(Ainsworth) up to the class level
3. Somatic structure of fungi, nutritional and environmental needs of fungi.

4. Reproduction in fungi: asexual and sexual reproduction, heterothallism (two allelomorph heterothallism only), heterokaryosis, a general idea of parasexual cycle.
5. Pathology of fungal plant diseases: A brief idea about disease symptoms, control of plant diseases; brief idea about the exclusion, eradication and protection of plants.
6. Importance of fungi both beneficial and harmful.
7. Life history of the following genera in brief:
Stemonitis, Synchytrium, Saprolegnia, Albugo, Rhizopus, Penicillium, Eryshiphe, Morchella, Ustilago, Puccinia, Agaricus, Alternaria.
8. Diversity of Microbiology: a general account.
9. Archaeobacteria and Eubacteria: General account, Gram positive and Gram negative bacteria, nutrition, reproduction and economic importance.
10. Viruses: Characteristics, chemical nature, replication, transmission of viruses, economic importance.
11. Lichens: Characteristics, general structure, reproduction, economic importance, symbiotic relationship and habitats.

Bot. 103: Lab course (Practical)

Max. Marks: 40

Algae

To study and identify the following algal material by preparing the temporary slides: *Nostoc, Chlamydomonas, Chara, Oedogonium, Spirogyra, Vaucheria, Sargassum, Fucus, Polysiphonia* including some genera available at local level.

To study and comment upon the specimens/slides of the given material.

Bryophyta

A. To study the morphological and anatomical features of the following material and identify them: *Riccia, Marchantia, Pellia, Anthoceros, Funaria* or locally available material.

B. To comment upon the specimens/slides given.

Fungi and Microbiology

A. To study and identify the following fungal material by preparing the temporary slides: *Albugo, Rhizopus, Mucor, Penicillium, Aspergillus, Puccinia, Ustilago, Alternaria.*

B. To study and comment upon the following specimens/slides of fungi: *Morchella*, *Agaricus*, Smut, Rust, Powdery mildew, White rust, *Synchytrium*, Spores of *Puccinia*, Conidia of *Alternaria*

Microbiology

- A.** Study of different types of lichens: foliose, fructicose and crustose. Morphological features of viral infected plants, study of bacterial infections in plants.
- B.** To comment on the specimens.

Suggested readings:

- Kumar H.D. 1999. Introductory phycology. Affiliated East West Press, New Delhi.
- Parihar, N.S. 1991. An introduction to bryophyta Vol I. Central Book Depot Allahabad.
- Parihar, N.S. 1991. An introduction to bryophyta Vol II. Central Book Depot Allahabad.
- Vashishta, B.R., Sinha A.K. 2012 Botany for degree students: Fungi. S.Chand New Delhi
- Vashishta, B.R., Sinha A.K. and Singh, V.P 2012 Botany for degree students: Algae. S.Chand New Delhi
- Vashishta, P.C., Sinha A.K. and Kumar Adarsh. 2012. Botany for degree students: Bryophyta. S. Chand, New Delhi
- Matthews, R.E. 2013 Fundamentals of Plant Virology ELSEVIER India
- Tandan, Neeraj 2014 Advances in Microbiology. Anmol
- Tauro, P. 1986. An Introduction to Microbiology. New Age International

Semester-II

Bot. 201: PAPER III PTERIDOPHYTA AND GYMNOSPERMS

Max. Marks: 80

1. Introduction and salient features of Pteridophyta and economic importance.
2. Alternation of generation in Pteridophyta.
3. Classification of Pteridophyta(Bierhort) upto order level pointing out the features of special significance of each class.

4. Studies on *Rhynia*, *Lycopodium*, *Selaginella*, *Equisetum*, *Adiantum* on the basis of morphology and anatomy of vegetative plant body, spore producing organs and sexual reproduction.
5. Stellar system, heterospory, seed habit and Telome theory.
6. Introduction and salient features of Gymnosperms and their place among the plant kingdom.
7. Classification of gymnosperms upto order level pointing out the features of special significance of each class.
8. Alternation of generation in Gymnosperms.
9. Comparative study of *Cycas*, *Pinus* and *Ephedra* on the basis of morphology and anatomy of the vegetative plant body, sporophylls (their arrangement) and sporangia, spores, male and female gametophytes, pollination, fertilization, embryology and seed germination.
10. Fossils, their types and process of fossilization.

Bot. 202: PAPER –IV ECOLOGY AND BIostatISTICS

Max. Marks: 80

1. Plant and environment: Principles of environment, atmosphere, light, temperature, water, soil.
2. Morphological, anatomical and physiological responses of plants to water (Hydrophytes and Xerophytes): temperature (thermoperiodism and vernalization): light (heliophytes and sciophytes).
3. Population: Growth curves, ecotype and ecads.
4. Definition of community, Structure and attributes of community: frequency, density, cover, life forms and biological spectrum, ecological succession.
5. Ecosystem concept, energy flow, food chain, food web and ecological pyramids.
6. Biogeochemical cycles with emphasis on carbon and nitrogen cycles.
7. Preliminary idea of environmental pollution-air, water, soil, noise and radioactive pollution.
8. Introduction, definition, scope and importance of statistics,
9. Sampling: aim, simple random sampling, stratified random sampling, systematic sampling.
10. Measures of central tendency: mean, median and mode.
11. Classification, tabulation and graphic presentation of data.

12. Measures of dispersion-range, variance, standard deviation, standard error, Chi-square test.
13. Correlation: correlation coefficient.

Bot. 203: Lab course (Practical)

Max. Marks: 40

Pteridophyta

- A. To study the anatomical features of the following material and identify them: *Lycopodium*, *Sellaginella*, *Equisetum*, fern sorus, *Adiantum*
- B. To comment upon the specimens/slides given.

Gymnosperm

- A. To study the anatomical features of the following material and identify them: *Cycas* leaflet, Pine needle, Pine stem (T.S., T.L.S., R.L.S.), male and female cone of *Pinus*, *Ephedra*
- B. To comment upon the specimens/slides given.

Ecology and Biostatistics

- A. To calculate the frequency, abundance, density and A/F ratio of the given data.
- B. To calculate the relative frequency, relative density, relative abundance and IVI of the given data by quadrat method and by developing artificial vegetation plots.
- C. To determine the leaf area of the given leaves.
- D. To calculate net primary productivity of a grass land
- E. To Study the soil pH and soil moisture content.
- F. To develop population structure diagram
- G. To calculate the mean, median and mode by analyzing the given data of individual, discrete and continuous series.
- H. To calculate the standard error and deviation
- I. To calculate the correlation coefficient
- J. To calculate the chi square value
- K. Representation of data by making graphs and diagrams etc.
- L. Comment upon given graphs, diagrams etc.
- M. Xerophytic stem: *Casuarina*, *Calotropis*; Hydrophytic stem: *Hydrilla*, *Nymphaea*

Suggested readings

- Bhatnagar S.P. and Moitra A. 1996. Gymnosperms. New Age International, Pvt Ltd (P) New Delhi.
- Vashishta, P.C., Sinha A.K. and Kumar Anil. 2012 Botany for degree students: Gymnosperm. S. Chand, New Delhi
- Vashishta, P.C., Sinha A.K. and Kumar Anil. Botany for degree students: 2012 Pteridophyta. S. Chand, New Delhi
- Sharma, P.D. 2014. (12th Edition). Ecology and Environment . Rastogi Publications, Meerut.
- Shkula R.S. and Chandel, P.S. 2014. Plant Ecology. S. Chand, New Delhi.
- Shukla, R.S. and Chandel, P.S. Biostatistics. S. Chand & Sons, New Delhi.

Semester-III

Bot.-301: PAPER V TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

Max. Marks: 80

1. Basic principles and broad outline of the classification proposal by Bentham and Hooker and Hutchinson.
2. International Code of Botanical Nomenclature
3. Botanical gardens and Herbaria and Botanical Survey of India
4. Distinguishing features of the following families Ranunculaceae, Brassicaceae, Caryophyllaceae, Rutaceae, Fabaceae, Rosaceae, Apiaceae, Asteraceae, Solanaceae, Lamiaceae, Orchidaceae, Liliaceae, Poaceae.

A brief knowledge of Botany and commercial utilization and uses of the following plants:

5. Cereals and millets- wheat, rice and maize, Ragi, Pearl millet
6. Sugar yielding plants- Sugarcane and Sugar beet
7. Fruits- Mango, apple, banana, Citrus and Litchi.
8. Fibers- Cotton, jute, hemp, coir, Agave and Semal.
9. Vegetables- Root vegetables, stem vegetables and fruit vegetables.
10. Timbers- Teak, shisham, sal, chir and deodar.
11. Medicinal plants- *Aconitum*, *Atropa*, *Cinchona*, *Rauwolfia*, *Ephedra* and *Withania*.
12. Oils, Beverages, Fumitories, masticatories, Spices and Condiments yielding plants.

Bot. 302: PAPER VI: EMBRYOLOGY AND MORPHOGENESIS

Max. Marks: 80

1. Structure of anther and pollen, microsporogenesis and male gametophyte.
2. Structure and types of ovules, megasporogenesis and female gametophyte.
3. Pollination mechanism, Fertilization, double fertilization.
4. Endosperm types, dicot and monocot embryo.
5. General concept of morphogenesis.
6. Seed germination and dormancy.
7. Elementary movements.
8. A general account of Plant Growth Regulators.
9. Physiology of Flowering- Photoperiodism and Vernalization.

Bot. 303: Lab course (Practical)

Max. Marks: 40

Taxonomy of Angiosperms and Economic Botany

- A.** To identify the flowering twigs of given families by studying the taxonomic characters using technical terms: At least two specimens from each family should be studied: Ranunculaceae, Brassicaceae, Malvaceae, Caryophyllaceae, Rosaceae, Fabaceae, Apiaceae, Asteraceae, Solanaceae, Lamiaceae, Liliaceae, Poaceae.
- B.** To study and comment on the given specimens.
To study the economically important plants and their parts:
Cereals: Wheat, Rice, Maize
Millets: Finger millet, Foxtail, Ragi
Pulses: Gram, Green gram, Pea, Pigeon pea, Soybean, Chick pea,
Timbers: shisam, sal, teak, deodar, pine
Medicinal plants: Dhatura, Berginia, Hedychium, Poppy, Basil, Barberry
Beverages: Tea, Coffee
Oils: Mustard, Sesame, Coconut, Linseed, Groundnut, Castor, Laung, Sandal wood,
Mentha
Spices: Coriander, Cardamom, Curcuma, Cinamom, Laung, Cumin, Thyme, Nigella,
Cinamom leaf
Fibers: Jute, Coconut, Hemp, Urtica, Cotton

Sugars and starch yielding plants: Sugarcane, potato, Beet root

Fruits and vegetables available in the area.

Gums and Resins.

Embryology and morphogenesis

A. To study the androecium and gynoecium of different families.

To study the type of anthers and T. S. of the anther

To study the pollen grains of different families.

To study the placenta types by cutting the sections of the ovary.

B. To study and comment on the given specimens/slides/photographs.

Suggested readings

- Bhojwani, S.S., Bhatnagar, S.P., Dantu, P.R. The Embryology of Angiosperms-6th Edition. Vikas Publishing House. New Delhi.
- Saxena, N.B. and Saxena, S. 2009. Plant Taxonomy. Pragati Prakashan Meerut.
- Simpson M.G. 2006. Plant systematics. Elsevier Academic Press San Diago. CA, USA
- Singh V and Jain D.K. 2012. Taxonomy of Angiosperms. Rastogi Publications, Meerut.
- Singh, G. 2012. Plant systematic. Theory and practice. Oxford and IBH Pvt. Ltd.

Semester-IV

Bot. 401: PAPER-VII PLANT ANATOMY

Max. Marks: 80

1. Meristematic tissues: Root and Shoot apical meristems and their function; Permanent tissues Simple, Complex and Special types of tissues.
2. Epidermal tissue system: stomata and epidermal outgrowth
3. Anatomy of dicot root, stem and leaf.
4. Anatomy of monocot root, stem and leaf.
5. Root-stem transition
6. Secondary growth: vascular cambium, structure and function.
7. Secondary growth in root and stem: seasonal activity, annual ring, sapwood , heart wood.

8. Anomalous secondary growth in dicot and monocot stem and root.

Bot. 402: PAPER – VIII GENETICS AND PLANT BREEDING

Max. Marks: 80

1. **Structure and function of nucleic acid:** Structure of DNA & RNA, different forms of DNA (A, B, Z)
2. **Genetic code:** properties of genetic code, classical and modern concept of gene.
3. **Law of inheritance:** Mendel's experiments, principle of segregation, independent assortment, incomplete dominance.
4. **Chromosomal aberration:** structural (deficiency, duplication, inversion & translocation) and numerical (euploidy & aneuploidy), alteration in chromosomes.
5. **Sex determination:** sex chromosomes, sex determination in *Drosophila*, Man and plants specially *Melandrium*.
6. Sex linked inheritance.
7. **Gene Interaction-** Complementary, Epistasis (Dominant & Recessive), Supplementary
8. **Plant breeding:** aims and objectives, basic techniques of plant breeding (selection, plant introduction and acclimatization, hybridization and mutational breeding), hybrid vigour.

Bot. 403: Lab course (Practical)

Max. Marks: 40

Anatomy

- A. To study the anatomical characters of different plant organs of monocots and dicots by preparing temporary slides of transverse and vertical transverse sections of the following material and identify them.

Monocot root: Maize

Dicot root: Sunflower or any other

Epiphytic root: Orchid and *Ficus*

Monocot stem: Maize, *Cynodon*

Dicot stem: Sunflower and Cucurbita

Monocot leaf: Maize or any grass leaf

Dicot leaf: *Nerium*, Mango

Anomalous features: *Mirabilis*, *Anemone*, *Bignonia*, *Boerhaavia*, *Nyctanthes*, *Salvadora*, *Leptedenia*, *Dracena* and *Beta vulgaris* root.

To study the slides

Genetics and Plant Breeding

A. To analyze the mendelian ratios in a given data set by applying the chi square test.

To study the incomplete dominance.

Techniques of emasculation

B. Line drawing photographs of scientists (Mendel, Watson, Beadle and Tatum etc)

Photographs of deletion, duplication, inversion, translocation

Karyotype of *Drosophila*, Structure of DNA, RNA, Gynandromorph, Down's syndrome, Turner syndrome, Klinefelter syndrome etc.

Sex chromosomes in plants

Suggested readings

- Easu, K. Anatomy of seed plants. Wiley Eastern Pvt Ltd. New Delhi.
- Metcalfe, C.R and Chalk, L 1983. Anatomy of Dicotyledons and Monocotyledons. 2 vols. Clarendon Press, Oxford.
- Pandey, S.N. Plant Anatomy. Rastogi Publication Meerut.
- Singh, B.D. 2002. Plant Breeding Principles and Methods. Kalyani Publ. New Delhi

Semester-V

Bot. 501: PAPER- IX PLANT PHYSIOLOGY

Max. Marks: 80

1. Diffusion, osmosis, water potential and its components, Plasmolysis, Imbibition and Absorption of water, root pressure and guttation.
2. Transpiration and its significance, Factors affecting transpiration, mechanism of stomatal opening and closing.

3. Mineral nutrition: Essential elements, macro and micro nutrients, criteria of essentiality of elements, role of essential elements, minerals deficiency symptoms, Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.
4. Translocation in phloem: composition of phloem sap, girdling experiment, pressure flow model, phloem loading and unloading
5. Respiration: ATP- The biological currency, redox potential, aerobic and anaerobic respiration. Oxidative phosphorylation, Electron transport system, Pentose phosphate pathway fermentation, R.Q and factors affecting respiration.
6. Photosynthesis: photosynthetic pigments, mechanism of photosynthesis, light phase (excitation of chlorophyll, ATP and NADPH formation, PS I and PS II), Dark phase, Path of carbon in C₃ plants (C₃ cycle), C₄ plants (C₄ cycle), CAM pathway, photorespiration, factors affecting rate of photosynthesis.

Bot. 502: PAPER X BIOCHEMISTRY

Max. Marks: 80

1. Foundation of Biochemistry: Forces and interaction of biomolecules; chemical bonds- covalent and ionic bond; stabilizing interaction (Vander wall, electrostatic, hydrogen bonding, hydrophobic interaction, concept of pH, pKa, titration curve, acid, bases and buffers, Henderson Hasselbalch equation).
2. Carbohydrate: Classification into mono-, di- and poly- saccharides; Glyoxylate cycle, Pentose- phosphate pathway.
3. Protein: Basic aspects of protein conformation; protein synthesis (activation of amino acid, initiation, elongation, termination).
4. Fats and Lipids: Structure and function of lipids, saturated and unsaturated fatty acids; β -oxidation.
5. Enzymes: Classification; mechanism of action; factors affecting enzymes activities; concept of holoenzymes, apoenzyme and co-factors.

Bot. 503: Lab course (Practical)

Max. Marks: 40

Plant Physiology

- To demonstrate the process of diffusion.
- To demonstrate the process of osmosis by potato/ radish/ egg osmoscope.
- To demonstrate the process phenomenon of imbibition.

- To demonstrate the process of respiration by Ganog's respiroscope
- To demonstrate that CO₂ is liberated in anaerobic respiration
- To demonstrate the process of photosynthesis by inverted funnel method and Wilmott's bubbler.
- To demonstrate that CO₂ is necessary for the process of photosynthesis
- To demonstrate that light is necessary for photosynthesis
- To compare the rate of absorption with the rate of transpiration.
- To measure the rate of transpiration by Ganong's potometer.
- To compare the rate of transpiration on the two surfaces of a dorsiventral leaf by 4 leaf method and cobalt chloride paper method.
- To measure the rate of photosynthesis in different light conditions.
- To measure the R.Q. (respiratory quotient) in different respiratory substrate.
- To separate the chlorophyll pigment by preparing the crude extract of spinach leaf and to separate the plant pigments by filter paper chromatography.

Biochemistry

- To test the proteins in milk and pulses by Xanthoproteic reaction, Millon's test, Biuret test.
- To test the reducing and non reducing sugar in glucose/ sucrose in different plant samples by Fehling solution test, hydrolysis test.
- To test the starch in: rice/wheat / potato/ sweet potato by Iodine test
- To test the fats /oils in different seeds/ vegetable by Sudan test and Osmic acid test

Suggested readings

- Jain, V.K. 2014 (17th edition). Fundamentals of plant physiology. S. Chand, New Delhi
- Verma, S.K. and Verma M. 2014. A text book of Plant physiology, biochemistry and biotechnology. S. Chand, Meerut.

Semester- VI.

Bot. 601: PAPER - XI CELL AND MOLECULAR BIOLOGY

Max. Marks: 80

1. Cell structure: Prokaryotic and eukaryotic cells; ultrastructure of eukaryotic cell, cell wall and plasma membrane (ultrastructure, chemical composition and models of plasma membrane).
2. Structure and functions of cell organelles: Mitochondria, Chloroplast, Endoplasmic reticulum, Golgi complex, Ribosome, Microbodies (Lysosomes, Peroxisomes, Glyoxisomes); structure and function of Nucleus and Nucleolus.
3. Cell division: cell cycle, process and significance of mitosis and meiosis and crossing over
4. Eukaryotic chromosome: structure , chemical composition, Karyotype analysis, Ideogram; structure and functions of Polytene and Lampbrush chromosomes
5. DNA chemistry and DNA replication; replication error and repair mechanism.
6. Molecular basis of gene mutation.
7. C-DNA and C-DNA library.
8. Molecular markers: A general idea of PCR and non PCR based markers.
9. Polymerase chain reaction techniques (PCR), A brief idea of DNA finger printing.

Bot. 602: PAPER-XII BIOTECHNOLOGY

Max. Marks: 80

1. Introduction to Biotechnology: Role in modern life, history and ethical issues connected with Biotechnology.
2. Genetic Engineering: Recombinant DNA Technology, Enzymes and vectors involved in genetic engineering, Gene cloning steps and uses.
3. Plant tissue culture: Basic requirements of Tissue culture Laboratory, different types of media, General account of micropropagation, organogenesis, somatic embryogenesis and cryopreservation, protoplast isolation and fusion, somatic hybridization.
4. Industrial Biotechnology: With reference to drinks and beverages.

- 5.
6. Biotechnology with regard to microorganisms: Mycotoxin based health hazards and their control, single cell protein.

Bot. 603: Lab course (Practical)

Max. Marks: 40

Molecular Biology

- To study the working of following instruments: PCR, incubator, Gel electrophoretic assembly, water bath, Spectrophotometer, Gel documentation Unit and centrifuge etc.
- To study about life history of various scientists and their contribution in the field of Molecular Biology

Biotechnology

- To study the working of following instruments: PCR, Laminar air flow chamber, autoclave, incubator, and centrifuge.
- To study the Gram positive and Gram negative bacteria in root nodule, curd and soil.
- Culture media preparation.
- Sterilization techniques including surface sterilization of explants.
- Study the use of *Azolla* as biofertilizer
- Comment upon the given photographs, specimens etc.

Suggested reading

- Dubey, R.C. Advanced Biotechnology. S. Chand & Sons, New Delhi .
- Chawala, H. S. Biotechnology