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## Course Contents for Subjects with Code: BOT

This document only contains details of courses having code **BOT**.



Code	Subject Title	Cr. Hrs	Semester
BOT-101	Botany-I (Plant Diversity)	3	I
Year	Discipline		
1	Botany, Zoology, Chemistry-I		

**Syllabus Outline:** Comparative study of the different plant groups with representative examples, including Viruses, Bacteria, Algae, Fungi, Lichens, Bryophytes, Pteridophytes and Gymnosperms.

**Course Outline:**

Comparative study of life form, structure, reproduction and economic signification of

- a. **Viruses** (RNA and DNA types) with special reference to Tobacco Mosaic Virus (TMV).
- b. **Bacteria and Cyanobacteria** (*Nostoc*, *Oscillatoria*).
- c. **Algae:** (*Chlamydomonas*, *Spirogyra*, *Chara*, *Pinnularia*, *Ectocarpus* and *Polysiphonia*).
- d. **Fungi:** (*Mucor*, *Penicillium*, *Phyllactinia*, *Ustilago*, *Puccinia* and *Agaricus*), their effects on crop production and industrial applications.
- e. **Lichens:** (*Physcia*).
- f. **Bryophytes:**
  - i- *Riccia*
  - ii- *Anthoceros*
  - iii- *Funaria*
- g. **Pteridophytes:**
  - i- Fossils and Fossilization
  - ii- Major Groups and their Affinities
    - a. Psilopsida (*Psilotum*)
    - b. Lycopsida (*Selaginella*)
    - c. Sphenopsida (*Equisetum*)
    - d. Pteropsida (*Marsilea*)
  - iii- Seed Habit
- h. **Gymnosperms:** (*Cycas*, *Pinus* and *Ephedra*)

**Module Aims:** The course is designed to provide an adequate knowledge about basic concept of different plant groups and their phylogenetic relationship.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Students are expected to familiarize with the morphological and systematic knowledge about different plant groups. They will be able to make use of this knowledge for detailed study in other disciplines.



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**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Lee, E. R. (2007).** *Phycology*. (4<sup>th</sup> Ed.) Cambridge University Press U.K.
  2. **Sambamurty, A.V.S.S. (2005).** *A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. I.K. International Pvt. Ltd. New Delhi, Bangalore, Mumbai. 573 pp.
  3. **Agrios, G.N. (2004).** *Plant Pathology*. (8<sup>th</sup> Ed.), Academic Press London.
  4. **Prescott, L.M., Harley, J.P. and Klein, A.D. (2004).** *Microbiology*, (3<sup>rd</sup> Ed.) WM. C. Brown Publishers.
  5. **Mauseth. J.D. (2003).** *Botany: An Introduction to Plant Biology*. (3<sup>rd</sup> Ed.) Jones & Bartlett Pub.UK.
  6. **Biswas, C, and Johri, B.M. (1999).** *The Gymnosperms*. Narosa Publishing House. New Delhi and London.
  7. **Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1996).** *Introductory Mycology*. (4<sup>th</sup> Ed.) John Wiley and Sons, UK.
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Code	Subject Title	Cr. Hrs	Semester
BOT-102	Botany Lab-I (Plant Diversity)	1	I
Year	Discipline		
1	Botany, Zoology, Chemistry-I		

**Syllabus Outline:** Culturing, preservation and staining of microorganisms. Study of morphology and reproductive structures of the plant types mentioned in theory identification of various plant types mentioned from prepared slides and fresh specimens.

**Course Outline:**

Culturing and staining of microbial types.  
 Maintenance and preservation of cultures of microbes (Bacteria / Cyanobacteria / Algae / Fungi)  
 Identification of various types mentioned in the syllabus from fresh / preserved specimens and prepared slides.  
 Study of morphology and reproductive structures of the types mentioned in theory (Specimens/prepared slides)

**Module Aims:** The course is designed to provide an adequate knowledge about basic microbial techniques and morphological characteristics of different plant groups.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Students are expected to familiarize with the morphological and systematic knowledge about different plant groups. They are able to make use of this knowledge for detail study in other disciplines.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Lee, E. R. (2007).** *Phycology* (4<sup>th</sup> Ed). Cambridge University Press U.K.
2. **Sambamurty, A.V.S.S. (2005).** *A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. I.K. International Pvt. Ltd. New Delhi, Bangalore, Mumbai. 573 pp.
3. **Agrios, G.N. (2004).** *Plant Pathology*. (8<sup>th</sup> Ed.), Academic Press London.



4. **Mauseth, J.D. (2003).** *Botany: An Introduction to Plant Biology.* (3<sup>rd</sup> Ed.) Jones & Bartlett Pub.UK.
  5. **Prescott, L.M., Harley, J.P. and Klein, A.D. (2004).** *Microbiology.* (3<sup>rd</sup> Ed.), WM. C. Brown Publishers.
  6. **Biswas, C, and Johri, B.M. (1999).** *The Gymnosperms.* Narosa Publishing House. New Delhi and London.
  7. **Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1996).** *Introductory Mycology.* (4<sup>th</sup> Ed.), John Wiley and Sons, UK.
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Code	Subject Title	Cr. Hrs	Semester
BOT-103	Botany-II (Plant Systematic Anatomy & Development Theory)	3	II
Year	Discipline		
1	Botany, Zoology, Chemistry-I		

**Syllabus Outline:** Introduction to Plant Systematics, aims and objectives. History of classification, Introduction to nomenclature, International Code, Morphological Study of Families, Anatomical study of cell wall and the Internal Structure (Tissues) of the Plant Body, Simple and Complex Tissues Structure, Function and Relationship, Developmental Embryology.

**Course Outline:**

**Plant Systematics:**

Introduction to Plant Systematics: Aims, Objectives and Importance.

**Classification:** Brief History of Various Systems of Classification (Artificial, Natural and Phylogenetic) with emphasis on Takhtajan's System of Classification.

**Nomenclature:** Introduction: Importance of Latin Names and Binomial Nomenclature with an Introduction to International Code of Botanical Nomenclature (ICBN), St. Louis Code.

**Morphology:** Brief Account of various morphological characters of root, stem and leaf, Inflorescence, Flower, Placentation and Fruit Types.

**Diagnostic Characters:** Economic Importance and Distribution Patterns of the following Families:

- i. Ranunculaceae
- ii. Brassicaceae
- iii. Fabaceae
- iv. Rosaceae
- v. Euphorbiaceae
- vi. Solanaceae
- vii. Lamiaceae
- viii. Apiaceae
- ix. Asteraceae
- x. Liliaceae
- xi. Poaceae



**Anatomy:**

**Cell Wall:** Cell Wall Structure and Chemical Composition.

**Simple Tissues:** Parenchyma, Collenchyma, Sclerenchyma

**Epidermis:** Epidermis and Epidermal Appendages including Stomata.

**Complex Tissues:** Xylem, Phloem

**Meristem:** Types of Meristem, Stem and Root Apices, Secondary Meristem, Vascular Cambium and Periderm. Structure and Development of Primary Root and Stem, Structure of Leaf.

**Developmental Embryology:**

*Capsella bursa-pastoris*, Structure of Anther, Microsporogenesis, Microgametophyte, Structure of Ovule, Megasporogenesis, Megagametophyte, Endosperm Formation.

**Module Aims:** The course is designed to provide an insight to the basic concepts of Plant Systematics and its Role in Classification. Anatomy in relation to Basic Structure of Plants and their Developmental Biology.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Students are expected to learn about the history of Plant Systematics and its role in classification. They are able to make use of this knowledge for the identification and grouping of different plants based on the anatomy.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Raven, P.H., Even, R.E. and Eichhom, S.E. (2010).** *Biology of Plants*. W.H. Freeman and Company Worth Publisher.
2. **Stuessy, T.F. (2009).** *Plant Taxonomy*. Columbia University Press. USA.
3. **Lawrence, G.H.M. (2007).** *Taxonomy of Vascular Plants*. (2<sup>nd</sup> Ed.). MacMillan and Co. New York.
4. **Raymond, F. and Eichhorn, S.E. (2005).** *Esau's Plant Anatomy. Meristems cells and tissue of the plant body*, (3<sup>rd</sup> Ed.) John Wiley and Sons & Sons Inc.



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5. **Panday, B.P. (2004).** *A Text Book of Botany (Angiosperms)*. S. Chand & Co. New Delhi.
  6. **Moore, R.C., Clark, W.D. and Vodopich, D.S. (2003).** *Botany*. McGraw Hill Company, U.S.A.
  7. **Mauseth, J. D. (1998).** *An Introduction to Plant Biology: Multimedia Enhanced*. Jones and Bartlett Publisher. UK.
  8. **Fahn, A. (1990).** *Plant Anatomy*. Pergamon Press Oxford.
  9. **Maheshwari, P. (1971).** *Embryology of Angiosperms*. McGraw Hill. New York.
  10. **Esau, K. (1960).** *Anatomy of Seed Plants*. John Wiley and Sons, New York.
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Code	Subject Title	Cr. Hrs	Semester
BOT-104	Botany Lab-II (Plant Systematic Anatomy & Development Theory)	1	II
Year	Discipline		
1	Botany, Zoology, Chemistry-I		

**Syllabus Outline:** Identification of Families, Technical Description of Flower, Field Tours, Specimen Collection, Epidermis, Epidermal Appendages, Study of Stomata, Study of Xylem, Transverse Section of Leaf and Stem.

**Course Outline:**

Identification of Families with the help of keys,  
Description of Flowers (in technical terms) of following Families;  
Ranunculaceae, Brassicaceae, Fabaceae, Rosaceae, Euphorbiaceae, Cucurbitaceae, Solanaceae, Lamiaceae, Apiaceae, Asteraceae, Liliaceae and Poaceae.

**Study Tours:** Field tours shall be undertaken to study and collect local plants. Students are required to submit Forty (40) fully identified herbarium specimens.

**Anatomy:** Study of Epidermis, Stomata and Trichomes.

**Tissues:** Study of Simple Tissues from fresh material and prepared slides as well. Study of Complex Tissues (Xylem), Maceration and Study of Xylem from Macerated Material.

**Stem and Leaf:** Make a Transverse Section of Stem and Leaf of Angiosperm.

**Module Aims:** This course is designed to provide an insight of basic concepts of Plant Systematics, its Role in Classification, Anatomy in relation to Basic Structure of Plants and their Developmental Biology.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Students are expected to learn about classification on the basis of anatomical difference into different groups.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Raven, P.H., Even, R.E. and Eichhom, S.E. (2010).** *Biology of Plants*. W.H. Freeman and Company Worth Publisher.



2. **Lawrence, G.H.M. (2007).** *Taxonomy of Vascular Plants.* (2<sup>nd</sup> Ed.). MacMillan and Co. New York.
3. **Raymond, F. and Eichhorn, S.E. (2005).** *Esau's Plant Anatomy. Meristematic cells and tissue of the plant body,* (3<sup>rd</sup> Ed.) John Wiley and Sons Inc. New York.
4. **Panday, B.P. (2004).** *A Text Book of Botany (Angiosperms).* S. Chand and Co. New Delhi.
5. **Moore, R.C., Clark, W.D. and Vodopich, D.S. (2003).** *Botany.* McGraw Hill Company, U.S.A.
6. **Foster, F. (2002).** *Practical Plant Anatomy.* John Wiley and Sons, New York.
7. **Mauseth, J.D. (1998).** *An Introduction to Plant Biology: Multimedia Enhanced.* Jones and Bartlett Publisher. UK.
8. **Zahur, M.S. (1992).** *The Taxonomy of Angiosperms.* Al-Hejaz Printers. Lahore.
9. **Fahn, A. (1990).** *Plant Anatomy.* Pergamum Press Oxford.
10. **Maheshwari, P. (1971).** *Embryology of Angiosperms.* McGraw Hill. New York.
11. **Esau, K. (1960).** *Anatomy of Seed Plants.* John Wiley and Sons, New York.



Code	Subject Title	Cr. Hrs	Semester
BOT-201	Botany-III (Cell Biology, Genetics and Evolution)	3	III
Year	Discipline		
2	Botany, Zoology, Chemistry-I		

**Syllabus Outline:** An Introduction to Morphology and Functioning of Cell, Cellular Organelles and Mechanisms of Cell Division, Study of Genes and their Inheritance Patterns, Concept of Evolution.

**Course Outline:**

**a) Cell Biology:**

1. Structures and brief description of Bio-molecules
  - i. Carbohydrates
  - ii. Lipids
  - iii. Proteins
  - iv. Nucleic Acids
2. Cell: Physico-Chemical Nature of Plasma Membrane and Cytoplasm.
3. Ultrastructure of plant cell with a brief Description and Functions of the following Organelles:
  - i. Endoplasmic Reticulum
  - ii. Plastids
  - iii. Mitochondria
  - iv. Ribosomes
  - v. Dictyosomes
  - vi. Vacuole
  - vii. Microbodies (Glyoxysomes and Peroxisomes)
4. Nucleus: Nuclear Membrane, Nucleolus, Ultrastructure and Morphology of Chromosomes, Karyotype Analysis.
5. Reproduction in Somatic and Embryogenic Cell, Mitosis and Meiosis, Cell Cycle.
6. Chromosomal Aberrations; Changes in the Number of Chromosomes Aneuploidy and Euploidy, Changes in the Structure of Chromosomes, Deficiency, Duplication, Inversion and Translocation.



**b) Genetics:**

1. Introduction, Scope and brief History of Genetics, Mendelian Inheritance; Laws of Segregation and Independent Assortment, Back Cross, Test Cross, Dominance and Incomplete Dominance.
2. Sex linked inheritance, Sex Linkage in *Drosophila* and Man (Color Blindness), XO, XY, WZ Mechanisms, Sex Limited and Sex Linked Characters, Sex Determination.
3. Linkage and Crossing Over, Definition, Linkage Groups, Construction of Linkage Maps, Detection of Linkage. Recombination.
4. DNA Replication, Nature of Gene, Genetic Code, Transcription, Translation, Regulation of Gene Expression (*e.g. lac* operon).
5. Transmission of Genetic Material in Bacteria; Conjugation and Gene Recombination in Co-Transduction and Transformation.
6. Principles of Genetic Engineering / Biotechnology; Basic Genetic Engineering Techniques.
7. A Brief Introduction of Gene Mutation.
8. Evolution

**Module Aims:** To introduce the students to basic aspects of Cell Biology, Genetics and Evolution to provide the students with fundamental knowledge of these courses for the understanding applied aspects of this course.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** On successful completion of this module students will be able to describe, apply and integrate the basic concepts of Cell Biology including Genetics and Evolution, Structure and Functions of Organisms.



**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Bretscher, A. (2007).** *Molecular Cell Biology*. W. H. Freeman and Company
2. **Weaver, R.F. (2005).** *Molecular Biology*. McGraw Hill, St. Louis.
3. **Griffiths, J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2003).** *An Introduction to Genetic Analysis*. W.H. Freeman and Company.
4. **Sinha, U. and Sinha, S. (2003).** *Cytogenesis, Plant Breeding and Evolution*. Vini Educational Books, New Delhi.
5. **Strickberger, M.V. (2003).** *Genetics*. MacMillan Press Ltd., London.
6. **Karp, G. (2002).** *Cell and Molecular Biology. Concepts and Experiments*. (4<sup>th</sup> Ed.), John Wiley and Sons. New York.
7. **Gilmartin, P.M. and Bowler. C. (2002).** *Molecular Plant Biology*. (Vol. 1 & 2). Oxford University Press. UK.
8. **Carroll, S.B., Grenier, J.K. and Vernerbee, S.D. (2001).** *From DNA to Diversity—Molecular Genetics and the Evolution of Animal Design*. Blackwell Science.
9. **Hoelzel, A.R. (2001).** *Conservation Genetics*. Kluwer Academic Publishers.
10. **Lodish, H. (2001).** *Molecular Cell Biology*. W.H. Freeman and Company.
11. **Dyonsager, V. R. (2000).** *Cytology and Genetics*. (3<sup>rd</sup> Ed.), TATA and McGraw Hill Publication Co. Ltd, New Delhi.



Code	Subject Title	Cr. Hrs	Semester
BOT-202	Botany Lab-III (Cell Biology, Genetics and Evolution)	1	III
Year	Discipline		
2	Botany, Zoology, Chemistry-I		

**Syllabus Outline:** Development of Concepts about Cell Structure, Chromosomal Morphology, mechanisms of Cell Division, Extraction of Protein, DNA, RNA from Plant Sources, Genetical Problems related to Transmission and Distribution of Genetic Material.

**Course Outline:**

**a) Cell Biology:**

1. Study of cell structure using Compound Microscope and elucidation of Ultrastructure from Electron Microphotographs.
2. Measurement of Cell Size.
3. Study of Mitosis and Meiosis by Smear/Squash Method and from Prepared Slides.
4. Study of Chromosome Morphology and Variation in Chromosome Number.
5. Extraction and Estimation of Carbohydrates, Proteins, RNA and DNA from Plant Material.

**b) Genetics:**

1. Genetic Problems related to Transmission and Distribution of Genetic Material.
2. Identification of DNA in Plant Material (Carminum/ Orcein Staining).
3. Study of salivary gland chromosomes of *Drosophila*.

**Module Aims:** The aim of this course is to provide the knowledge to the students about the structure and functions of different cell structure organelles under laboratory conditions.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** The learning outcomes will be same as theory paper. On completion the students will be able to understand Scientific Methods for Implementation in Applied Courses of Cell Biology, Genetics and Evolution.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Bretscher, A. (2007).** *Molecular Cell Biology*. W. H. Freeman and Company



2. **Griffiths, J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2003).** *An Introduction to Genetic Analysis*. W.H. Freeman and Company.
  3. **Sinha, U. and Sinha, S. (2003).** *Cytogenesis, Plant Breeding and Evolution*. Vini Educational Books, New Delhi.
  4. **Strickberger, M.V. (2003).** *Genetics*. MacMillan Press Ltd., London.
  5. **Karp, G. (2002).** *Cell and Molecular Biology. Concepts and Experiments*. (4<sup>th</sup> Ed.), John Wiley and Sons. New York.
  6. **Gilmartin, P.M. and Bowler. C. (2002).** *Molecular Plant Biology*. (Vol. 1 & 2). Oxford University Press. UK.
  7. **Lodish, H. (2001).** *Molecular Cell Biology*. W.H. Freeman and Co.
  8. **Dyonsager, V R. (2000).** *Cytology and Genetics*. (3<sup>rd</sup> Ed.), TATA and McGraw Hill Publication Co. Ltd, New Delhi.
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Code	Subject Title	Cr. Hrs	Semester
BOT-203	Botany-IV (Plant Physiology and Ecology)	3	IV
Year	Discipline		
2	Botany, Zoology, Chemistry-I		

**Syllabus Outline:** The course content include Water Relation, Mineral Nutrition, Photosynthesis, Respiration in relation to growth of Plants, Aims and Application of Ecology.

### Course Outline:

#### a) Plant Physiology:

- 1. Water Relations:** Water Potential, Osmotic Potential, Pressure Potential, Matric Potential; Absorption and Translocation of Water.
- 2. Mineral Nutrition:** Soil as a Source of Minerals, Passive and Active Transport of Nutrients, Essential Mineral Elements, Role and Deficiency Symptoms of Macronutrients.
- 3. Photosynthesis:** Introduction, Mechanism of Oxygenic and Non-Oxygenic Photosynthesis: Light Reactions (Electron Transport and Photophosphorylation) and Dark Reactions (Calvin Cycle), Differences between C<sub>2</sub> and C<sub>3</sub> Plants, Factors affecting Photosynthesis.
- 4. Respiration:** Definition and Respiratory Substrates, Mechanism of Glycolysis, Krebs Cycle, Electron Transport and Oxidative Phosphorylation, Anaerobic Respiration, Energy Balance in Aerobic and Anaerobic Respiration.
- 5. Growth:** Definition; Role of Auxins, Cytokinins, Gibberellins, Abscisic Acid and Ethylene in controlling Growth.
- 6. Photoperiodism:** Definition, Historical Background, Classification of Plants based on Photoperiodic Response, Role of Phytochromes, and Hormones and Metabolites in photoperiodism.
- 7. Dormancy:** Definition and Causes of Seed and Bud Dormancy; Methods of breaking Seed Dormancy, Physiological processes during Seed Germination.
- 8. Plant Movements:** Classification, Phototropism, Nastic Movements, Gravitropism and their Mechanisms

#### b) Ecology:

1. Introduction, aims and applications of Ecology.
- 2. Soil:** Physical and Chemical Properties of Soil (Soil Formation, Soil Texture, pH, EC, Soil Organisms, Soil Organic Matter) and their relationship to plants.
- 3. Light and Temperature:** Quality of Light, Diurnal and Seasonal Variations, Ecophysiological Responses.
- 4. Water:** Field Capacity and Soil Water Holding Capacity, Characteristics of Xerophytes and Hydrophytes, Effects of Precipitation on Distribution of Plants.
- 5. Wind:** Wind as an Ecological Factor and its Importance
- 6. Population Ecology:** Introduction to Population Ecology.
- 7. Community Ecology:**
  - i. Ecological Characteristics of Plant Community
  - ii. Methods of Sampling Vegetation (Quadrat and Line Intercept)
  - iii. Succession.



iv. Major Vegetation Types of the Local Area.

**8. Ecosystem Ecology:**

- i. Definition and Components of Ecosystem.
- ii. Food Chain and Food Web.
- iii. Biogeochemical Cycles, Definition, Types with emphasis on Nitrogen and Hydrological Cycles.

**Module Aims:** Specific objectives of this course will be to understand the following topics, viz.; Water Relations, Conduction of Water and Organic Matter; the Role of Mineral Nutrients in Growth and Development, Metabolic Processes of Photosynthesis and Respiration, Hormonal Regulation of Growth and Development; Plant Movements, Environmental (Light, Temperature), Control of Growth and Development.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** The aim is to give the students increased knowledge of metabolism, physiology and structure of plants together with a better understanding of regulation of growth and development and influence of environment.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**BOOKS RECOMMENDED:**

1. **Taiz, L. and Zeiger, E. (2010).** *Plant Physiology*. 5<sup>th</sup> Edition. Sinauers Publishing, Company. Inc. California.
2. **Illahi, I. (2009).** *Plant Physiology. Biochemical Processes in Plants*. UGC Press.
3. **Witham, F.W, Devlin, A., Blaydes, D.F. and Devline, R.M (1986)** *Exercises in Plant Physiology*. Prindle, Weber and Schmidt, Boston.
4. **Schultz, E. (2005).** *Plant Ecology*. (2<sup>nd</sup> Ed. ) Springer-Verlag, Berlin.
5. **Smith, R. L. (2002).** *Ecology and Field Biology*. Harper and Row Publishers, New York.
6. **Salisbury, F.B. and Ross, C.B. (2002).** *Plant Physiology*. (7<sup>th</sup> Ed.), Wordsworth Publishing Co. Belmont CA.
7. **Ricklefs, R.E. (2001).** *The Economy of Nature*. W.H. Freeman and Company .UK.



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8. **Hopkins, W.B. (2000).** *Introduction to Plant Physiology*. (2<sup>nd</sup> Ed.), John Wiley and Sons. New York.
  9. **Rick, R.E. (2000).** *Ecology*. (1<sup>st</sup> Ed.). W.H. Freeman and Company, U.K.
  10. **Smith, R. L. (2000).** *Elements of Ecology*. Harper and Row Publishers, New York.
  11. **Subrahmanyam, N.S. and Sambamurthy. A.V.S.S. (2000).** *Ecology*. Narosa Publishing House, New Delhi.
  12. **Townsend, C.R., Harper, J.L. and Begon, M.E. (2000).** *Essentials of Ecology*. Blackwell Scientific Publications, U.K.
  13. **Barbour, M.O., Burke, H.J. and Pitts, D.W. (1999).** *Terrestrial Plant Ecology*. The Benjamin, Cumming Publishing Co. California, USA.
  14. **Hussain, F. (1999).** *Field and Laboratory Manual of Plant Ecology*. National Academy of Higher Education, Islamabad.
  15. **Krebs, C. J. (1997).** *Ecology and Field Biology*. Addison Wesley Longman Inc, New York.
  16. **Chapman, J.L. and Reiss, M.J. (1995).** *Ecology; Principles and Applications*. Cambridge University Press. U.K.
  17. **Odum, E.P. (1970).** *Basic Ecology*. V/B. Saunders. Philadelphia.
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Code	Subject Title	Cr. Hrs	Semester
BOT-204	Botany Lab-IV (Plant Physiology and Ecology)	1	IV
Year	Discipline		
2	Botany, Zoology, Chemistry-I		

**Syllabus Outline:** Water uptake by swelling seeds, loss of permeability by beet root cells, Rate of transpiration by means of photometer, Cobalt Chloride Paper Method, Extraction of Chlorophyll and Separation of Component Pigments, Studies of Absorption Spectra, Winkler's Method to Determine Oxygen Utilization by a Respiring Plant, Amylase from Germinating Seeds and its Effect on Starch Breakdown, Carbon Dioxide Evolution during Respiration by Titration Method, Seed Germination.

**Course Outline:**

**a) Plant Physiology:**

1. Determination of Uptake of Water by Swelling Seeds when placed in Sodium Chloride Solution of Different Concentrations.
2. Determination of the Temperature at which Beet Root Cells lose their permeability.
3. Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a photometer by Cobalt Chloride Paper Method.
4. Extraction of Chlorophyll from the leaves and Separation of Component Pigments on a Paper Chromatogram.
5. Study of Absorption Spectra using Spectrophotometer.
6. Estimation of Oxygen utilized by a Respiring Plant by Winkler's method.
7. Extraction of Amylase from Germinating Wheat Seeds and study of its effect on Starch Break Down.
8. Measurement of Carbon Dioxide Evolution during Respiration of Germinating Seeds by the Titration Method.
9. Effect of Light and Temperature on Seed Germination.

**b) Ecology:**

1. Determination of Physical and Chemical Characteristics of Soil.
2. Measurement of Light and Temperature.
3. Measurement of Vegetation by Quadrat and Line Intercept Methods.
4. Measurements of Wind Velocity.
5. Field Trips to Ecologically Diverse Habitats.

**Module Aims:** Specific objectives of this course will be to understand the Soil Plant Relationship with reference to Environmental Factors and Plant Physiology.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop



**Learning Outcome:** The aim is to give the students increased knowledge of metabolism, physiology and structure of plants together with a better understanding of regulation of growth and development and influence of environment.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Taiz, L. and Zeiger, E. (2010).** *Plant Physiology*. (5<sup>th</sup> Ed.), Sinauers Publishing, Co. Inc. California.
2. **Illahi, I. (2009).** *Plant Physiology. Biochemical Processes in Plants*. UGC Press.
3. **Witham, F.W., Devlin, A., Blaydes, D.F. and Devline, R.M. (1986)** *Exercises in Plant Physiology*. Prindle, Weber and Schmidt, Boston.
4. **Schultz, E. (2005).** *Plant Ecology*. (2<sup>nd</sup> Ed.) Springer-Verlag, Berlin.
5. **Smith, R. L. (2002).** *Ecology and Field Biology*. Harper and Row Publishers, New York.
6. **Salisbury, F.B. and Ross, C.B. (2002).** *Plant Physiology*. (7<sup>th</sup> Ed.), Wordsworth Publishing Co. Belmont CA.
7. **Ricklefs, R.E. (2001).** *The Economy of Nature* W.H. Freeman and Company. UK.
8. **Hopkins, W.B. (2000).** *Introduction to Plant Physiology*. (2<sup>nd</sup> Ed.) John Wiley and Sons. New York.
9. **Rick, R.E. (2000).** *Ecology*. (1<sup>st</sup> Ed.) W.H. Freeman and Company, UK.
10. **Smith, R. L. (2000).** *Elements of Ecology*. Harper and Row Publishers, New York.
11. **Subrahmanyam, N.S. and Sambamurthy, A.V.S.S. (2000).** *Ecology*. Narosa Publishing House, New Delhi.
12. **Townsend, C.R., Harper, J.L. and Begon, M.E. (2000).** *Essentials of Ecology*. Blackwell Scientific Publications, UK.
13. **Barbour, M.O., Burke, H.J. and Pitts, D.W. (1999).** *Terrestrial Plant Ecology*. The Benjamin, Cumming Publishing Company California, USA.
14. **Hussain, F. (1999).** *Field and Laboratory Manual of Plant Ecology*. National Academy of Higher Education, Islamabad.



15. **Krebs, C.J. (1997).** *Ecology and Field Biology*. Addison Wesley Longman Inc, New York.
  16. **Chapman, J.L. and Reiss, M.J. (1995).** *Ecology. Principles and Applications*. Cambridge University Press. U.K.
  17. **Odum, E.P. (1970).** *Basic Ecology*. V/B. Saunders. Philadelphia.
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Code	Subject Title	Cr. Hrs	Semester
BOT-301	Higher Fungi	3	V
Year	Discipline		
3	Botany		

**Syllabus Outline:** Advanced features and complexity in structure of fungi.

**Course Outline:**

**Ascomycotina:** Mycelium, hyphae, cells and fungal tissues, Ascus, Sexual Reproduction, Compatibility, Non-Sexual Reproduction, Classification, Comparative study of Biology, Life Cycle Patterns, Ascospore Formation, Mode of Ascocarp Development, Types of Centra and its Significance in various Ascomycetes genera of classes Hemiascomycetes, Plectomycetes, Pyrenomycetes, Discomycetes and Loculoascomycetes, Origin of Ascomycotina.

**Basidiomycotina:** Mycelium, Hyphal Cells and Fungal Tissues, Basidium and Sexual Reproduction, Compatibility, Classification, Comparative study of Biology, Occurrence, Importance, General Life Cycle, Morphology, Development and Anatomy of Basidiocarp, Basidiospores and Spore Dispersal in various **Hymenomycetes** Orders viz.; Agaricales, Aphyllophorales and Non-Hymenomycetous Fungi of Gasteromycetes, **Teliomycetes;** Occurrence and importance as Phytopathogenic Fungi, Life Cycle Patterns, Spores and Spore Stages and Heteroecism in **Rust Fungi** (Uredinales) Biology, Economic Importance, Life Cycle, Teliospores and Teliospore Germination in Smut Fungi (Ustilaginales).

**Deuteromycotina (Fungi Imperfecti):** Their Characteristics, Telomorph, Anamorph Concept, Classification, Conidia, Conidiophores and Conidial Ontogeny, Heterokaryosis, Parasexuality and its significance, Economic Importance of Conidial Fungi,

**Lichens:** General Characters and Anatomy of Thallus.

**Module Aims:** The aim of this course is to know about the Diversity of Fungi which possess cross walls in their hyphae, Knowledge about Occurrence of Pathogenic, Mutualistic and Saprophytic Groups of these Fungi along with their Habitat and Growth Condition.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** The study would be able to know about different fungal groups around them and their economic importance.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz



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5. Tests

**Books Recommended:**

1. **Funder, S. (2010).** *Practical Mycology*. Hafner Publishing Company, Inc., New York and Kingston-upon-Thames.
  2. **Webster, J. (2009).** *Introduction to the Fungi*. (4<sup>th</sup> Ed), Cambridge University Press. U.K.
  3. **Sharp, R.F. (2006).** *Investigative Mycology*. (2<sup>nd</sup> Ed.). Heinemann Edu. Books. London. U. K.
  4. **Moore-Landecker, E. (2002).** *Fundamentals of Fungi*. Prentice Hall Inc. New Jersey, USA.
  5. **Khan, S.M. (1999).** *Laboratory Manual for Plant Pathogens*. Pakistan. Phytopathological Society, Faisalabad, Pakistan.
  6. **Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1996).** *Introductory Mycology*. (4<sup>th</sup> Ed.) John Wiley and Sons, New York.
  7. **Saleem, A. and Nasir, M.A. (1991).** *Culture Media*. Government of the Punjab, Agriculture Department.
  8. **Ahmad, S. (1952).** *Gasteromycetes of West Pakistan*. Publication of Botany Deptt. P.U. Lahore.
  9. **Ahmad, S. (1980).** *Ascomycetes of Pakistan*. Vol. **I and II**. Biological Society of Pakistan.
  10. **Ahmad, S. (1972).** *Basidiomycetes of Pakistan*. Biological Society of Pakistan.
  11. **Ahmad, S. (1980).** *A Contribution to the Agaricales of Pakistan*. Biological Society of Pakistan.
  12. **Ahmad, S., Iqbal, S.H. and Khalid, A.H. (1997).** *Fungi of Pakistan*. Sultan Ahmad Mycological Society of Pakistan.
  13. **Kendric, B. (2000).** *The Fifth Kingdom*. (3<sup>rd</sup> Ed.), Focus Publishing Co. USA.
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Code	Subject Title	Cr. Hrs	Semester
BOT-302	Higher Fungi Lab	1	V
Year	Discipline		
3	Botany		

**Syllabus Outline:** Learning Techniques related to study of different Fungal Groups.

**Course Outline:**

1. Introduction to Microscopy, Light Microscope, Polarizing Microscope, Electron Microscope and Scanning Electron Microscope, Microphotography.
2. Isolation and Study of various Saprophytic, Parasitic and Mutualistic Forms in higher Fungi.
3. Study of various types of Ascocarps and Asci in various Representative Groups using Fresh/Preserved Specimens or Prepared Slides.
4. Basidiomycetous Fungal Forms using Fresh/Preserved Specimens or Prepared Slides.
5. Hyphal Systems in Polyporaceae.
6. Rusts and Smuts of Various Types.
7. Ectomycorrhizae.
8. Morphological and Anatomical Features of Lichens.
9. Isolation of Lichen Crystals in various Solvent Systems.

**Module Aims:** Basic aim of this course is to familiarize students with Fungi possessing Septate Hyphae, Prominent Fruiting Bodies, their Identification and Biology with relation to Economic Importance.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Students would be able to distinguish between different Taxa of Ascomycota and Basidiomycota. They will become familiar with edible and poisonous fungi and their association with trees.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Webster, J. (2009).** *Introduction to the Fungi*. (4<sup>th</sup> Ed), Cambridge University Press.



2. **Sharp, R.F. (2006).** *Investigative Mycology*. (2<sup>nd</sup> Ed.). Heinemann Edu. Books. London. U. K.
3. **Saleem, A. and Nasir, M.A. (2001).** *Culture Media for Fungal Growth*. Government of the Punjab, Agriculture Department.
4. **Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1996).** *Introductory Mycology*. (4<sup>th</sup> Ed.), John Wiley and Sons, New York.
5. **Ahmad, S. (1982).** *Gastromycetes of West Pakistan*. Publication of Department of Botany P.U. Lahore.
6. **Ahmad, S. (1980).** *A Contribution to the Agaricales of Pakistan*. Biological Society of Pakistan.
7. **Ahmad, S. (1980).** *Ascomycetes of Pakistan*. (Vol. I and II), Biological Society of Pakistan.
8. **Ahmad, S. (1972).** *Basidiomycetes of Pakistan*. Biological Society of Pakistan.



Code	Subject Title	Cr. Hrs	Semester
BOT-303	Microbial and Molecular Genetics	3	V
Year	Discipline		
3	Botany		

**Syllabus Outline:** Genetic Study of Prokaryotes and Eukaryotes.

**Course Outline:**

**Recombination in Bacteria:** Chromosome of Bacteria, Transformation, Transduction, Conjugation, Episomes and Plasmids.

**Genetic Structure and Recombination in Viruses:** Phage, Phenotype, Virulent, Phages, Temperate, Phages.

**Transposable Genetic Elements:** Transposable Elements in Bacteria, Transposable elements in Eukaryotes, Genetic and Evolutionary Significance of Transposable Elements.

**Gene Mutation:** Spontaneous and Induced Mutation the Molecular Basis of Mutation, Gene Suppression, Chemically Induced Mutations Practical Applications of Mutations.

**Genetic Code:** General Nature of Genetic Code, Biochemistry of Genetic Code, Confirmation of Genetic Code, Chain Termination Triplets.

**Mechanism of Genetic Change – Recombination:** General Homologous Recombination the Holiday Model, Enzymatic Mechanism of Recombination, Site Specific Recombination, Recombination and Chromosomal Rearrangements.

**DNA Repair:** Photoreactivation, Exscion Repair, Post-Replication Repair.

**The Nature of the Gene:** How Gene Works? Gene-Protein Relationship, Genetic Observations explained by Enzyme Structure, Genetic Fine Structure Complementation. **The Structure and Function of Eukaryotic Chromosomes:** One DNA molecule per chromosome the role of Histone Proteins in packaging of DNA Higher Order coiling Hetrochromatin and Euchromatin Chromosome Bands Sequence Organization Replication and Transcription of Chromatin.

**Control of Gene Expression:** Induction and Repression in Prokaryotes, Basic Control Circuits, Discovery of the *lac* Operon- Negative Control; Catabolite Repression of the *lac* Operon - Positive Control, The Phage: a Complex of Operons, Gene Regulation in Eukaryotes.

**Module Aims:** Course is designed to provide knowledge about Microbes their Evolution and Phylogenetic Relationship, Study of Heredity Material, Gene Analysis and their Product, Repair and Recombination.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop



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**Learning Outcome:** Students are expected to have knowledge about Structure and Function of Microbes; their Role in Genetic Diversity, Variation of Genes in Gene Pool and Awareness about Specificity and Complexity of genes.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Strickberger, M.W. (2009).** *Genetics*, (5<sup>th</sup> Ed.) Macmillan Publishing N.Y.
  2. **Goodenough, U. (2006).** *Genetics*. Saunders College Publishing, USA.
  3. **Old, R.W. and Primrose, S.B. (2004).** *Principals of Gene Manipulation*, (3<sup>rd</sup> Ed.) University of California Press.
  4. **Griffiths, A.J. F., Miller, J.H., Suzuki, D. T., Lewontin, R.C. and Gelbart, W. M., (2003).** *An introduction to Genetic Analysis*. W. H. Freeman and Company, New York.
  5. **Lewin, L. (2000).** *Gene V*. John Wiley and Sons. New York.
  6. **Brown, T.A. (1999).** *Genetics, A Molecular Approach*, Van Nostrand Reinhold Int.,
  7. **Maloy, S.R., Cronan, Jr., J.E. and Freifelder, D. (1994).** *Microbial Genetics*, Jonest Bartelet Publisher, Boston, London.
  8. **Smith-Keary, P.F. (1975).** *Genetic Structure and Function*, Macmillan Press, Ltd., London.
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Code	Subject Title	Cr. Hrs	Semester
BOT-304	Microbial and Molecular Genetics Lab	1	V
Year	Discipline		
3	Botany		

**Syllabus Outline:** Study of Microbiological Techniques with relation to Genetics and Numerical Problems.

**Course Outline:**

**Numerical Problems:**

- a) Recombination in Bacteria
- b) Recombination in Viruses
- c) Gene Mutation
- d) Transposable Genetic Elements
- e) Control of Gene Expression
- f) Mechanism of Genetic Change – Recombination

**Practicals:**

- a) Bacterial Genetics
- b) Bacterial Culture Techniques
- c) Gram Staining
- d) Transformation
- e) Conjugation

**Module Aims:** Course is designed for study of microbes and their growth behavior, Selective Recombination of Bacteria and Viruses, Effects of Mutation on possible gene outcome.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Students expected to identify Bacteria, their Reproduction, Strategy Recombination Pattern and Gene Expression.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Maloy, S.R., Cronan, Jr., J.E. and Freifelder, D. (2008).** *Microbial Genetics*, Jonest Bartelet Publisher, Boston, London.
2. **Old, R.W. and Primrose, S.B. (2007).** *Principals of Gene Manipulation*, (3<sup>rd</sup> Ed.), University of California Press.



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3. **Goodenough, U. (2004).** *Genetics*, Saunders College Publishing, USA.
  4. **Grifths A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2003).** *An introduction to Genetic Analysis*. W.H. Freeman and Company, New York.
  5. **Strickberger, M.W. (2003).** *Genetics*, (5<sup>th</sup> Ed.), *Macmillan Publishers, London*.
  6. **Lewin, L. (2000).** *Gene V*. John Wiley and Sons. New York.
  7. **Brown, T.A. (1999).** *Genetics, A Molecular Approach*, Van Nostrand Reinhold Int., London.
  8. **Smith-Keary, P.F. (1995).** *Genetic Structure and Function*, Macmillan Press, Ltd., London.
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Code	Subject Title	Cr. Hrs	Semester
BOT-305	Evolutionary Trends in Trachaeophytes	3	V
Year	Discipline		
3	Botany		

**Syllabus Outline:** Evolution; Modern Concepts and its Implications, Structural Organization of Early Vascular Land Plants, Microphylophyta, Sphenophyta and Filicophyta, Gymnosperms and Angiosperms; their Evolutionary Importance, Origin and Diversification of Angiosperms.

**Course Outline:**

**Evolution:** Definition, Modern Trends, Concepts of Primitive and Advanced Characters

**Trachaeophytes:** Definition; Transition to Land and Modifications; Origin and Alternation of Generations According to Homologous and Antithetic Theories.

**The Structure and Organization of Land Plants:** Organization of the Primary Plant Body, leaf Morphology and Anatomy, Primary Development, Secondary Development, Structure of Primary Xylem and Phloem, Stele Types, Xylem Maturation Patterns,

**Early Vascular Land Plants:** General Characters and Evolutionary Implications in Rhyniophyta, Importance of Rhynie Chert Plants; Cooksonoids and their Importance; Zosterophyllophyta, Trimerophytophyta, Psilophyta (Psilopsida).

**Microphylophyta (Lycopsida):** General Characters, Classification and Evolutionary Implications, Spores Morphology and Diversity.

**ArthropHYta (Sphenopsida):** General Characters, Classification and Evolutionary Implications.

**Pteridophyta:** General Characters, Classification and Evolutionary Implications in Eusporangiate and Leptosporangiate Ferns, Origin and Development of Seed Habit.

**Gymnosperms:** General Characters, Organography, Classification and Evolutionary Implications.

**Angiosperms:** General Characters, Organography, Evolutionary Importance, Origin of Angiosperms.

**Module Aims:** The course is designed to provide an adequate knowledge of Trachaeophytes and their Evolutionary Importance with special emphasis on Vegetative and Reproductive Biology including morphology of Lower Vascular Land Plants.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** After studying this course students will develop better understanding of the Concept of Evolution and Modern Evolutionary Trends. Students will be expected to know about the Evolutionary Architecture of Early Vascular Land Plants, Lycophytes, Sphenophytes and Ferns. General Characteristics of



Gymnosperms and Angiosperms would be taken in to account for their evolutionary implication with respect to their origin.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Kramer, K.U., Green, P.S. and Götz, E. (2010).** *Pteridophytes and Gymnosperms (The Families and Genera of Vascular Plants)*. (1<sup>st</sup> Ed.). Springer Link. 410pp. **ISBN-13: 978-3642080807.**
2. **Ward, L.F. (2010).** *Sketch of Paleobotany*. Nabu Press, 128pp. **ISBN-13: 978-1176480469.**
3. **Berry, E.W. (2009).** *Paleobotany; A Sketch of the Origin and Evolution of Floras*. General Books LLC. 90pp. **ISBN-13: 978-1151323286.**
4. **Ranker, T.A. and Haufler, C.H. (2008).** *Biology and Evolution of Ferns and Lycophytes*. Cambridge University Press. 500 pp. **ISBN-13: 978-0521874113.**
5. **Taylor, T.N., Taylor, E.N. and Krings, M. (2008).** *Paleobotany: The Biology and Evolution of Fossil Plants*. (2<sup>nd</sup> Ed.), Academic Press.1252 pp. **ISBN-13: 978-0123739728.**
6. **Arnold, C.A. (2007).** *An Introduction to Paleobotany*. Miller Press. 432 pp. ISBN-13: 978-1443723046.
7. **Burek, C.V. and Wilding, R. (2005).** *History of Palaeobotany: Selected Essays (Geological Society Special Publication)*. (1<sup>st</sup> Ed.), Geological Society of London, 304pp.**ISBN-13: 978-1862391741.**
8. **Sambamurty, A.V.S.S. (2005).** *A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. I.K. International Pvt. Ltd. 584 pp. **ISBN-13: 978-8188237456.**
9. **Kenrick, P. and Davies, P. (2004).** *Fossil Plants (Smithsonian's Living Past)*. Smithsonian Books. 232pp. **ISBN-13: 978-1588341563.**
10. **Willis, K.J. and McElwain, J.C. (2002).** *The Evolution of Plants*. Oxford University Press. 392 pp. **ISBN-13: 978-0198500650.**
11. **Bell, P.R. and Hemsley, A.R. (2000).** *Green Plants: Their Origin and Diversity*. (2<sup>nd</sup> Ed.), Cambridge University Press. 360pp. **ISBN-13: 978-0521646734.**



Code	Subject Title	Cr. Hrs	Semester
BOT-306	Evolutionary Trends in Trachaeophytes Lab	1	V
Year	Discipline		
3	Botany		

**Syllabus Outline:** Morphological studies of Representative Members, Section Cutting and Double Staining Procedure, Field Excursion and Plants Collection, Presentation of Preserved Specimens for Herbarium.

**Course Outline:**

1. Study of morphological and anatomical features of representative members of plants mentioned in the text through prepared slides and preserved/actual specimens.
2. Free Hand Sectioning and Staining (Single and Double) of the Representative Specimens Mentioned in the text.
3. Field Excursion Tours and Report Writing. Students shall be required to undertake a field study tour to the higher/lesser Himalayas to achieve the following objectives.
4. Study of Trachaeophytes in their Natural Habitat and prepare Field Notes. They will collect at least Fifty (50) plants including Lower and Higher Trachaeophytes. Plants should be properly Identified and Mounted on Herbarium Sheets including all Technical Informations/Data.
5. Each student shall be required to present a Comprehensive Field Report during the Practical Examination covering all aspects of the Field-Work duly supported by well-documented photographs.

**Module Aims:** The course is designed to provide an adequate knowledge of the Trachaeophytes and their evolutionary importance with special emphasis on vegetative and reproductive structure of Lower Vascular Land Plants.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Through this course students will get the better opportunity to understand the plants taught in theory, their morphological and anatomical features through preserved specimens and slides. Students would get the opportunity to collect the specimens and learn to present these in the form of preserved and pressed specimens.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests



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**Books Recommended:**

1. **Kramer, K.U. Green, P.S. and Götz, E. (2010).** *Pteridophytes and Gymnosperms (The Families and Genera of Vascular Plants)*. (1<sup>st</sup> Ed.). Springer Link. 410pp. **ISBN-13: 978-3642080807.**
  2. **Taylor, T.N., Taylor, E.N. and Krings, M. (2008).** *Paleobotany: The Biology and Evolution of Fossil Plants*. (2<sup>nd</sup> Ed.), Academic Press. 1252 pp. **ISBN-13: 978-0123739728.**
  3. **Sambamurty, A.V.S.S. (2005).** *A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. I.K. International Pvt. Ltd. 584 pp. **ISBN-13: 978-8188237456.**
  4. **Kenrick, P. and Davies, P. (2004).** *Fossil Plants (Smithsonian's Living Past)*. Smithsonian Books. 232pp. **ISBN-13: 978-1588341563.**
  5. **Willis, K.J. and McElwain, J.C. (2002).** *The Evolution of Plants*. Oxford University Press. 392 pp. **ISBN-13: 978-0198500650.**
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Code	Subject Title	Cr. Hrs	Semester
BOT-307	Environmental Biology	3	V
Year	Discipline		
3	Botany		

**Syllabus Outline:** Study of Environmental Factors and Pollutants with relation to Biolife.

**Course Outline:**

**Introduction:** Aim and Scope, Interdisciplinary Approach.

**Natural Resources:** Nature and Conservation of the following: Energy, Water, Mineral and Land Resources. Agriculture, Forestry, Range Land, Wild Life and Aquaculture.

**Environmental Pollution:** Nature and Classification.

**Air Pollution:** Sources and Effects of Pollutants on Plant Growth viz; Fluoride, Sulphur dioxide (SO<sub>2</sub>), Ozone, Pan + Smog, Ammonia, Chlorine, Ethylene, Dusts etc., Nature, Causes, Prevention and Control of Air Pollution (Vehicular Pollution and Industrial Chimney Wastes).

**Water Pollution:** Sources of Water Pollution, Nature of Pollutants. Ground Water and Marine Pollution, Impacts of Water Pollution, Prevention of Water Pollution.

**Radiation Pollution:** Nuclear Concepts and Terminology, Comparative Radiosensitivity of Organisms, Radiation Effects at Ecosystem level, Fate of radio-nuclides in the environment, The Fall Out Problem, Nuclear Waste Disposal.

Sources, Nature and Impacts of **Solid Waste Pollution, Noise and Thermal Pollution.**

**Pesticides and Agro-Chemicals:** Herbicides, Insecticides and Fungicides as Plant Poisons and their Impact on Ecosystem.

**Environmental Crisis:** Major Causes and Solutions, Ozone Hole, Green House Effect, Acid Rains, Chemical and Biological Warfare.

**Biodiversity and Conservation:** Evaluation, Criteria and Values; Inventory and Measuring of Biodiversity; *In-situ* and *Ex-situ* Conservation of Plants.

**Module Aims:** Completion of this program will produce a working knowledge of ecological sampling, analysis and interpretation of biological data and prepare graduates to study and resolve the ecological consequences of environmental problems.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** The students will acquire knowledge about the hazardous effects of different Environmental Pollutants and Relative Measures for their Control/Prevention.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz



5. Tests

**Books Recommended:**

1. **Koziol, M.J. and Whatley, F.R. (2009).** *Gaseous Air Pollution and Plant Metabolism.* Butterworths. U.K.
2. **Goodstein, E.S. (2008).** *Economics and the Environment.* Prentice Hall Publishers. New Jersey.
3. **Mitsa, W.J. and Gosselink, A. (2007).** *Wetlands.* Johan Wiley and Sons, Inc. New York.
4. **Simmons, I.G. (1981).** *The Ecology of Natural Resources.* Edward Arnold.
5. **Emery, M. (2005).** *Promoting nature in cities and towns.*
6. **Varshney, C.K. (2005).** *Water Pollution and Management,* Wiley Eastern Limited.
7. **Johnson, C.E. (2004)** *Eco-Crisis.* John Wiley and Sons. Inc., New York.
8. **Agrawal, K.C. (2001).** *Environmental Biology,* Agro Botanical Publishers, India.
9. **Chhatwal, D.R., Mehra, M.C., Satake, M., Katyal, T., Katyal, M. and Nagahiro. T. (2001).** *Encyclopedia of Environmental Pollution and its Control.* (6 Vols.), Anmol Publication, New Delhi, India.
10. **Moriarty, F. (2001)** *Ecotocology.* Acadmeic Press Inc.
11. **Nobel, B.J. and Kormond, Y. (2001).** *Environmental Science.* Prentice Hall Inc. New Jersey. USA.
12. **Treshow, M. (2001)** *Environment and Plant Response.* McGraw Hill New York.
13. **Usher, M. (2001).** *Widllife Conservation Evaluation.* Chapman and Hall.
14. **Rao, D.N., Ahmad, K.J., Younas, and Singh, S.N. (2000).** *Perspectives in Environmental Botany (Vol. I,)* Print House, Lucknow, India.
15. **Smith, L. and Graham, A. (2000).** *Impact Assessment and Sustainable Resource Management.* John Wiley and Sons, New York.
16. **Jeffrey, A.M. (1999).** *Economics and Biological diversity. International union for conservation of Nature and Natural Resources in Gland, Switzerland.*
17. **Owen, O.S. (1999)** *Natural Resources Conservation - An Ecological Approach.* MacMilian Co., New York.



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18. **Southwick, C.H. (1997).** *Global Ecology*, Sinauer Associates Inc. Sunderland, Massachusetts. USA.
  19. **Mansfield, T.A. (1990).** *Effect of Air Pollutants on plants*. Cambridge University Press, London, New York, Melbourne.
  20. **Duffey, E. (1980).** *The Conservation of Nature*, McGraw Hill Book Company, New York.
  21. **Odum, E.P. (1971)** *Fundamentals of Ecology*. W.B. Saunders Company, Philadelphia, PA.
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Code	Subject Title	Cr. Hrs	Semester
BOT-308	Environmental Biology Lab	1	V
Year	Discipline		
3	Botany		

**Syllabus Outline:** The course include different laboratory techniques used for soil and water analysis from industrial waste and visit to different industries.

**Course Outline:**

- Examination of Industrial Waste Water and Municipal Sewage for
  - Total Dissolved Solids (TDS)
  - pH and EC
  - BOD and COD
  - Chlorides, Carbonates, Bicarbonates and Nitrates.
- Examination of Water Samples from different sites for the Presence and Diversity of Organisms.
- Examination of the Effects of Automobile Exhaust on the Adjacent Vegetation.
  - Lead Count
  - Chlorophyll Content
  - Symptoms
  - Soot and Particulate Matter.
- A visit to EPA to study the Instruments used for Monitoring Pollution.
- A visit to the Industrial Organizations to examine their Effluent Treatment System.
- A visit to the municipal Organization to study their Sewage Treatment System.
- A Study Tour to a National Park and a wetland site to evaluate attributes criteria and values of the area concerned.
- Irradiation of Seeds and study of the Effects of Seed Irradiation on Seed Germination, Growth and Yield of plants.
- Field observation on the Sources and Impacts of various Air Pollutants.

**Module Aims:** Completion of this program will produce a working knowledge of Ecological Sampling, Analysis and Interpretation of Biological Data and prepare graduates to study and resolve the Ecological Consequences of Environmental Problems.

**Learning Strategies:**

- Lectures
- Group Discussion
- Laboratory work
- Seminar/ Workshop

**Learning Outcome:** The students will acquire knowledge about the Hazardous Effects of different Environmental Pollutants and the Measures for their Control/Prevention by using different Laboratory Techniques.

**Assessment Strategies:**

- Lecture Based Examination (Objective and Subjective)
- Assignments



3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Koziol, M.J. and Whatley, F.R. (2009).** *Gaseous Air Pollution and Plant Metabolism.* Butterworths. London.
  2. **Goodstein, E.S. (2008).** *Economics and the Environment.* Prentice Hall Publishers, New Jersey.
  3. **Varshney, C.K. (2005).** *Water Pollution and Management,* Wiley Eastern Limited.
  4. **Chhatwal, D.R., Mehra, M.C., Satake, M., Katyal, T., Katyal, M. and Nagahiro. T. (2001).** *Encyclopedia of Environmental Pollution and its control.* (6 vols.), Anmol Publication, New Delhi, India.
  5. **Mansfield, T.A. (1990).** *Effects of Air Pollutants on Plants.* Cambridge University Press, London, New York, Melbourne.
  6. **Odum, E.P. (1971)** *Fundamentals of Ecology.* W.B. Saunders Company, Philadelphia.
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Code	Subject Title	Cr. Hrs	Semester
BOT-309	Bioinformatics	3	VI
Year	Discipline		
3	Botany		

**Syllabus Outline:** Study of different softwares in relation to Macromolecules including DNA, Protein etc.

**Course Outline:**

Current state of Data on Genomes, Information on Genome Data-Bases and Web Sites etc., Retrieval and Interpretation of Genomic Data, Use of Software relating to Biodiversity and Ecological and Taxonomical studies, Software related to Structure of Macromolecules including Proteins, DNA, etc. and Reaction Kinetics.

**Module Aims:** The course is designed to provide knowledge about basic bioinformatics tools for detailed study of life sustaining elements at molecular level and taxonomical, and Phylogenetic relationship of organisms.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** Students are expected to have awareness about Structural and Functional Strategies of Biomolecules. They are expected to have a complete knowledge to Construct, Develop and Predict Genomic Data.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Edwards, D., Stajich, J.E. and Hansen, D. (2009).** *Bioinformatics Tools and Application*. Springer Link Publishers. ISBN: 0387927379.
2. **Bach, J.S. and Rubin, E. (2004).** *The New Avenues in Bioinformatics*. Kluwer Academic Publisher. Netherlands.
3. **Hancock, J.M. and Zvelebil, M.J. (2004).** *Dictionary for Bioinformatics and Computational Biology* (1<sup>st</sup> Ed), John Wiley and Sons Inc. New York.
4. **Baxevanis, A.D. and Ouellette, B.F.R. (2005).** *Bioinformatics: A practical Guide to the Analysis for Genes and Proteins* (3<sup>rd</sup> Ed.), John Wiley and Sons, New York.



Code	Subject Title	Cr. Hrs	Semester
BOT-310	Bioinformatics Lab	1	VI
Year	Discipline		
3	Botany		

**Outline of Syllabus:** Study of different Software in relation to Macromolecules including DNA, Protein etc. by using Internet Facilities.

**Course Outline:**

Database Search, NCBI BLAST, Pairwise sequence alignment, Multiple sequence alignment (Clustal W) Phylogenetic analysis 4, Sequencing Genomes: Physical Mapping, Genome Structure, Interpreting Genomic Sequence Data: Gene Finding, Structure Prediction, Expassy Tools, Primer Designing Protein Translation, Oligonucleotide Properties Calculator.

**Module Aims:** The course is designed to provide knowledge about basic bioinformatics books for detailed study of Life Sustaining Elements at Molecular Level, Taxonomical, and Phylogenetic relationship of organisms.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Students are expected to have awareness about Structural and Functional Strategies of Biomolecules. They are fully guided to Construct, Develop and Predict Genomic Data.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Edwards, D., Stajich, J. E. and Hansen, D. (2009).** *Bioinformatics Tools and Application.* Springer Link Publisher. **ISBN: 0387927379**
2. **Bach, J.S. and Rubin, E. (2004).** *The New Avenues in Bioinformatics.* Kluwer Academic Publishers, Netherlands.
3. **Hancock, J.M. and Zvelebil, A. (2004).** *Dictionary for Bioinformatics and Computability.* John Wiley Liss.



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4. **Baxevanis, A.D. and Ouellette, B.F.R. (2005).** *Bioinformatics: A practical Guide to the Analysis for Genes and Proteins* (3<sup>rd</sup> Ed.), John Wiley and sons. New York.
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Code	Subject Title	Cr. Hrs	Semester
BOT-311	Plant Anatomy (Advance Course)	3	VI
Year	Discipline		
3	Botany		

**Syllabus Outline:** An introduction of primary internal structures of tissue of root, stem, leaf flower and secondary growth of stem and analysis related to it.

**Course Outline:**

**Secondary Xylem:** Axial and Ray System, Growth Layers, Reaction Wood, Gymnosperm Wood, Angiosperm Wood, Differentiation in Secondary Xylem, Strength of Wood in Relation to Structure.

**Stem:** Tissue Systems, Leaf Traces, Leaf Gaps, Branch Traces and Branch Gaps, Vascular Bundles, Concept of Stele Delimitation of Vascular Region, Endodermis, Pericycle, Origin of Vascular Cambium, Common Forms of Secondary Growth.

**Anomalous Secondary Growth:** Secondary Growth in Monocots, Grafting and Wound Healing.

**Types of Stems:** Conifer. Woody Dicotyledons, Dicotyledonous Vine, Herbaceous Dicotyledons, Herbaceous Monocotyledons.

**Leaf:** Histology of Angiosperm, Leaf, Mesophyll, Vascular System, Bundle Sheaths, Supporting Structure, Secretary Structures, Petiole, Histology of Gymnosperm Leaf, Development of Leaf, Growth of Leaf Lamina, Monocotyledonous Leaf, Development of Vascular Tissues, Abscission of Leaves.

**Root:** Concept, Origin, Morphology, Primary Structure, Root Cap, Vascular Cylinder, Development of Histogens, Primary and Secondary Growth, Development of Lateral Roots, Development of Adventitious Roots, Development of Buds on Roots, Structure in Relation to Function.

**Root-Shoot Transition:** Secretary Structures, Glands, Nectaries, Hydathodes, Internal Secretary Structures, Laticifers.

**Flower:** Concept, Structure, Vascular System, Different Parts, Sepals, Petals, Stamen, Carpel, Ovule, Organogenesis, Histogenesis, Abscission.

**Module Aims:** To introduce Basic Concept of Primary Plant Body a learning Idea of Root-Shoot Transition, Secondary Growth and Anomalies, Types of Stem, Root and Leaf.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** Student will understand basic anatomical concepts of Primary Structure of Root, Stem, Leaf and Flower. They will be able to discuss the idea of secondary growth.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz
5. Tests



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**BOOKS RECOMMENDED:**

1. **Evert, R.F. and Easu, K. (2006).** *Esau's Plant Anatomy*. John Wiley and Sons, Inc.
  2. **Fahn, A. (2001).** *Plant Anatomy (5<sup>th</sup> Ed.)*. Ergamon Press. Oxford.
  3. **Dickinson, W.C. (2000).** *Integrative Plant Anatomy*. Academic Press. London.
  4. **Esau, K. (2000).** *Anatomy of Seed Plants*. John Wiley and Sons Inc. New York.
  5. **Robson, N.K.B., Cutler, D.F. and Gregory, M. (2000).** *New Research in Plant Anatomy*. Academic Press, London.
  6. **Eames, E. (1990).** *An Introduction to Plant Anatomy*. McGraw Hill Book Co. Inc. New York.
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Code	Subject Title	Cr. Hrs	Semester
BOT-312	Plant Anatomy (Advance Course) Lab	1	VI
Year	Discipline		
3	Botany		

**Syllabus Outline:** Concept of Leaf Vascular Bundle, Mesophyll Tissue Distribution, Primary Structure of Root, Stem and Leaf, Structure of Wood.

**Course Outline:** Study of Tissues from the Living and Preserved Material of Stems, Roots and leaves.

**Module Aims:** This course is designed to provide understandings about Primary and Secondary Plant Body, Secondary Growth and Primary and Secondary Anomalous Structures in plants, Leaf, Stem, Root and Flower Anatomy, Basic Structure of Root, Stem and leaf, and Wood Structure.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Student will be able to understand the Tissues Arrangement in Root, Stem, Leaf and Secondary Plant Body.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Evert, R.F. (2006).** *Esau's Plant Anatomy*. John Wiley and Sons, Inc., New York.
2. **Fahn, A. (2001).** *Plant Anatomy*. (5<sup>th</sup> Ed.), Ergamon Press, Oxford.
3. **Dickinson, W.C. (2000).** *Integrative Plant Anatomy*. Academic Press London.
4. **Esau, K. (2000).** *Anatomy of Seed Plants*. John Wiley and Sons, Inc., New York.
5. **Robson, N.K.B., Cutler, D.F. and Gregory, M. (2000).** *New Research in Plant Anatomy*. Academic Press, London.
6. **Eames, E. (1990).** *An Introduction to Plant Anatomy*. McGraw Hill Book Co. Inc., New York.



Code	Subject Title	Cr. Hrs	Semester
BOT-313	Gene Cloning (Advance Course)	3	VI
Year	Discipline		
3	Botany		

**Syllabus Outline:** Principles and Strategies for Gene Cloning including Conjugation, Transformation and Transduction.

**Course Outline:**

**The Principles of Cloning DNA:**

- i) General Principles of Cloning
- ii) Strategies for gene cloning

**Vehicles: Plasmid and Bacteriophages:**

**Plasmids**

- i) Basic Features of Plasmids
- ii) Size and Copy Number
- iii) Conjugation and Compatibility
- iv) Plasmid Classification

**Bacteriophages:**

- i) Basic Features of Bacteriophages
- ii) Lysogenic Phages
- ii) Viruses as Cloning Vehicles

**Purification of DNA:**

- i) Preparation of total Cell DNA
- ii) Preparation of Plasmid DNA
- iii) Preparation of Bacteriophage DNA

**Manipulation of Purified DNA:**

- i) The range of DNA Manipulative Enzymes
- ii) Enzymes for Cutting DNA- Restriction Endonucleases
- iii) Ligation- Joining DNA Molecule together

**Introduction of DNA into Living Cells:**

- i) Transformation
- ii) Selection for Recombinants
- iii) Introduction of phage DNA into Bacterial Cells
- iv) Selection for Recombinant Phage

**The Applications of Cloning in Gene Analysis:**

- i) Cloning of Specific Gene
- ii) Studying Gene Location and Structure
- iii) Studying of Gene Expression

**Gene Cloning in Research and Biotechnology:**

- i) Production of Protein from Cloned Gene
- ii) Gene Cloning in Medicine
- iii) Gene Cloning in Agriculture

**Module Aims:** The course work is designed to highlight importance of Gene Cloning in Research and Biotechnology, learning about the Concept of Cloning Agents, their Behavior, Structure and Manipulations.



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**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Students are expected to have an understanding about the importance of cloning, techniques to construct genomic libraries and a broad view about cloning vector types and strategies.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Primrose, S.B., and Twyman, R. M. (2006).** *Principles of Gene Manipulation and Genomics*. Blackwell Scientific Publications.
2. **Pierca, B.A. (2005).** *Genetics; A Conceptual Approach*. W. H. Freeman and Company, New York.
3. **Snustad, D.P. and Simmons, M. J., (2005).** *Principles of Genetics*, (4<sup>th</sup> Ed.). John Wiley and Son, Inc. New York.
4. **Gardner, E.J. (2004).** *Principles of Genetics*. John Willey and Sons, New York.
5. **Primrose, S.B., Twyman, R.M. and Old, R.W. (2004).** *Principles of Gene Manipulation, an Introduction to Genetic Engineering*. (6<sup>th</sup> Ed.), Blackwell Scientific Publications.
6. **Synder, L. and Champness, W. (2004).** *Molecular Genetics of Bacteria*. ASM Press, Washington D.C.
7. **Wilson, J. and Hunt, T. (2004).** *Molecular Biology of the Cell – The Problems book*, Garland Publishing Inc.
8. **Old, R.W. and Primrose, S.B. (2003).** *Principals of Gene Manipulation*. University of California Press.
9. **Glover, D.M. (2001).** *Gene Cloning. The Mechanics of DNA Manipulation*. Chapman and Hall.
10. **Brown, T.A. (2000).** *Gene Cloning and DNA Analysis; An Introduction*. Chapman and Hall Publishers.



Code	Subject Title	Cr. Hrs	Semester
BOT-314	Gene Cloning (Advance Course) Lab	1	VI
Year	Discipline		
3	Botany		

**Syllabus Outline:** Techniques for the DNA Isolation and Transformation.

**Course Outline:**

1. Problems Related to Gene Cloning
2. Conjugation
3. Total Cell lysate preparation
4. Plasmid DNA Isolation
5. Plasmid DNA detection on Gel Electrophoresis
6. Transformation of Plasmid DNA to *E. coli*.

**Module Aims:** Module designed to impart a detailed knowledge to students about Cloning Techniques and their Practical Applications.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Students are expected to have knowledge about parameters involved in Cloning of Desired Gene in Cloning Vector, Useful Approach for Isolation of Gene of Interest and its Practical Applications.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Primrose, S.B. and Twyman, R.M. (2006).** *Principles of Gene Manipulation and Genomics*. Blackwell Scientific Publications.
2. **Pierca, B.A. (2005).** *Genetics; A Conceptual Approach*. W. H. Freeman and Company, New York.
3. **Gardner, E.J. (2004).** *Principles of Genetics*, John Willey and Sons, New York.
4. **Primrose, S.B., Twyman, R.M. and Old, R.W. (2004).** *Principles of Gene Manipulation, an Introduction to Genetic Engineering*. (6<sup>th</sup> Ed.), Blackwell Scientific Publications.
5. **Wilson, J. and Hunt, T. (2004).** *Molecular Biology of the Cell: The Problems Book*, Garland Publishing Inc.



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6. **Old, R.W. and Primrose, S.B. (2003).** *Principals of Gene Manipulation*, University of California Press.
  7. **Glover, D.M. (2001).** *Gene Cloning. The Mechanics of DNA Manipulation.* Chapman and Hall.
  8. **Brown, T.A. (2000).** *Gene Cloning and DNA Analysis. An Introduction.* Chapman and Hall.
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Code	Subject Title	Cr. Hrs	Semester
BOT-315	Plant Tissue Culture (Advance course)	3	VI
Year	Discipline		
3	Botany		

**Syllabus Outline:** Study of different Techniques used in Plant Tissue Culture

**Course Outline:**

Introduction to Plant Tissue Culture  
 A Plant Tissue Culture Laboratory  
 Aseptic Technique  
 Tissue Culture Media,  
 Cellular Totipotency  
 Callus Cultures  
 Cell Suspension Cultures  
 Protoplast Cultures  
 Anther and Pollen Culture  
 Production of Pathogen –free Plants.

**Module Aims:** The subject is offered with the aim of understanding the basic principles of Plant Tissue Culture Technology and its Applications.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** At the end of the course the students should be able to understand the different techniques used in Plant Tissue Culture including Plant Micropropagation, Callus and Suspension Culture and their Applications.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Dixon, R.A. and Gonzales, R.A. (2003).** *Plant Cell Culture. A Practical Approach.* Oxford University Press, Oxford, New York.
2. **Bhojwani, S.S. and Razdan, M.K. (2001).** *Plant Tissue Culture: Theory and Practice.* Elsevier, Amsterdam, Oxford, New York.
3. **Dodds, J.H. and Roberts, L.W. (2000).** *Experiments in Plant Tissue Culture.* Cambridge University Press. Cambridge, London, New York.



Code	Subject Title	Cr. Hrs	Semester
BOT-316	Plant Tissue Culture Lab	1	VI
Year	Discipline		
3	Botany		

**Syllabus Outline:** Practical knowledge about different protocols used in Plant Tissue Culture.

**Course Outline:**

1. Acquaintance with a Plant Tissue Culture Laboratory.
2. Concepts and Demonstration of Equipment used in a Plant Tissue Culture Laboratory.
3. Aseptic Techniques.
4. Preparation of Plant Tissue Culture Media.
5. Culture of various Explants, Observation and Growth Studies of Callus Cultures.

**Module Aims:** The laboratory exercise is based on concepts and research proposals used in Plant Tissue Culture. The module will provide opportunity for the students to learn Sterile Techniques into Plant Tissue Culture Techniques and the Interaction of Plant Hormones.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** The students will have an understanding about the functioning of various Equipments used in Tissue Culture Work. The students will be able to understand about how Plants obtain Nutrients, Energy and Water while growing under Laboratory Conditions.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Dixon, R.A. and Gonzales, R.A. (2003).** *Plant Cell Culture. A Practical Approach.* Oxford University Press, Oxford, New York.
2. **Bhojwani, S.S. and Razdan, M.K. (2001).** *Plant Tissue Culture: Theory and Practice.* Elsevier, Amsterdam, Oxford, New York.
3. **Dodds, J.H. and Roberts, L.W. (2000).** *Experiments in Plant Tissue Culture.* Cambridge University Press. Cambridge, London, New York.



Code	Subject Title	Cr. Hrs	Semester
BOT-317	Palynology (Advance course)	3	VI
Year	Discipline		
3	Botany		

**Syllabus Outline:** Palynology; its Scope and Importance, Neopalynology and Palaeopalynology, Structure, Morphology, Ornamentation Pattern of Spores and their Technical Description, Branches of Neopalynology, Chemical Composition of Exine and Organic Thermal Maturity, Maceration Techniques to Isolate Palynomorphs and Field Work.

**Course Outline:**

**Neopalynology:**

Production and Dispersal of Spores and Pollen

Ultra-structure and Stratification of Exine.

Spore and Pollen Diversity, Morphology and Ornamentation Pattern, Technical Description.

Environmental Palynology, Occurrence and Significance of Airborne Pollen with respect to Allergies and Asthma, Control Measures.

Mellitopalynology, Aeropalynology and Archaeopalynology. Palynology in Medicine and Criminology.

**Palaeopalynology:**

Ultra-structure and Chemical composition of Fossil Exine.

Palynomorphs as Sedimentary Particles, Preservation in Sediment, Post Depositional Hazards.

Palynomorphs in Oil and Gas Exploration, Geochronology, Stratigraphic Correlation, Reconstruction of Past Plant communities, Index Palynomorphs, Organic Thermal Maturity.

Technical Description of Palynomorphs.

Maceration Techniques and Field Work.

**Module Aims:** This course is designed to understand the Importance, Scope and Applications of Palynology in other Fields, Techniques used to Isolate Palynomorphs, their Technical Description and Evaluation of Palynological Data.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** After getting through this course students would be able to know about Palynology, its Branches and their Importance, they would be able to Isolate Palynomorphs from Sedimentary Rock samples through different Maceration Techniques. Field Study Tour would enhance their knowledge of theory and better understanding of the subject.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments



3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Brooks, J. (2010).** *Organic Maturation Studies and Fossil Fuel Exploration.* Academic Press, London.
2. **Agashe, S.N. and Caulton, E. (2009).** *Pollen and Spores: Applications with Special Emphasis on Aerobiology and Allergy.* Science Publishers. 412pp. **ISBN-13: 978-1578085323.**
3. **Scott, A.C. (2009).** *Coal and Coal-bearing strata; recent advances.* Blackwell Scientific Publishers, Oxford.
4. **Erdtman, G. (reprinted 2008).** *An Introduction to Pollen Analysis.* Morison Press. 260pp. **ISBN-13: 978-1443723077.**
5. **Traverse, A. (2007).** *Paleopalynology: Topics in Geobiology.* (2<sup>nd</sup> Ed.), Springer Link Publishers. 813 pp. **ISBN-13: 978-1402066849.**
6. **Harley, M., Morton, C.M. and Blackmore, S. (2000).** *Pollen and Spores: Morphology and Biology,* Royal Botanic Gardens, Kew. 530pp.
7. **Kapp, R.O., Davis, O.K. and King, J.E.** [Illustrated by Hall, R.C.] (2000). *Ronald O. Kapp's Pollen and Spores.* (2<sup>nd</sup> ed.), AASP Found. 279 pp. **ISBN 931871-05-0.**
8. **Kurmann, M.H. and Doyle, E. (1994).** *Ultrastructure of Fossil Spores and Pollen.* Royal Botanic Gardens, Kew. 227pp. **ISBN-13: 978-0947643607.**
9. **Collinvaux, P.A., De Oliveira, P.E. and Moreno, E. (1999).** *Amazon: Pollen Manual and Atlas.* Harwood Academic Publishers. 344pp. **ISBN-13: 978-9057025877.**
10. **Traverse, A. (1996).** Nomenclature and Taxonomy: Systematics. In: *Jansonius, J. and McGregor, D.C. Eds., Palynology: Principles and Applications, American Association of Stratigraphic Palynologists Foundations,* 11-28, Publishers Press.
11. **Jones, G.D., (1995).** *Pollen of the Southeastern United States: with Emphasis on Melissopalynology and Entomopalynology.* AASP Foundation Contribution Series No. 30: 76 pp., 104 photographic plates. **ISSN 0160-8843.**
12. **Punt, W., Blackmore, S., Nilsson, S. and Thomas, A.L. (1994).** *Glossary of Pollen and Spore Terminology.* LPP Contributions Series No. 1: 71pp. LPP Foundation, Laboratory of Palaeobotany and Palynology, University of Utrecht, Utrecht, The Netherlands. **ISBN 90-393-0230-8.**



Code	Subject Title	Cr. Hrs	Semester
BOT-318	Palynology Lab	1	VI
Year	Discipline		
3	Botany		

**Syllabus Outline:** Extraction of Pollen and Spores, Preparation of Strew Mount Slides, Single Grain Manipulation and their Technical Description, Field Study Tour for the Collection of Rock Samples from Salt Range, Pakistan and a Comprehensive Field Report of Study Tour.

**Course Outline:**

1. Extraction of pollen and spores from Anther/Strobili/Sori, their Identification and Technical Description.
2. Palynological Analysis of Paleozoic, Mesozoic and Cenozoic Rock samples through Standard Procedures.
3. Preparation of Strew Mount Slides and Single Grain Manipulation(s).
4. Field Tour to the Salt Range, Pakistan to study Paleozoic, Mesozoic and Cenozoic Outcrops including Sample Collecting Techniques. Each student shall be required to submit a comprehensive Field Tour Report at the time of Practical Examination. Specific marks shall also be allocated for such a report.

**Module Aims:** This course is designed to understand the Importance, Scope and Applications of Palynology in other Fields, techniques used to Isolate palynomorphs, their Technical Description and Evaluation of Palynological Data.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** After getting through this subject, students would be able to study Extant and Extinct Palynomorphs extracted through different Standard Techniques, to describe the Data Technically and Preparation of Permanent Mounts of this material, Field Study Tour would enhance their knowledge pertaining to the Preparation of Comprehensive Field Report and presentation of the data scientifically.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests



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**Books Recommended:**

1. **Hesse, M., Halbritter, H., Weber, M., Buchner, R., Frosch-Radivo, A. and Ulrich, S. (2010).** *Pollen Terminology: An Illustrated Handbook*. (1<sup>st</sup> Ed.), Springer Link Publishers. 264pp. **ISBN-13: 978-3211999356.**
  2. **Icon Group International, (2010).** *Microtechnique: Webster's Timeline History, 1893 – 2005*. 24pp. ICON Group International, Inc. **ASIN: B003L5DP80.**
  3. **Phipps, D. and Playford, G. (2010).** *Techniques for Extracting Palynomorphs from Sediments*. Department of Mineralogy and Geology. sp. pub. Univ. Queensland, Brisbane, Australia.
  4. **Shah, S.M.I. (1977).** *Stratigraphy of Pakistan*. Memoirs of the Geological Survey of Pakistan, v. 22, pp. 381.
  5. **Traverse, A. (2007).** *Palaeopalynology: Topics in Geobiology*. (2<sup>nd</sup> Ed.), Springer Link Publishers. 813 pp. **ISBN-13: 978-1402066849.**
  6. **Punt, W., Blackmore, S., Hoen, P.P., Nilsson, S. and Thomas, A. Le (2007).** Glossary of Pollen and Spore Terminology. *Review of Palaeobotany and Palynology*, 143(1): 1-81.
  7. **Armstrong, H. and Brasier, M. (2005).** *Microfossils*. (2<sup>nd</sup> Ed.). J. Wiley-Blackwell Scientific Publishers. 304pp. **ISBN-13: 978-0632052790.**
  8. **Harley, M., Morton, C.M. and Blackmore, S. (2000).** *Pollen and Spores: Morphology and Biology*, Royal Botanic Gardens, Kew. 530pp.
  9. **Gee, E R. (2000).** *Geological Maps of Salt Range*. Geological Survey of Pakistan.
  10. **Kurmann, M.H. and Doyle, E. (1994).** *Ultrastructure of Fossil Spores and Pollen*. Royal Botanic Gardens, Kew. 227pp. **ISBN-13: 978-0947643607.**
  11. **Soil Survey of Pakistan (2000).** *Topographic Sheets of Salt Range, Pakistan*.
  12. **Collinvaux, P.A., De Oliveira, P.E. and Moreno, E. (1999).** *Amazon: Pollen Manual and Atlas*. Harwood Academic Publishers. 344pp. **ISBN-13: 978-9057025877.**
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Code	Subject Title	Cr. Hrs	Semester
BOT-319	Laboratory Techniques	2	VI
Year	Discipline		
3	Botany		

**Syllabus Outline:** Visit of different laboratories of the department to learn different Techniques being used along with the working of different Instruments.

**Course Outline:**

Students shall be required to visit all Research Laboratories in the Department on a Regular Basis to learn Advanced Techniques. They will submit Report about each Laboratory at the end of the Semester, which should elaborate and highlight details of all Advanced Techniques/Instrumentation in the written form. Each student will appear for Viva Voce Examination pertaining to that report during which time he/she shall be asked various questions pertaining to the said techniques. Total marks for this course would be divided into two parts viz.; Written Report and Viva Voce Examination. Students shall consult Books available in the Library for each the discipline as directed by the respective Teacher/Faculty Member.

**Module Aims:** The aim of this course is to acquaint the student with the working of various Instruments and Techniques used in different laboratories.

**Learning Strategies:**

1. Group Discussions
2. Laboratory Work

**Learning Outcome:** The students are expected to learn about the basic concepts of different Instruments and experiments being performed in different laboratories.

**Assessment Strategies:**

1. Written Reports
2. Class Discussion
3. Oral Presentation



Code	Subject Title	Cr. Hrs	Semester
BOT-320	Seminar	2	VI
Year	Discipline		
3	Botany		

**Syllabus Outline:** Presentation

**Course Outline:**

Each student will be allocated a specific topic pertaining to a particular discipline in the subject of Botany for preparation of Seminar. The Student shall be required to prepare Seminar in consultation with the respective Teacher(s) by using latest books / research papers available in the library or elsewhere. At the end of the Semester he/she will be required to submit a Written Report on that particular topic followed by Comprehensive Oral Presentation. The seminar would be evaluated by a Special Committee constituted for that purpose and convened by the Chairman. Separate marks shall be allocated for Written Report and Oral Presentation.

**Module Aims:** The course is designed to give awareness about the preparation of scientific talk. The module contains Literature Survey by using Books and Research Articles.

**Learning Strategies:**

1. Group Discussion
2. Assignment
3. Seminar/ Workshop

**Learning Outcome:** The student will be able to make a valuable Scientific Presentation and get confidence. They can also learn how to write a Scientific Report.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz
5. Tests

## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-401</b>	<b>Air Pollution, its Impacts and Control</b>	<b>3</b>	<b>VII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** Nature of Atmosphere, Air Pollution causing Factors and Measurements for their Remedies.

**Course Outline:**

Atmosphere Introduction: Nature and Scope.

Chemistry of Troposphere and Stratosphere, Primary Pollutants, Troposphere Ozone and its Impacts, Stratospheric Ozone and its Destruction, Atmospheric Aerosols; Origin, Types, Functions and Impacts, Acid Rain and its Adverse Effects.

Trace Gases and Global Warming, The Greenhouse Theory, The Culprit Gases and their Warming Potential, Estimates of Greenhouse Impacts.

Air Quality in Urban Atmosphere; Introduction. Exhaust Emissions from Motor Vehicles, Waste Heat, Primary and Photochemical Pollutants, Urban Pollution Rankings in Pakistan and other Countries, Catalyst System for Emission Control from Motor Vehicles, Organ Metallic Compounds in the Environment, (Organ Lead and Organ Mercury). The Health Effects of Environmental Pollutants, Effects on Inert Materials and General Adverse Effects.

Radiation and Nuclear Explosion: Background Information, Radiation Impact at Ecosystem Level and Comparative Sensitivity of Organisms, Fate of Radionuclides and Fall Out Problem, Disposal of Radioactive Wastes, the Lessons of Chernobyl, Nuclear Winter, Environmental Consequences of Nuclear War, Uncertainties and Recent Developments.

Control of Air Pollution; Air Quality Standards, International Air Quality Programmes, Control of Atmospheric Pollution at Source.

**Module Aims:** The objective of this course is to develop skills in formulating and solving problems arising from Emerging Technologies for the Energy and Industrial Waste. The course

is designed to know the Effects of Air Pollution as motivation for control of Anthropogenic Omissions to the Atmosphere.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** To make the student capable to design a System Component and Process for Controlling Pollution/Environmental Hazards. On completion of the course, the students are able to discuss and explain Fundamental reasons of Air Pollution, to create awareness on Pollution generated at different stage of Industries Outcome Procession.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Bridgeman, H.A (2009).** *Global Air Pollution*. Belhaven Press, London.
  2. **Southwick, C.H. (2007).** *Global Ecology*. Sinauer Associates, Inc. Sunderland, Massachusetts.
  3. **Crawley, M.J. (2007).** *Plant Ecology* (3<sup>rd</sup> Ed.). Blackwell Science Ltd. (U.K).
  4. **National Research Council, USA, (2007).** Committee on Medical and Biological Effects of Environmental Pollutants; Ozone and other Photochemical Oxidants. National Academy of Sciences, Washington, D.C.
  5. **Schneider, S.H. (2005).** *Global Warming*. Sierra Club Books. San Francisco.
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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-402</b>	<b>Air Pollution, its Impacts and Control (Lab.)</b>	<b>1</b>	<b>VII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** Air Sampling, Ambient Air Analysis, Polluting Agents, Bioindicators for Pollution Alerts, Field Survey of Densely Polluted Areas, Study of Environmental Pollutants in relation to reduction the Hazardous Effects.

### Course Outline:

1. Air Sampling: General Considerations in sampling and use of various Instruments.
2. Analysis of Ambient Air for Ozone.
3. Analysis of Ambient Air for NO<sub>2</sub>.
4. Analysis of Ambient Air for SO<sub>2</sub>.
5. Identification of Sources of various Air Pollutants and study of their Characteristics.
6. Bio-Indicators and study of Symptoms of Air Pollutants on Vegetation.
7. Study of Impact of Radiation on Germination and early Seedling Growth.
8. Field Work, Visit to Industrial Sites showing Air Pollution.

**Module Aims:** To study important Particulate Matter that our especially important in Air Pollution Control Effect of Radiation on Plant Growth.

### Learning Strategies:

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

### Learning Outcome:

To understand various air pollutants their impact on plants and control.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Bridgeman, H.A (2009).** *Global Air Pollution*. Belhaven Press, London.
2. **Southwick, C.H. (2007).** *Global Ecology*. Sinauer Associates, Inc. Sunderland, Massachusetts.
3. **Crawley, M.J. (2007).** *Plant Ecology* (3<sup>rd</sup> Ed.). Blackwell Science Ltd. (U.K).
4. **National Research Council, USA, (2007).** Committee on Medical and Biological Affects of Environmental Pollutants; Ozone and other Photochemical Oxidants. National Academy of Sciences, Washington, D.C.
5. **Schneider, S.H. (2005).** *Global Warming*. Sierra Club Books. San Francisco.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-403</b>	<b>Biohazards, Biosafety, Bioethics</b>	<b>3</b>	<b>VII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** Hazardous role of Microbes Ethical Manipulation of Gene and Safety Measures to Overcome Environmental Pollution.

### Course Outline:

Hazardous Roles of Microbes in the Environment, Microorganisms as a Source of Disease and other Nuisances, Solution to various Hazards, new trends in Monitoring of toxic Environmental Hazards by Microbes.

Safety and the Genetic Manipulation of Organisms, Risk Assessment in Genetic Manipulation, Deliberate Release of Genetically Modified Microorganisms (GMOs), Role of Genetic Modification Safety Committee, Hazard Groups of Organisms, Guidelines for Microbial and Animal Cell Culture.

Cloning of Animal and Human Beings; Moral, Ethical, Legal and Patent Issues, Trade Secrets. International Regulations and contained Use of Genetically Modified Organisms (GMOs).

Radiation, Health and Safety; Sources and Laboratory use of Radiation, Radiation Protection, disposal of Radioactive Materials from Laboratories, Protection of Workers and Public. Environmental Pollution and Law.

**Module Aims:** The course is designed to provide essential knowledge about various Agents causing Biohazards. Highlighting the Reasons for Unethical use of Biodiversity and Guidance about Measurements leads to Biosafety.

### Learning Strategies:

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Students are expected to have knowledge about the Measurements of Environmental Sustainability. They will have idea for how to utilize the Biological Resources which are friendly to Environment.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **S.I. Cutter, (2003).** *Environmental Risks and Hazards.* Publishers Prentice Hall.
2. **Donnellan, C. (2002).** *Cloning.* Independent Educational Publication.
3. **Donnellan, C. (2001).** *The Ethics of Genetic Engineering.* Independent Educational Publication.
4. **O'Mahony, P.J. (2000).** *Nature, Risk, and Responsibility: Discourses of Biotechnology.* Routhedge Routhedge Publisher.
5. **Hansen, D.J. (2000).** *The Work Environment; Healthcare, Laboratories and Biosafety.* Lewi Publishers.
6. **Torrance, I. (2000).** *Bio-Ethics for new Millennium,* Saint Andrew Press.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-404</b>	<b>Biohazards, Biosafety, Bioethics (Lab.)</b>	<b>1</b>	<b>VII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** Demonstration for Handling of Microbes Aseptically, Learning of Appropriate Safety Precautions and Ethical Use of Biodiversity.

### Course Outline:

1. Microbiological Procedures that are related to hazards will be Demonstrated and Evaluated in Laboratory Exercise.
2. Demonstration of Aseptic Techniques.
3. Techniques to Release/Dispose off Microbial Cultures.
4. Handling of Pathogenic Bacteria.
5. Hazards commonly found in Microbiological Laboratories and appropriate Safety Precautions and Responses.
6. Hazards of working with Bacteria, Virus, Parasites, Recombinant and Procedures and regulations.

**Module Aims:** The course designed for guidance about techniques for microbiological procedure which are not hazardous for Environment and friendly human health.

### Learning Strategies:

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** Students are expected to have knowledge about Safety Measures followed for handling of Microbial Molecules and Laboratory Precautions for their proper Dispose off.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **S.I. Cutter, (2003).** *Environmental Risks and Hazards*, Prentice Hall.
  2. **Donnellan, C. (2002).** *Cloning*. Independent Educational Publication.
  3. **Donnellan, C. (2001).** *The Ethics of Genetic Engineering*. Independent Educational Publication.
  4. **O'Mahony, P.J. (2000).** *Nature, Risk, and Responsibility: Discourses of Biotechnology*. Routhedge Routhedge Publisher.
  5. **Hansen, D.J. (2000).** *The Work Environment; Healthcare, Laboratories and Biosafety*. Lewi Publishers.
  6. **Torrance, I. (2000).** *Bio-Ethics for new Millennium*, Saint Andrew Press.
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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-405</b>	<b>Plant Nutrition and Soil Fertility</b>	<b>3</b>	<b>VII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** To study composition of different nutrients, absorption, translocation and assimilation of various nutrients, Nitrogen fixation.

### Course Outline:

Introduction, Scope and History of Mineral Plant Nutrition.

The Inorganic Components of Plants, Water, Dry Matter, Mineral Competition, Essential and other Mineral Elements, Macronutrient and Micronutrient Elements, Comparative Macronutrient and Micronutrient Elements; Comparative Elemental Requirements of Higher Plants; Deficiencies and Tissue Analysis, Deficiency Symptoms of Individual Elements.

The Media of Plant Nutrition, The Variety of Nutrient Media: Soil; Solution Culture; Chemical Composition of Nutrient Solutions; Modified Solution Culture, Culture Solutions compared with Soil Solutions.

The Acquisition of Nitrogen Absorption of Nitrate and Ammonium Ions; Nitrogen Fixation, Physiology of Formation of Root Nodules, Physiology of Symbiotic Nitrogen Fixation.

Mineral Metabolism, The Functions of Nutrients, Nutrient Elements as Constituents of Metabolites and Complexes, Nutrient Elements as Activators, Cofactors or Regulators of Enzymes, Nutrient Elements in Physiological Processes.

Ecological Aspects of Plant Nutrition, Phenotypic Plasticity, The Concept of the Ecotype, Role of Mineral Elements in Plant Ecology, Interplay between Plants and their Mineral Media.

Soil Fertility Evaluation.

Soil and Fertilizer N, P, K, Ca, Mg, S, Fe and Trace Elements.

Liming and Use of Gypsum.

Fertilizers and Efficient Use of Water.

**Module Aims:** The students will be able to get an update on issues related to Plant Nutrition and Soil Fertility Integrated on Sustainable Land Use and Natural Resource Management.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** The students will develop an insight into the Mineral Requirements, Media Preparations and Mineral Metabolism. All Agriculture Practices based on fertilization will be analyzed.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Taiz, L.D. and Zeiger, E. (2010).** *Plant Physiology*. (5<sup>th</sup> Ed.), Sierauer Associates.
2. **Barker, A.V. and Pilbeam, D.J. (2007).** *Hand Book of Plant Nutrition*. CRC Press Washington D.C.
3. **Epstein, E. and Bloom, J.A. (2005)** *Mineral Nutrition of Plants: Principles and Perspectives*. (2<sup>nd</sup> Ed.), Sierauer Associates.
4. **Tisdale, S. and Nelson, W. (2005).** *Soil Fertility and Fertilizers*. (3<sup>rd</sup> Ed.), Mchillans.
5. **Wallace, T. (2005).** *The Diagnosis of Mineral Deficiencies in Plants*. Her Majesty's Stationery Office, London.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-406</b>	<b>Plant Nutrition and Soil Fertility (Lab.)</b>	<b>1</b>	<b>VII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** Study of different media for plant growth, macro and micronutrients, determination of total water requirements.

### Course Outline:

1. Sand and Water Culture Methods.
2. Study of Deficiency Symptoms of Macro and Micronutrient Elements.
3. Phenotypic Adaptations of plants to Nutrients, Deficiency and Methods of Growth Analysis.
4. Plant Tissue Analysis for Principle Inorganic Ions.
5. Determination of P, Ca and Mg Content of Soil.
6. Preparation of Fertilizer Mixtures.
7. Determination of total Water Requirements of a Crop by using Climatic Data (Blaney and Criddle Formula will be used).
8. Preparation of Standard Acid, Alkali and Indicator Solutions.

**Module Aims:** This Laboratory Course will help students to solve problems related to Soil Fertility and Fertilizers. Students will learn about various techniques of growing plants.

### Learning Strategies:

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** Experiments based on Theory Syllabus will be explored. Students will be able to grow plants in different media. Students will be able to observe different symptoms due to deficiency of various nutrients in the media

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Taiz, L.D. and Zeiger, E. (2010).** *Plant Physiology*. (5<sup>th</sup> Ed.), Sierauer Associates.
2. **Barker, A.V. and Pilbeam, D.J. (2007).** *Hand Book of Plant Nutrition*. CRC Press Washington D.C.
3. **Epstein, E. and Bloom, J.A. (2005)** *Mineral Nutrition of Plants: Principles and Perspectives*. (2<sup>nd</sup> Ed.), Sierauer Associates.
4. **Tisdale, S. and Nelson, W. (2005).** *Soil Fertility and Fertilizers*. (3<sup>rd</sup> Ed.), McMillans.
5. **Wallace, T. (2005).** *The Diagnosis of Mineral Deficiencies in Plants*. Her Majesty's Stationery Office, London.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-407</b>	<b>Biodegradation and Bioremediation</b>	<b>3</b>	<b>VII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** Environmental Pollutants, Biodegradation and Microbial Technologies, Strategies for Bioremediation.

### Course Outline:

The Environment and Pollution: Introduction, Environmental Law.

Treatment Technologies.

Traditional Approaches to Pollution Control.

- a. Biotreatment Technologies for Pollution Control.
- b. Biocatalyst Selection and Genetic Modification.
- c. Enrichment and Screening Strategies.
- d. Design of enrichment strategies relating to the Environmental Source.
- e. Microbiological Techniques for Enrichment and Selection.
- f. Genetical Approach.

The Carbon Cycle and Xenobiotic Compounds:

Biodegradation and Microbial Technologies by Microorganisms.

- a. Acclimation
- b. Detoxification
- c. Activation
- d. Sorption
- e. Bioavailability: Sequestering and Complexing.
- f. Co-metabolism
- g. Environmental Effects.

Effects of Metals and Radionuclide on Environment.

Metal and Radionuclide Microbial Treatment.

Biotechnology for Metal and Radionuclide Removal and Recovery.

Recalcitrant Molecules.

**Module Aims:** The course is designed to provide the students the knowledge of Biodegradation of Pollutants and its Application in Biodegradation Studies.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:** After studying this course students will be able to understand the Chemistry of Biodegradation and its Application in Biodegradation Studies.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Tortora, G.J., Christine L., Case, C.L., Funke, B.R., Funke, B. and Case, C. (2006).** *Microbiology: An Introduction*. Pearson Education Publishers.
2. **Borlak, J. (2005).** *Handbook of Toxicogenomics: Strategies and Applications*. John-Wiley and Sons Limited.
3. **Heikki, M., Hokkanen, T. and Hajek, A.E. (2004).** Environmental Impacts of microbial Insecticide: Needs and Methods for Risk Assessment, Science.
4. **McEldowney, S., Hardmen, D.J. and Waite, S. (2003).** *Pollution: Ecology and Biotreatment*. Longman Scientific Technical.
5. **Mitchell, R. (2002).** *Environmental Microbiology*. (2<sup>nd</sup> Ed.), Wiley Liss.
6. **Tickner, J.A. (2002).** *Precaution, Environmental Science, and Preventive Public Policy*. Island Press.
7. **Sunahara, G.I., Agnes, Y., Renoux, A.Y., Thellen, C., Gaudet, C.L., and Pilon, A. (2002).** Environmental Analysis of Contaminated Sites. John-Wiley and Sons Limited.
8. **Chapelle, F.H. (2001).** *Ground – Water Microbiology and Geochemistry* (2<sup>nd</sup> Ed.), John Wiley and Sons. Inc.

9. **Alexander, M. (1999).** *Biodegradation and Bioremediation*. Academic Press, Inc.
10. **Poole, R.K. and Gadd, G. M (1989).** *Metal Microbe Interaction*. IRL Press.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-408</b>	<b>Biodegradation and Bioremediation (Lab.)</b>	<b>1</b>	<b>VII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** Bacterial Isolation from different Environmental Sources, Techniques for Testing Degradation Ability of Bacteria.

### Course Outline:

1. Isolation of Bacteria from Oil Wastes, Polluted Water from Industries and Sewage.
2. Spray Plate Technique for Testing the Degradation Ability of Bacteria for different Aromatic Hydrocarbons.
3. Bioremediation from Culture by Metal Resistant Bacteria.

**Module Aims:** The course is designed in a way to understand how Biodegradation of Pollutants is done practically.

### Learning Strategies:

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** After studying this course, students will be in a condition to understand how we can Clean our Environment from Pollutants by Depredating Organisms and its Practical Applications.

### Assessment Strategies:

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz
5. Tests

**BOOKS RECOMMENDED:**

1. **Tortora, G.J., Christine L., Case, C.L., Funke, B.R., Funke, B. and Case, C. (2006).** *Microbiology: An Introduction*. Pearson Education Publishers.
2. **Borlak, J. (2005).** *Handbook of Toxicogenomics: Strategies and Applications*. John-Wiley and Sons Limited.
3. **Heikki, M., Hokkanen, T. and Hajek, A.E. (2004).** Environmental Impacts of microbial Insecticide: Needs and Methods for Risk Assessment, Science.
4. **McEldowney, S., Hardmen, D.J. and Waite, S. (2003).** *Pollution: Ecology and Biotreatment*. Longman Scientific Technical.
5. **Mitchell, R. (2002).** *Environmental Microbiology*. (2<sup>nd</sup> Ed.), Wiley Liss.
6. **Tickner, J.A. (2002).** *Precaution, Environmental Science, and Preventive Public Policy*. Island Press.
7. **Sunahara, G.I., Agnes Y., Renoux, A.Y., Thellen, C., Gaudet, C.L., and Pilon, A. (2002).** *Environmental Analysis of Contaminated Sites*. John-Wiley and Sons Limited.
8. **Chapelle, F.H. (2001).** *Ground – Water Microbiology and Geochemistry* (2<sup>nd</sup> Ed). John Wiley and Sons. Inc.
9. **Alexander, M. (1999).** *Biodegradation and Bioremediation*. Academic Press, Inc.
10. **Poole, R. K. and Gadd, G.M (1989).** *Metal Microbe Interaction*. IRL Press.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-409</b>	<b>Microbes, Man and the Environment</b>	<b>3</b>	<b>VIII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** Types of Microbes and their Evolution; Distribution of Microbes in the Environment and Strategies for Success, Positive and negative Interactions of microbes with men.

### **Course Outline:**

**Microbial Evolution and Nutrition:** The Origin of Life, Phylogeny, Evolution of Microbes, Bacteria, Archaea and Fungi, Evolution of Microbes into Diversifying Ecosystems, Diversity of Energy Generating Systems of Microbes.

**Microbial Structure, Replication and Motility:** Bacterial Replication, Adhesion, Motility and Growth, Fungal Replication, Yeasts, Molds and Spores, Diversity of Viruses and Viral Replication.

**Microbes in the Environment:** Microbes and Nutrients. Carbon Cycling in the Ecosystem. Brown rots and White Rots, Microbes and Nutrients, Nitrogen Cycling in the Ecosystem., Ammonification, Nitrification, De-Nitrification.

**Microbial Partnership:** Microbial Associations with Plant Roots, Legumes, Rhizobia and Nitrogen Fixation, Mycorrhizal Associations with Plant Roots, from Trees to Orchids, Animal Fermenters, Ruminants and Hind Gut Fermenters, Cellulose Digestion, Methanogens and Chytrids, Microbes and Insects.

**Microbes as Pathogens:** Bacterial Pathogens of Plants, Colonization and Invasion Strategies, Fungal Pathogens of Plants, Colonization and Invasion Strategies, Using Microbes to Fight Pests and Disease, Biological Control, Bacterial Diseases of Man, Colonization and Invasion of Tissues, Models of Toxin Action, Fungal Diseases of man, Dermatophytes, *Candida* and Aspergillosis, Viral diseases of Man, Antimicrobials and Targets, Antibiotics and Antiviral Agent, Targets and Modes of Action, Emergence and Mechanism of Antibiotic Resistance.

**Exploitation of Microbes in Industry:** Microbes as Cell Factories, Primary and Secondary Metabolites, Fermentation Systems, Enzymes and Industry, Microbes and Food, Use of Microbes in Food and Beverage Production, Food Spoilage and Toxins, Exploitation of Natural Microbial Communities in the Treatment of Sewage.

**Module Aims:** To highlight the Role of Microbes in the Environment and Ecosystem and to show their Beneficial and Detrimental Roles in the Environment and on men.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** To enhance the understanding of Microbes to students, their Importance and Positive/Negative Interactions with Man.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Edwards, C. (2008).** *Microbiology of Extreme Environments; Environmental Biotechnology.* McGraw Hill Publishers.
2. **Mitchell, R. (2006).** *Environment Microbiology.* John Wiley and Sons, Inc. New York.
3. **Black, J.G. (2005).** *Microbiology: Principles & Explorations.* (6<sup>th</sup> Ed.). McGraw Hill, Publishers.
4. **Holt, J.G., Krieg, N.R., Speath, P.H.A., Steley, J.T. and Williams, S.T. (2005).** *Bergey's Manual of Determinative Bacteriology.* (10<sup>th</sup> Ed.), William and Wilkins Publishers.
5. **Cappuccino, J.G. and Sherman, N. (2002).** *Microbiology, A laboratory Manual,* (4<sup>th</sup> Ed.), The Benjamin Cummings Publishing Company Inc.
6. **Sayler, G.S. and Fox, R. and Blackburn, J.W. (2001).** *Environmental Biotechnology for Waste Treatment.* Plenum Publishing Corporation.
7. **Alexander, M. (2001).** *Biodegradation and Bioremediation.* Academic Press, Inc.
8. **Mitchell, R. (1992).** *New Concepts in Environmental Microbiology.* Alan R. Liss.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-410</b>	<b>Microbes, Man and the Environment (Lab.)</b>	<b>1</b>	<b>VIII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** Types of Microbes and their Evolution; Distribution of Microbes in the Environment and Strategies for Success; Positive and Negative Interactions of Microbes with Men.

### Course Outline:

The practicals in this course will introduce the students to a wide range of Microbiological Laboratory Techniques. Skill development in the handling and growth of Microorganisms is a key part of the Practical. Students will perform Assays on Antibiotics and study a range of Yeast, Bacteria and Fungi. Assessment will comprise a practical skill Competence Test and short Answers Questions.

**Module Aims:** To highlight the Role of Microbes in the Environment and Ecosystem and to show their Beneficial and Detrimental Roles in the Environment and on Men.

### Learning Strategies:

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** To enhance the understanding of MICROBES to students, their Importance and Positive/Negative Interactions with Man.

### Assessment Strategies:

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz
5. Tests

### Books Recommended:

1. **Edwards, C. (2008).** *Microbiology of Extreme Environments; Environmental Biotechnology.* McGraw Hill.

2. **Mitchell, R. (2006).** *Environment Microbiology*. John Wiley and Sons, Inc. New York.
3. **Black, J.G. (2005).** *Microbiology: Principles and Explorations*, (6<sup>th</sup> Ed.). McGraw Hill, Publishers.
4. **Holt, J.G., Krieg, N.R., Speath, P.H.A., Steley, J.T. and Williams, S.T. (2005).** *Bergey's Manual of Determinative Bacteriology*. (10<sup>th</sup> Ed.), William and Wilkins Publishers.
5. **Cappuccino, J.G. and Sherman, N. (2002).** *Microbiology, A laboratory Manual*, (4<sup>th</sup> Ed.), The Benjamin Cummings Publishing Company Inc.
6. **Sayler, G.S. and Fox, R. and Blackburn, J.W. (2001).** *Environmental Biotechnology for Waste Treatment*. Plenum Publishing Corporation.
7. **Alexander, M. (2001).** *Biodegradation and Bioremediation*. Academic Press, Inc.
8. **Mitchell, R. (1992).** *New Concepts in Environmental Microbiology*. Alan R. Liss.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-411</b>	<b>Water Pollution, its Management and Control</b>	<b>3</b>	<b>VIII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** To identify Water Quality and its Parameters; Organic and Inorganic Pollutants, Pesticides, Oil, Thermal and Heavy Metal Pollutions in Water; Water Pollution Management and Control.

**Course Outline:**

Introduction; Nature and Scope, Water Requirements in Society, Water Pollution Parameters., Properties of Polluted Water, Sources of Water Pollution.

Organic Pollution and Eutrophication, Origin of Organic Pollutants, Pathogens. Effects of Organic Pollutants, Eutrophication, Sources of Nutrients, Effects of Eutrophication and its Control.

Pesticide, Thermal and Oil Pollution of Water, Sources of Pesticides in Water, Bioaccumulation and Degradation of Pesticides, Adverse Effects of Pesticides, Thermal Pollution of Water and its Impacts, Sources and Nature of Oil-Pollution, its Effects and Control.

Heavy Metals in Aquatic Environment, Nature and Concern about Heavy Metals, Sources of Contamination of Mercury, Lead, Cadmium, Arsenic, Chromium, Zinc, Copper and Manganese and their Toxicity.

Waste Water Management; Introduction, Chemical Treatment (Primary, Secondary and Tertiary Treatments), Biological Treatment (Aerobic and Anaerobic Treatments).

Water Pollution Control: Background Information, Legislation, Various approaches to Water Pollution Control.

**Module Aims:** To highlight the importance of Water Pollution to student and to acquaint them with its different types. To teach them the ways to Control Water Pollution and teach its Arrangements.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** The student is expected to know the parameters which determine Water Pollution, the various ways in which it can become polluted, the Management and Control of Polluted Water Habitants.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Lenihan, J. and Fletcher, W.W. (2004).** *The Marine Environment: Environment and Man* (Vol. VI). (Ed.). Blackie and Sons, Glasgow and London.
2. **Southwick, C.H. (2003).** *Global Ecology*. Sinauer Associates Inc. Publishers. Sunderland, Massachusetts.
3. **Ciaccio, L.L. (2001).** *Water and Water Pollution Handbook*. Marcel-Dekker, Inc. New York.
4. **Mason, C.F. (2001).** *Biology of Freshwater Pollution*. Longman Printing Company, London and New York.
5. **Harrison, R.M. (2000).** *Pollution: Causes, Effects and Control*. The Royal Society of Chemistry. Cambridge.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-412</b>	<b>Water Pollution, its Management and Control (Lab)</b>	<b>1</b>	<b>VIII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** Physicochemical Analysis of Polluted Water Samples from different Polluted Sites through use of Equipments.

### Course Outline:

1. Water Sampling: General Considerations in Sampling.
2. Analysis of Industrial and Sewerage Waste-Water for important Physical and Chemical Parameters.
3. Field Work: Visit to Industrial Sites showing Water Pollution.

**Module Aims:** To make the student capable of a detailed Analysis of any Water Sample to render it Polluted and to Determine the Degree of Pollution.

### Learning Strategies:

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** The student should be able to determine Water Quality and Indicate if the sample is polluted.

### Assessment Strategies:

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Lenihan, J. and Fletcher, W.W. (2004).** *The Marine Environment: Environment and Man* (Vol. VI). (Ed.). Blackie and Sons, Glasgow and London.
2. **Southwick, C.H. (2003).** *Global Ecology*. Sinauer Associates Inc. Publishers. Sunderland, Massachusetts.
3. **Ciaccio, L.L. (2001).** *Water and Water Pollution Handbook*. Marcel - Dekker, Inc. New York.
4. **Mason, C.F. (2001).** *Biology of Freshwater Pollution*. Longman Printing Company, London and New York.
5. **Harrison, R.M. (2000).** *Pollution: Causes, Effects and Control*. The Royal Society of Chemistry. Cambridge.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-413</b>	<b>Challenges of a Changing Earth</b>	<b>3</b>	<b>VIII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** Impact of Air Pollution on Plant Growth, Impact of Industrial Waste Effluents on Plant Growth, Climate Change in Pakistan.

### Course Outline:

Achievements and Challenges; Food, Land, Water and Oceans, Out of Breath, Air Quality in the 21<sup>st</sup> Century, Managing Planetary Metabolism, The Carbon Cycle, Global Change and the Challenge for the Future, Advances in Understanding Global Biogeochemistry, Understanding the Metabolic System of the Planet, Land Ocean Interactions, Regional Global Linkages, The Climate System: Prediction, Change and Variability, Hot Spots of Land Use Change, The Climate System; A Regional or Global Concern, Looking at the Future: Stimulating and Observing the Earth System, Does the Earth System need Biodiversity? Can Technology spare the Planet towards Global Sustainability?

**Module Aims:** This course is designed to provide the knowledge about the present Conditions of the Earth, major Challenges and possible Strategies to coup the Present Day Earth's Crisis.

### Learning Strategies:

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** After studying this subject, student will have an insight of learning the major achievements of modern day earth and various global challenges that earth is facing. Student may also have knowledge of past, present climate prospects and future's plans to combat these challenges.

### Assessment Strategies:

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz

## 5. Tests

### **Books Recommended:**

1. **Bell, J.N.B. and Treshow, M. (2002).** *Air Pollution and Plant Life*. John Wiley & Sons, Inc. New York.
2. **IGBP New Letter, (2002).** The Newsletter of the International Geosphere Biosphere Programme: A study of Global Change. The Royal Swedish Academy of Science, Stockholm, Sweden.
3. **Newman, E.I. (2000).** *Applied Ecology and Environmental Management*. Blackwell Science Ltd., Oxford.
4. **Burrough, T. (2001).** *Climate Change: A Multidisciplinary Approach*. Cambridge Univ. Press, Cambridge, U.K.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-414</b>	<b>Challenges of a Changing Earth (Lab.)</b>	<b>1</b>	<b>VIII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** Impact of Air Pollution on Plant Growth, Impact of Industrial Waste Effluents on Plant Growth, Climate Change in Pakistan.

### Course Outline:

1. Impact of Air Pollution on Plant Growth.
2. Impact of Industrial Waste Effluents on Plant Growth.
3. Climate Change in Pakistan.

**Module aims:** This course is designed to provide the knowledge about the Present Conditions of the Earth, Major Challenges and Possible Strategies to Coup the Present Day Earth's Crisis.

### Learning Strategies:

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** After performing Practical work, students may have ability of understanding the Air and Water Pollution caused by various agencies and their effects on plants growth.

### Assessment Strategies:

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Bell, J.N.B. and Treshow, M. (2002).** *Air Pollution and Plant Life*. John Wiley and Sons, Inc. New York.
2. **IGBP New Letter, (2002).** The Newsletter of the International Geosphere Biosphere Programme: A study of Global Change. The Royal Swedish Academy of Science, Stockholm, Sweden.
3. **Newman, E.I. (2000).** *Applied Ecology and Environmental Management*. Blackwell Science Ltd., Oxford.
4. **Burrough, T. (2001).** *Climate Change: A Multidisciplinary Approach*. Cambridge Univ. Press, Cambridge, U.K.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-415</b>	<b>Microbiology</b>	<b>3</b>	<b>VIII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** All the basic Microbial techniques related to the growth and identification of bacteria and virus.

### Course Outline:

Introduction and History of Microbiology, Methods of Microbiology.  
Pure Culture Technique, Sterilization, Culture Media, Selective Media, Light Microscopy, Phase Contrast Microscopy, Fluorescent Microscopy, Electron Microscopy.  
Bacterial Morphology, Cell Structure and Reproduction.  
Bacterial Growth.  
Basis of Classification and Major Groups of Bacteria (Bacterial Diversity).  
Effect of Environmental Factors on Bacterial Growth.  
General Characteristics, Ultrastructure and Multiplication of Virus and Bacteriophages.  
Plant Virus, Transmission and Symptoms of Virus Infected Plants, Effect of Virus on Plant Metabolism.

**Module Aims:** The aim of this course is to train the students in the field of Microbiology. The student will also become acquainted with the Structure and Function of the wide range of Microorganisms studied in Microbiology

### Learning Strategies:

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** The student will be able to understand the vast Diversity of Bacteria and Viruses, related to the Isolation and Culturing Techniques.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class Discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Alcamo, I. E. (2010).** *Fundamentals of Microbiology.* (9<sup>th</sup> Ed.), Jones & Bartlett Publishers, USA.
2. **Tortora, G.J., Christine L., Case, C.L., Funke, B.R., Funke, B. and Case, C. (2008).** *Microbiology: An Introduction* (9<sup>th</sup> Ed), Pearson Education Publishers.
3. **Talaro, K.P. (2006).** *Foundations in Microbiology: Basic Principles.* McGraw Hill. Publisher.
4. **Black, J.G. (2005).** *Microbiology: Principles and Explorations,* (6<sup>th</sup> Ed.), Publisher McGraw Hill.
5. **Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. (2000).** *Microbiology.* (8<sup>th</sup> Ed.), MacGraw Hill.

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## BS (4 Years) for Affiliated Colleges



Code	Subject Title	Cr. Hrs	Semester
<b>BOT-416</b>	<b>Microbiology (Lab.)</b>	<b>1</b>	<b>VIII</b>
Year	Discipline		
<b>4</b>	<b>BOTANY</b>		

**Syllabus Outline:** All Basic Microbial Techniques related to the Growth and Identification of Bacteria and Viruses.

**Course Outline:**

**Culture Media Preparation:** Preparation and Sterilization of Culture Media, Solid Media, Semi-Solid media, Liquid Media, Agar Slopes, Streak Plates, Pour Plates.

**Staining Techniques:** Simple Staining, Negative Staining, Gram Stain, Acid-Fast Stain, Spore Stain, Capsule Stain.

**Cultural Techniques:** Culture Transfer Techniques, Isolation of Pure Cultures, Serial Dilution-Agar Plating Procedures to Quantify Viable Cells.

**Cultivation of Bacteria:** Nutritional Requirements-Routine and Selective Media, Effect of Temperature and pH on the Growth of Bacteria, Bacterial Growth Curves.

**Biochemical Activities of Bacteria:** Starch Hydrolysis, Casein Hydrolysis Test, Oxidase, Indole Production Test, Methyl Red Test, Urease Test, Nitrate Reduction Test, Oxidation Fermentation Tests.

**Module Aims:** Knowledge and practical skills shall be acquired by the students. The course is designed to enable the students about Aseptic Handling of Microorganisms. It will also introduce the students with the Protocols and Techniques used for the study of Microorganisms.

**Learning Strategies:**

1. Lectures
2. Group Discussion
3. Laboratory Work
4. Seminar/ Workshop

**Learning Outcome:** The outcome of this framework will be that the students will be acquainted with the techniques involved in Microbiology and other related Disciplines.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Books Recommended:**

1. **Pommerville, C.J. (2007).** *Alcama's Laboratory Fundamentals of Microbiology.* (8<sup>th</sup> Ed.). Elsevier Publishers.
2. **Gerhardt, P., Murray, R.G.E., Wood, W.A. and Krieg, N.R. (1994).** *Methods for General and Molecular Bacteriology.* American Society for Microbiology, Washington, DC.
3. **Cappuccino, J.G. and Sherman, N. (1992).** *Microbiology, A Laboratory Manual.* (3<sup>rd</sup> Ed.), The Benjamin / Cummings Publishing Company Inc.
4. **Jognson, T.R. and Case, C.L. (1992).** *Laboratory Experiments in Microbiology.* (3<sup>rd</sup> Ed.), The Benjamin / Cummings Publishing Company Inc.

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