FYUGP CURRICULAR FRAMEWORK FOR BOTANY AS MAJOR FOR BATCH 2024 AND ONWARDS

SEMESTER	COURSE CODE	TYPES OF COURSE	TITLE OF COURSE	CREDITS	
				THEORY	PRACTICAL
I	BOT124J	CT - 1	**BOTANY:** MICROBES AND ALGAE	4	2
II	BOT224J	CT - 1	**BOTANY:** MYCOLOGY AND PLANT PATHOLOGY	4	2
III	BOT324J	CT - 1	**BOTANY:** ARCHEGONIATES: BRYOPHYTES, PTERIDOPHYTES & GYMNOSPERMS	4	2
IV	BOT422J1	CT - 1	**BOTANY:** PLANT TAXONOMY	3	1
	BOT422J2	CT - 2	**BOTANY:** PLANT PHYSIOLOGY	4	2
	BOT422J3	CT - 3	**BOTANY:** PLANT BIOCHEMISTRY	4	2
V	BOT524J1	CT - 1	**BOTANY:** PLANT MORPHOLOGY AND ANATOMY	3	1
	BOT522J2	CT - 2	**BOTANY:** CELL BIOLOGY	4	2
	BOT522J3	CT - 3	**BOTANY:** PLANT MOLECULAR BIOLOGY	4	2
VI	BOT624J1	CT - 1	**BOTANY:** REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY OF ANGIOSPERMS	3	1
	BOT622J2	CT - 2	**BOTANY:** GENETICS & CYTOGENETICS	4	2
	BOT622J3	CT - 3	**BOTANY:** PLANT BREEDING	4	2
FYUGP HONOURS MODE					
VII	BOT722J1	CT - 1	**BOTANY:** PLANT ECOLOGY	3	1
	BOT722J2	CT - 2	**BOTANY:** PLANT BIOTECHNOLOGY	4	2
	BOT722J3	CT - 3	**BOTANY:** BIOSTATISTICS & BIOTECHNIQUES	4	2
VIII	BOT822J1	CT - 1	**BOTANY:** ECONOMIC BOTANY	3	1
	BOT822J2	CT - 2	**BOTANY:** CONSERVATION BIOLOGY	4	2
	BOT822J3	CT - 3	**BOTANY:** APPLIED AND EVOLUTIONARY ECOLOGY	4	2
FYUGP HONOURS WITH RESEARCH MODE					
VII	BOT722J1	CT - 1	**BOTANY:** PLANT ECOLOGY	3	1
	BOT722J2	CT - 2	**BOTANY:** PLANT BIOTECHNOLOGY	4	2
	BOT722J3	CT - 3	**BOTANY:** BIOSTATISTICS & BIOTECHNIQUES	4	2
VIII	BOT822J1	CT - 1	**BOTANY:** ECONOMIC BOTANY	3	1
	BOT824RP	PROJECT	**BOTANY:** PROJECT WITH DISSERTATION	12	

HoD / CONVENOR BOUGS

BACHELORS WITH BOTANY AS MAJOR (CT – I)
1st SEMESTER

BOT124J BOTANY _ MICROBES AND ALGAE

(CREDITS: THEORY: 04; PRACTICALS: 02)

OBJECTIVES:

To impart understanding about economic importance and diversity of viruses, bacteria and algae, and to acquaint them about the classification, structure, morphology and reproduction of viruses, bacteria and algae,

LEARNING OUTCOME:

The students will learn about basic concept, diversity, general characteristics of viruses, bacteria, algae; the significance of algal blooms and economic importance of bacteria and algae.

THEORY (4 CREDITS; 60 HOURS)

UNIT-I

Viruses: Evolution and general characteristics; structure, replication and life cycle of DNA and RNA viruses (T-phage, TMV); Isolation and purification of viruses; Overview of hosts and transmission.

UNIT-II

Bacteria: Evolution and diversity; Characteristics and cell structure; Growth and reproduction (conjugation, transformation and transduction); Bacterial nutrition; Economic importance.

UNIT-III

Algae: General characteristics, classification of algae (Fritsch 1935, 1945; Round 1965), criteria for classification of algae; range of thallus organization; morphology, reproduction and life cycle of *Nostoc*, *Chlamydomonas*, *Oedogonium*, *Vaucheria*, *Ectocarpus*, *Batrachospermum*;

UNIT-IV

Ecological and Economic Importance of Algae: Algal blooms; causal factors and control, algae as indicators of pollution, algae as sources of phycocolloids (Agar-agar, Algenic acid, Carrageenin, algae as food, algae as medicine, role of diatomaceous earth in industry, algae as source of biofuels.

PRACTICAL EXERCISES (2 CREDITS; 60 HOURS)

- Models/photographs of viruses T Phage and TMV, drawing/photograph of lytic and lysogenic Cycle.
- Types of bacteria from temporary/permanent slides/photographs; Gram staining
- Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas*, *Oedogonium*, *Vaucheria*, *Ectocarpus and Batrachospermum* through temporary preparations and permanent slides.

SUGGESTED READINGS

- Tortora, G.J., Funke, B.R., Case, C. L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
- Fritsch, F.E. 1979. The structure and reproduction of algae. Vols. I and II. Cambridge University Press.
- Prescott, G.W. 1984. The Algae: A Review. Otto Koeltz Science Publishers, Germany.
- Bold and Wynne. 1985. Introduction to the Algae. Prentice Hall, USA.
- Singh, V., Pande, C. and Jain, D. K. 2010. Diversity of Microbes and Cryptogams. Rastogi Publications
- Vashishta, B. R., Sinha, A.K. and Singh, V. P. 2008. Botany for Degree Students- Algae. S. Chand and Company Pvt. Ltd., New Delhi.
- Kumar, H. D. (1999). Introductory Phycology. Affiliated East-West Press Pvt. Ltd. Delhi.2nd edition.
- Raven, P. H., Johnson, G. B., Losos, J.B., Singer, S. R., (2005). Biology. Tata McGraw Hill, Delhi, India.

FYUGP CURRICULAR FRAMEWORK FOR BOTANY AS MINOR FOR BATCH 2024 AND ONWARDS

SEMESTER	COURSE CODE	TYPE OF COURSE	TITLE OF COURSE	CREDITS	
				THEORY	PRACTICAL
I	**BOT124N**	**CT - 1**	**BOTANY:** MICROBES AND ALGAE	**4**	**2**
II	**BOT224N**	**CT - 1**	**BOTANY:** MYCOLOGY AND PLANT PATHOLOGY	**4**	**2**
III	**BOT324N**	**CT - 1**	**BOTANY:** ARCHEGONIATES (BRYOPHYTES, PTERIDOPHYTES & GYMNOSPERMS)	**4**	**2**
IV	**BOT422N**	**CT - 1**	**BOTANY:** PLANT TAXONOMY	**3**	**1**
V	**BOT524N**	**CT - 1**	**BOTANY:** PLANT MORPHOLOGY AND ANATOMY	**3**	**1**
VI	**BOT624N**	**CT - 1**	**BOTANY:** REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY OF ANGIOSPERMS	**3**	**1**
VII	**BOT722N**	**CT - 1**	**BOTANY:** PLANT ECOLOGY	**3**	**1**
VIII	**BOT822N**	**CT - 1**	**BOTANY:** ECONOMIC BOTANY	**3**	**1**

HoD / CONVENOR BOUGS

BACHELORS WITH BOTANY AS MINOR (CT – I)
1st SEMESTER

BOT124N BOTANY _ MICROBES AND ALGAE

(CREDITS: THEORY: 04; PRACTICALS: 02)

OBJECTIVES:

To impart understanding about economic importance and diversity of viruses, bacteria and algae, and to acquaint them about the classification, structure, morphology and reproduction of viruses, bacteria and algae,

LEARNING OUTCOME:

The students will learn about basic concept, diversity, general characteristics of viruses, bacteria, algae; the significance of algal blooms and economic importance of bacteria and algae.

THEORY (4 CREDITS; 60 HOURS)

UNIT-I

Viruses: Evolution and general characteristics; structure, replication and life cycle of DNA and RNA viruses (T-phage, TMV); Isolation and purification of viruses; Overview of hosts and transmission.

UNIT-II

Bacteria: Evolution and diversity; Characteristics and cell structure; Growth and reproduction (conjugation, transformation and transduction); Bacterial nutrition; Economic importance.

UNIT-III

Algae: General characteristics, classification of algae (Fritsch 1935, 1945; Round 1965), criteria for classification of algae; range of thallus organization; morphology, reproduction and life cycle of *Nostoc*, *Chlamydomonas, Oedogonium*, *Vaucheria*, *Ectocarpus, Batrachospermum*;

UNIT-IV

Ecological and Economic Importance of Algae: Algal blooms; causal factors and control, algae as indicators of pollution, algae as sources of phycocolloids (Agar-agar, Algenic acid, Carrageenin, algae as food, algae as medicine, role of diatomaceous earth in industry, algae as source of biofuels.

PRACTICAL EXERCISES (2 CREDITS; 60 HOURS)

- Models/photographs of viruses T Phage and TMV, drawing/photograph of lytic and lysogenic Cycle.
- Types of bacteria from temporary/permanent slides/photographs; Gram staining
- Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Ectocarpus and Batrachospermum* through temporary preparations and permanent slides.

SUGGESTED READINGS

- Tortora, G.J., Funke, B.R., Case, C. L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
- Fritsch, F.E. 1979. The structure and reproduction of algae. Vols. I and II. Cambridge University Press.
- Prescott, G.W. 1984. The Algae: A Review. Otto Koeltz Science Publishers, Germany.
- Bold and Wynne. 1985. Introduction to the Algae. Prentice Hall, USA.
- Singh, V., Pande, C. and Jain, D. K. 2010. Diversity of Microbes and Cryptogams. Rastogi Publications
- Vashishta, B. R., Sinha, A.K. and Singh, V. P. 2008. Botany for Degree Students- Algae. S. Chand and Company Pvt. Ltd., New Delhi.
- Kumar, H. D. (1999). Introductory Phycology. Affiliated East-West Press Pvt. Ltd. Delhi.2nd edition.
- Raven, P. H., Johnson, G. B., Losos, J.B., Singer, S. R., (2005). Biology. Tata McGraw Hill, Delhi, India.

BACHELORS WITH BOTANY AS MAJOR (CT – I)

3rd SEMESTER

BOT324J: BOTANY ARCHEGONIATES: BRYOPHYTES, PTERIDOPHYTES, AND GYMNOSPERMS

CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVES:

To impart understanding about diversity and economic importance of bryophytes, pteridophytes, gymnosperms and some fossil species, and to acquaint students about the their classification, structure, morphology and reproduction.

LEARNING OUTCOME:

The students will learn about basic concept, diversity, general characteristics and economic importance of bryophytes, pteridophytes, gymnosperms and fossil species.

THEORY (4 CREDITS)

UNIT I:

General characteristics of bryophytes, Main criteria for classification of bryophytes, morphology, anatomy and reproduction (excluding developmental details) of *Marchantia Antheceros* and *Funaria*; a Evolution of sporophyte; apogamy and apospory; alternation of generation; economic importance of bryophytes.

UNIT II:

General characteristics of pteridophytes; criteria for classification of pteridophytes (Parihar 1996); morphology, anatomy and reproduction (excluding developmental details) of *Equisetum* and *Dryopteris*; heterospory and origin of seed habit; evolution of stellar systems in pteridophytes.

UNIT III:

General characteristics of gymnosperms, criteria for classification of gymnosperms. Distribution of gymnosperms in India; morphology, anatomy and reproduction (excluding developmental details) of *Cycas* and *Pinus*; evolutionary and economic importance of gymnosperms.

UNIT IV:

Adaptations to land habit. General account of fossil bryophytes (*Naiadita*) fossil pteridophytes (*Rhynia*), and fossil gymnosperms (*Lyginoptris*).Introduction to paleobotany, Geological time scale.

PRACTICAL EXERCISES (2 CREDITS)

- Study of vegetative and reproductive structures of *Marchantia Anthoceros* and *Funaria* through temporary slides and permanent slides.
- Study of vegetative and reproductive structures of *Selaginella*, *Equisetum* and *Dryopteris* through temporary slides and permanent slides.
- Study of vegetative and reproductive structures of *Cycas* and *Pinus*- through temporary slides and permanent slides

SUGGESTED READINGS

- Pteridophyta (vascular cryptogams) by Dr.P.C.Vashista,Dr.A.K.Sinha,Dr Anil Kumar
- Diversity of microbes and cryptograms and seed plant diversity and sytematics) by S.P.Pandey and S.K.Verma Pradeeps Botany by Dr.H.N.Shrivasta vol iii
- Gymnosperms by Dr.P.C.Vashista,Dr.A.K.Sinha,Dr Anil Kumar
- **B**ryophyte text book by Dr. O.P Sharma

BACHELORS WITH BOTANY AS MINOR (CT – I)

3rd SEMESTER

BOT324N: BOTANY ARCHEGONIATES: BRYOPHYTES, PTERIDOPHYTES, AND GYMNOSPERMS

CREDITS: THEORY: 4; PRACTICAL: 2

OBJECTIVES:

To impart understanding about diversity and economic importance of bryophytes, pteridophytes, gymnosperms and some fossil species, and to acquaint students about the their classification, structure, morphology and reproduction.

LEARNING OUTCOME:

The students will learn about basic concept, diversity, general characteristics and economic importance of bryophytes, pteridophytes, gymnosperms and fossil species.

THEORY (4 CREDITS)

UNIT I:

General characteristics of bryophytes, Main criteria for classification of bryophytes, morphology, anatomy and reproduction (excluding developmental details) of *Marchantia Antheceros* and *Funaria*; a Evolution of sporophyte; apogamy and apospory; alternation of generation; economic importance of bryophytes.

UNIT II:

General characteristics of pteridophytes; criteria for classification of pteridophytes (Parihar 1996); morphology, anatomy and reproduction (excluding developmental details) of *Equisetum* and *Dryopteris*; heterospory and origin of seed habit; evolution of stellar systems in pteridophytes.

UNIT III:

General characteristics of gymnosperms, criteria for classification of gymnosperms. Distribution of gymnosperms in India; morphology, anatomy and reproduction (excluding developmental details) of *Cycas* and *Pinus*; evolutionary and economic importance of gymnosperms.

UNIT IV:

Adaptations to land habit. General account of fossil bryophytes (*Naiadita*) fossil pteridophytes (*Rhynia*), and fossil gymnosperms (*Lyginoptris*).Introduction to paleobotany, Geological time scale.

PRACTICAL EXERCISES (2 CREDITS)

- Study of vegetative and reproductive structures of *Marchantia Anthoceros* and *Funaria* through temporary slides and permanent slides.
- Study of vegetative and reproductive structures of *Selaginella*, *Equisetum* and *Dryopteris* through temporary slides and permanent slides.
- Study of vegetative and reproductive structures of *Cycas* and *Pinus*- through temporary slides and permanent slides

SUGGESTED READINGS

- Pteridophyta (vascular cryptogams) by Dr.P.C.Vashista,Dr.A.K.Sinha,Dr Anil Kumar
- Diversity of microbes and cryptograms and seed plant diversity and sytematics) by S.P.Pandey and S.K.Verma Pradeeps Botany by Dr.H.N.Shrivasta vol iii
- Gymnosperms by Dr.P.C.Vashista,Dr.A.K.Sinha,Dr Anil Kumar
- **B**ryophyte text book by Dr. O.P Sharma

BACHELORS WITH BOTANY AS MAJOR (CT – I)
5th SEMESTER
BOT524J1 BOTANY _ PLANT MORPHOLOGY AND ANATOMY
CREDITS (THEORY: 3 PRACTICAL: 1)

UNIT I: PLANT MORPHOLOGY

- Introduction to plant morophology;habit and life forms
- Types and modifications of root and stem; leaves: phyllotaxy,types, shapes, and modifications
- Types of inflorescence;flowers-parts and symmetry; aestivation
- Androecium: types, position and number andfusion of stamens,nectaries.
- Gynoecium: parts of carpel, carpel fusion and number; ovary attachment and position; placentation and its types; fruit types.

UNIT II: PLANT TISSUES

- Meristematic tissue: classification, types and structures.
- Organization of shoot apex (Tunica Corpus theory); Organization of root apex (Apical cell theory)
- Structure and classification of permanent tissues; simple tissues (parenchyma, collenchyma, sclerenchyma); complex tissues (xylem and phloem)

UNIT III: INTERNAL ORGANIZATION AND SECONDARY GROWTH IN PLANTS

- Structural differences in monocot and dicot stem, root, and leaf, Kranz anatomy Cambium- types, structure and functions; general account of wood structure (heart wood and sap wood, early and late wood); secondary growth in stem;
- structure and function of cuticle, trichomes and stomata; types and arrangement of vascular bundles.

PRACTICAL EXERCISES:

- To study structure and types of xylem with the help of temporary and permanent slides.
- To study structure and types of phloem with the help of temporary and permanent slides.
- To study structure of stomata using *Allium* or *Tradescantia* leaves.
- To study different types of leaves.
- To study different types of inflorescences.
- To study different types of flowers.
- To study different types of fruits
- To study different types of placentation.
- To conduct two botanical trips for studying natural flora.
- To prepare herbarium with minimum 40 sheets.

BOOKS RECOMMENDED

- Plant Systematics (third edition, 2019) by Michael G. Simpson. Elsevier
- Plant Systematics (fourth edition, 2021) by Gurcaharan Singh. CBS Publishers and Distributors, New Delhi
- Plant Systematics (2021) by A K Pandey and S. Kasana. Jaya Publishing House, New Delhi
- Evert, R.F. and Esau, K. 2006. Esau's Plant Anatomy. John Wiley and Sons.
- Pandey, B.P. (2001). Plant Anatomy. S. Chand and Company, New Delhi.
- Fahn, A. (1974). Plant Anatomy, Pegmon Press USA

BACHELORS WITH BOTANY AS MAJOR (CT - II)
SEMESTER 5th

BOT522J2: BOTANY _ CELL BIOLOGY

CREDITS: THEORY: 4; INTERNSHIP / PRACTICAL

OBJECTIVES:

1. *Cell biology study will help the students to gain knowledge on the activities in which the giant molecules and miniscule structures that inhabit the cellular world of life are engaged.*
2. *This will provide insight into the organization of cell, its features and regulation at different levels.*
3. *Through the study of Cell Organelles, they will be able to understand the various metabolic processes such as respiration, photosynthesis etc. which are important for life.*

LEARNING OUTCOMES:

This course will be able to demonstrate foundational knowledge in understanding of:

1. *The relationship between the properties of macromolecules, their cellular activities and biological responses*
2. *Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelle*
3. *Contemporary approaches in modern cell and molecular biology*

THEORY (4 CREDITS)

UNIT I: THE CELL

Cell as a unit of life, structure and function, Characteristics of prokaryotic and eukaryotic cells, Cell theory; Origin of eukaryotic cell (Endosymbiotic theory). Cell wall: structure and functions, biogenesis and growth. Plasma membrane: structure and overview of membrane function; fluid mosaic model; Chemical composition of membranes; Mycoplasma, viruses, viroids, Virusoids & prions.

UNIT II: CELL ORGANELLES

Chloroplast, mitochondria and peroxisomes, Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast, Endomembrane system: Endoplasmic Reticulum – Structure, types, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosomes Different forms of lysosomes, role in cellular digestion, lysosomal storage diseases. Peroxisomes: assembly, functions, glyoxysomes

UNIT III: CYTOSKELETON

Composition, organization and functions of microfilaments, microtubules, intermediate filaments and associated proteins, centrioles and basal bodies. Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. Chromatin organization, structure and chromatin and chromosomes, heterochromatin, euchromatin.

UNIT IV: CELL CYCLE AND CELL DIVISION

Cell cycle: Phases and Regulation of cell cycle- checkpoints, role of protein kinases. Cell Division: Mitosis, phases of mitosis, regulation and its significance. Meiosis; Phases of meiosis, regulation and its significance. Cancer – types & causes of cancer. Apoptotic death in relation to cell cycle.

INTERNSHIP OR PRACTICALS (2 CREDITS)

1. Study of cell and its organelles with the help of electron micrographs.
2. Study of plant cell structure with the help of epidermal peel mount of Onion.
3. Demonstration of the phenomenon of protoplasmic streaming in Hydrilla leaf.
4. Measurement of cell size by the technique of micrometry.
5. Study different stages of mitosis and meiosis through temporary mounts and permanent slides.
6. Study the effect of organic solvent and temperature on membrane permeability
7. Study the phenomenon of plasmolysis and deplasmolysis.

SUGGESTED READINGS

1) Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2) Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill
3) Livingstone
4) Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W. H. Freeman
5) Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W. H. Freeman and Company
6) Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
7) Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
8) Hardin, J., Becker, G., Skliensmith, L. J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
9) Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
10) Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. 7th

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BACHELORS WITH BOTANY AS MAJOR (CT - III)

5th SEMESTER

BOT522J3: BOTANY _ PLANT MOLECULAR BIOLOGY

CREDITS: THEORY: 4; PRACTICALS: 2

COURSE OBJECTIVES

This course is to expose the students and make them understand the basic concepts in molecular biology, basic composition of nucleic acids, their structure and their mode of replication, conversion of genetic information coded in DNA to cellular macromolecules to the DNA structure, transcription in both prokaryotes and eukaryotes. It also familiarizes students with DNA damage and repair mechanisms, Different types of recombination models, transcription, RNA processing and Translation and regulation of Gene expression.

COURSE LEARNING OUTCOME

Successful completion of the Molecular Biology course will allow students to understand the chemical and molecular processes of life based on the genetic constituents of the cell. They will learn to Comprehend the properties of the heritable material along with all the enzymes involved for proper replication fidelity. Employ scientific methods and design the experiments along with interpreting biological data to communicate concepts of molecular biology to wider scientific community as well as general public.

UNIT: I

DNA STRUCTURE AND REPLICATION

DNA as genetic material, Double helical structure of DNA (Watson-Crick model), Various forms of DNA. DNA replication in Prokaryotes and Eukaryotes, DNA replication is semiconservative nature of DNA replication, Bidirectional Replication, The Geometry of DNA Replication, Enzymology of DNA replication, Discontinuous Replication, Events in the Replication Fork, Initiation of Synthesis of the Leading Strand, Termination of Replication, Methylation of DNA and Mismatch Repair, Replication of Eukaryotic Chromosomes. Fidelity of Replication.

UNIT II

DNA DAMAGE, REPAIR AND HOMOLOGOUS RECOMBINATION

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, recombinational repair, nonhomologous end joining. Homologous Recombination: Mechanisms and Models for Homologous Recombination (Holliday Model).Transposable Elements: An Overview of Transposition, Insertion sequences, Types of bacterial Transposons, Transposition, Replication of a transposon in the course of transposition between two plasmids, The Co-integrate as an Intermediate in transposition of Tn3, Deletions and Inversions Caused by Transposons, Role of IS elements in Hfr Formation, Transposable Elements in Eukaryotes, Retroposons, Limitation of Transposition.

UNIT III

TRANSCRIPTION AND RNA PROCESSING

RNA structures and Types: Transcription in Prokaryotes: Prokaryotic RNA polymerases, role of sigma factor, promoter, initiation, elongation and termination of RNA chains. Transcription in Eukaryotes: Eukaryotic RNA

polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance, elongation and termination Splicing and processing: Processing of pre-mRNA: 5' cap formation, polyadenylation, splicing of tRNA precursors, splicing of rRNA precursors, Splicing without a protein enzyme.

UNIT IV

REGULATION OF GENE EXPRESSION AND TRANSLATION

Regulation of activity of Genes and Gene products in Prokaryotes: General aspects of Regulation, Operon concept (inducible and repressible system), Relative positions of Promoters and Operators, Genetic code and its characteristics. Prokaryotic and Eukaryotic Translation, Ribosome structure and assembly, charging of tRNA, Aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, inhibitors of translation, posttranslational modifications of proteins.

PRACTICALS

1. Preparation of solutions for molecular biology experiments
2. Isolation of DNA from plant
3. Agarose gel electrophoresis for isolated DNA
4. Demonstration of quantification of DNA by Spectrophotometry.
5. Quantitative tests of Lipids & their separation by thin layer chromatography (TLC).
6. Preparation of LB medium and raising E. Coli.

SUGGESTED READINGS

1) Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2) Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
3) Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
4) Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
5) Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

BACHELORS WITH BOTANY AS MINOR (CT – I)
5th SEMESTER
BOT524N BOTANY _ PLANT MORPHOLOGY AND ANATOMY
CREDITS (THEORY: 3 PRACTICAL: 1)

UNIT I: PLANT MORPHOLOGY

- Introduction to plant morophology;habit and life forms
- Types and modifications of root and stem; leaves: phyllotaxy,types, shapes, and modifications
- Types of inflorescence;flowers-parts and symmetry; aestivation
- Androecium: types, position and number andfusion of stamens,nectaries.
- Gynoecium: parts of carpel, carpel fusion and number; ovary attachment and position; placentation and its types; fruit types.

UNIT II: PLANT TISSUES

- Meristematic tissue: classification, types and structures.
- Organization of shoot apex (Tunica Corpus theory); Organization of root apex (Apical cell theory)
- Structure and classification of permanent tissues; simple tissues (parenchyma, collenchyma, sclerenchyma); complex tissues (xylem and phloem)

UNIT III: INTERNAL ORGANIZATION AND SECONDARY GROWTH IN PLANTS

- Structural differences in monocot and dicot stem, root, and leaf, Kranz anatomy Cambium- types, structure and functions; general account of wood structure (heart wood and sap wood, early and late wood); secondary growth in stem;
- structure and function of cuticle, trichomes and stomata; types and arrangement of vascular bundles.

PRACTICAL EXERCISES:

- To study structure and types of xylem with the help of temporary and permanent slides.
- To study structure and types of phloem with the help of temporary and permanent slides.
- To study structure of stomata using *Allium* or *Tradescantia* leaves.
- To study different types of leaves.
- To study different types of inflorescences.
- To study different types of flowers.
- To study different types of fruits
- To study different types of placentation.
- To conduct two botanical trips for studying natural flora.
- To prepare herbarium with minimum 40 sheets.

BOOKS RECOMMENDED

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- Plant Systematics (fourth edition, 2021) by Gurcaharan Singh. CBS Publishers and Distributors, New Delhi
- Plant Systematics (2021) by A K Pandey and S. Kasana. Jaya Publishing House, New Delhi
- Evert, R.F. and Esau, K. 2006. Esau's Plant Anatomy. John Wiley and Sons.
- Pandey, B.P. (2001). Plant Anatomy. S. Chand and Company, New Delhi.
- Fahn, A. (1974). Plant Anatomy, Pegmon Press USA

BACHELORS WITH BOTANY AS MAJOR (CT - I)
7th SEMESTER

BOT722J1: BOTANY _ PLANT ECOLOGY

CREDITS: THEORY: 3; PRACTICALS: 1

***OBJECTIVES**:*

The course aims to familiarize the students with the fundamental principles of the discipline of ecology and the processes and interactions that shape the diversity, distribution, and abundance of organisms at multiple spatio-temporal scales.

***LEARNING OUTCOMES**:*

- *Appreciate the scope of scientific inquiry in the field of ecology in order to better understand the natural world.*
- *Develop an understanding of the structural and functional attributes of ecological entities at various levels of organizations, such as population, community and ecosystem.*
- *Become familiar with the variety of ways that organisms interact and evolve, communities develop and ecosystems' function and respond to biotic and abiotic environment.*
- *Learn techniques for collecting and analysing field data and conduct laboratory experiments on different aspects of ecology.*

THEORY (3 CREDITS)

UNIT-I

The Environment: Physical environment (atmosphere: composition, layering; lithosphere: properties of Earth's crust, mantle and core; hydrosphere: hydrologic cycle)
Habitat and Niche: Concept of habitat and niche; fundamental and realized niche, niche parameters, factors affecting niche parameters, niche width and overlap; ; resource partitioning; character displacement. Life history strategies (r and K selection); concept of metapopulation – demes

UNIT-II

Population Ecology: Characteristics of a population (Fecundity, mortality); presentation of demographic data (life tables and survivorship curves); population growth (Geometric, exponential and logistic population growth); population regulation: intraspecific competition and self-thinning in populations; age structure of populations.
Species Interactions: Types of interactions, interspecific competition, herbivory, parasitism and mutualism.

Community Ecology: Nature of communities (individualistic and organismic views); community characteristics; Species diversity (richness and evenness), latitudinal and elevational species diversity gradients; parametric and non-parametric measures of species diversity; ecotones and edge effect.
Ecological Succession: Types; mechanisms; changes involved in succession; concept and theories related to characterization of climax.

UNIT-III

Ecosystem Ecology: Ecosystem concept; structure (biotic and abiotic components, food chain, food web; trophic cascades; ecosystem function; energy flow and mineral cycling (C,N,P, reservoirs, fluxes, transformations and processes); primary production - Gross and Net Primary productivity; variations in net productivity across ecosystems; factors controlling primary productivity in terrestrial and aquatic ecosystems; decomposition (process of litter decompositions; influence of substrate quality, biotic and abiotic factors on litter decomposition).

Biogeography: Theory of island biogeography: immigration, extinction and equilibrium; species-area relationships, recent modifications of island biogeography theory; non-equilibrium ecology (basic idea); Major terrestrial biomes and aquatic ecosystems-general characteristics; biogeographical zones of India.

PRACTICAL EXERCISES (1 CREDIT):

1. Determining the minimum quadrat size using species-area curve approach.
2. Using random sampling to measure the frequency, density and abundance of various different species in a given plant community.
3. Assessment of soil texture, porosity, aggregate stability and bulk density.
4. Determining the soil pH and its ecological implications.
5. Determining the level of dissolved oxygen in given water samples and primary productivity on the basis of light-dark bottle methods.
6. Assessing primary productivity using biomass harvest approach.

SUGGESTED READINGS:

1. J.S. Singh, S.P. Sigh, S.R. Gupta (2014) Ecology, Environmental Sciences and Conservation. S. Chand & Company Pvt. Ltd. 7361, New Delhi
2. Paul A Keddy (2017) Plant Ecology: Origins, Processes and Consequences. Cambridge University Press
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6. Thomas M. Smith and Robert L. Smith (2015) Elements of Ecology (9^{th} Edition) Pearson Education India.
7. Michael L. Cain, William D. Bowman, and Sally D. Hacker (2017) Ecology (4^{th} edition) OUP USA.
8. F. Stuart Chapin III, Pamela A. Matson, and Peter M. Vitousek (2011) Principles of Terrestrial Ecosystem Ecology. Springer.
9. C. Barry Cox, Peter D. Moore, and Richard J. Ladle (2016) Biogeography: An Ecological and Evolutionary Approach. Wiley-Blackwell.

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BACHELORS WITH BOTANY AS MAJOR (CT - II)
7th SEMESTER
BOT722J2: BOTANY _ PLANT BIOTECHNOLOGY

CREDITS: THEORY: 4; PRACTICALS: 2

COURSE OBJECTIVES:

1. *To give students new knowledge on handling of classical and modern plant biotechnology processes, including tissue culture for healthy plants, plants with improved characteristics.*
2. *To explore the use of biotechnology to genetic variation in plants and to understand how factors at the cellular level contribute to the expression of genotypes and hence to phenotypic variation.*
3. *Understanding of biotechnological processes such as recombinant DNA technology and its applicative value in pharmaceuticals, food industry, agriculture, ecology etc. This knowledge is central to our ability to modify plant responses and properties for global food security and commercial gains in biotechnology and agriculture.*

LEARNING OUTCOMES*:*

1. *Learn the basic concepts, principles and processes in plant biotechnology.*
2. *Use basic biotechnological techniques to explore molecular biology of plants*
3. *Explain how biotechnology is used for plant improvement and discuss the biosafety concern and ethical issue of that use.*

UNIT 1: PLANT TISSUE CULTURE: Historical perspective, Composition of media, Nutrient and hormone requirement, Totipotency, Organogenesis, Embryogenesis (somatic and zygotic); Micro propagation (Clonal propagation of elite species). Somatic hybridization: isolation, culture and fusion of protoplasts; selection, regeneration and utility of somatic hybrids and cybrids.

UNIT II: Soma-clonal Variation, Secondary Metabolite Production: In-vitro production of secondary metabolites: Hairy root cultures and Bioreactors-techniques and significance. Tissue culture applications (micropropagation, androgenesis, Embryo and Endosperm culture, virus elimination, Haploids, Triploids, Synthetic seed production, Cryopreservation; Germplasm Conservation). Transgenic Plants: Technique of transformation-Agrobacterium mediated and physical methods (Micro projectile and electro oration) Application of transgenic plants.

UNIT III: Introduction, scope and applications of recombinant DNA technology, Restriction Endonucleases-characteristics and utility of type-II restriction enzymes in gene cloning, Molecular Probes – preparation and labeling; Cloining vectors – characteristics and construction of Plasmid (PBR, PUC), bacteriophage (Lambda phage) and cosmid vectors, bacterial transformation and selection of recombinant clones,

UNIT IV: Genomic and cDNA libraries – construction and utility; Southern blotting technique for isolation of gene of interest; gel electrophoresis – principle and applications, Polymerase Chain Reaction (PCR) - principle and application; brief account of molecular markers and their utility in DNA fingerprinting

PRACTICAL

1. Preparation of MS medium.
2. Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants.
3. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
4. Isolation of protoplasts.
5. DNA extraction method in plants/bacteria (CTAB) and quantification
6. Gel electrophoresis apparatus and assembly
7. Construction of restriction map from the data provided
8. Demonstration of different vectors (plasmid, phage, cosmid) using charts, ppts etc.
9. Demonstration of PCR and its applications
10. Demonstration of transgenic plants (Bt cotton, Golden rice, Transgenic Banana as Edible Vaccine, FlavrSavr tomato) through photographs.

SUGGESTED READINGS

1) Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2) Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3) Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5thedition.
4) Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
5) Molecular Biotechnology: Principles Application of Recombinant DNA 2nd Edition. Glick, B. R. and Pasternak, J. J. (1998) ASM press Washington DC.
6) Genetic Engineering. Ahluwalia, K. B. (2002) New Age International (P) Ltd.
7) An Introduction to Genetic Engineering 2nd edition Desmond Nicholl S.T. (2002) Cambridge University Press.

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BACHELORS WITH BOTANY AS MAJOR (CT - III)
7th SEMESTER
BOT722J3: BOTANY _ BIOSTATISTICS AND BIOTECHNIQUES

CREDITS: THEORY: 4; PRACTICALS: 2

LEARNING OBJECTIVES:

The objectives of the course are to impart to the students an in-depth understanding and training of collection, analysis, interpretation and presentation of data; hypothesis testing through statistical tests, sampling techniques, designing of experiments and the correlation and regression; and the applications of various bio-techniques.

LEARNING OUTCOME:

The students will be able to comprehend the types, collection and analyze the data, learn the sampling techniques, will be able to design experiments in biology, test the hypothesis through statistical tests and will be able to understand the principles and application of various scientific techniques like chromatography, electrophoresis, centrifugation etc. in biology

THEORY (4 CREDITS)

UNIT: I

Data types and collection: data types- data on ratio, interval, ordinal and nominal scales; continuous and discrete data; methods of primary and secondary data collection and their limitations; frequency and cumulative frequency distributions.

Processing and analysis of data: measures of central tendency- arithmetic mean, mode, median; measures of dispersion- mean deviation, variance, standard deviation, coefficient of variation.

UNIT: II

Sampling techniques: principles and various steps in sample survey; procedures and practices involved in simple, systematic, stratified, cluster and multistage random sampling.

Design and analysis of experiments: principles of experimentation; experimental designs- layout, analysis of variance and comparison of treatments in completely randomized design, randomized complete block design and factorial experiments.

UNIT: III

Probability Distribution: Probability distributions (Binomial, Poisson and Normal) (Brief concept)

Testing of hypothesis: basic concepts, procedure for hypothesis testing; test difference between two means (-independent and paired samples); test of proportions and test of goodness of fit.

Simple correlation and regression: basic idea, scatter diagram, calculation of an estimated correlation coefficient, significance tests for correlation coefficients; simple linear regression- calculation of regression coefficient, standard errors and significance test.

UNIT: IV

Chromatography: principles and applications of paper, thin layer, HPLC, ion exchange and gas liquid chromatographic techniques.

Electrophoretic and Centrifugation Techniques: Gel electrophoresis; ultra-centrifugation

Biophysical methods: concepts of spectroscopy, laws of photometry, Beer-Lambert's law, use of various spectroscopic techniques like UV-Visible in biology

Radio-labeling Techniques: properties of different radio-isotopes and their applications in biology, Safety guidelines.

LABORATORY EXERCISES (2 CREDITS):

- Collection of raw data on different parameters and classification of ungrouped data into grouped data (discrete and continuous series) i.e. frequency distribution
- Frequency distribution table and Construction of Simple bar chart, Histogram and Scatter plot.
- To find the various measures of central tendency (mean, mode and median) of the given data.
- To find the various measures of dispersion (mean deviation, standard deviation, variance and coefficient of variation) of the given data.
- Drawing of a sample from a given population by various sampling techniques (simple random, systematic and stratified sampling)
- Drawing of a sample from a given population by lottery method and random number table method
- To perform the t-test of two paired and independent samples
- To perform One-way ANOVA and Two-way ANOVA of the given data sets.
- To estimate the correlation (though scatter diagram and correlation coefficient) and linear regression between variables
- Gel electrophoresis techniques and analysis.
- Paper and thin layer (TLC) chromatography.

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BACHELORS WITH BOTANY AS MINOR (CT - I)
7th SEMESTER

BOT722N: BOTANY _ PLANT ECOLOGY

CREDITS: THEORY: 3; PRACTICALS: 1

OBJECTIVES:

The course aims to familiarize the students with the fundamental principles of the discipline of ecology and the processes and interactions that shape the diversity, distribution, and abundance of organisms at multiple spatio-temporal scales.

LEARNING OUTCOMES:

- *Appreciate the scope of scientific inquiry in the field of ecology in order to better understand the natural world.*
- *Develop an understanding of the structural and functional attributes of ecological entities at various levels of organizations, such as population, community and ecosystem.*
- *Become familiar with the variety of ways that organisms interact and evolve, communities develop and ecosystems' function and respond to biotic and abiotic environment.*
- *Learn techniques for collecting and analysing field data and conduct laboratory experiments on different aspects of ecology.*

THEORY (3 CREDITS)

UNIT-I

The Environment: Physical environment (atmosphere: composition, layering; lithosphere: properties of Earth's crust, mantle and core; hydrosphere: hydrologic cycle)
Habitat and Niche: Concept of habitat and niche; fundamental and realized niche, niche parameters, factors affecting niche parameters, niche width and overlap; ; resource partitioning; character displacement. Life history strategies (r and K selection); concept of metapopulation – demes

UNIT-II

Population Ecology: Characteristics of a population (Fecundity, mortality); presentation of demographic data (life tables and survivorship curves); population growth (Geometric, exponential and logistic population growth); population regulation: intraspecific competition and self-thinning in populations; age structure of populations.
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Ecological Succession: Types; mechanisms; changes involved in succession; concept and theories related to characterization of climax.

UNIT-III

Ecosystem Ecology: Ecosystem concept; structure (biotic and abiotic components, food chain, food web; trophic cascades; ecosystem function; energy flow and mineral cycling (C,N,P, reservoirs, fluxes, transformations and processes); primary production - Gross and Net Primary productivity; variations in net productivity across ecosystems; factors controlling primary productivity in terrestrial and aquatic ecosystems; decomposition (process of litter decompositions; influence of substrate quality, biotic and abiotic factors on litter decomposition).

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PRACTICAL EXERCISES (1 CREDIT):

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