"समानो मन्त्र समिति समानी"

UNIVERSITY OF NORTH BENGAL

PROPOSED COURSE STRUCTURE

FOUR YEAR UNDERGRADUATE PROGRAM (FYUGP) WITH SINGLE MAJOR

BOTANY

UNDER THE NEW CURRICULUM AND CREDIT FRAMEWORK, 2022

2023

COURSE STRUCTURE FOR 1st Year

Year	Semester	Course type	Course code	Course name	Credits	Credit distribution	
						Theory	Practical
I	1	Major	UBOTMAJ11001	Origin of Life and Plant Diversity	4	3	1
		Minor	UBOTMIN10001	Biodiversity of Plant Kingdom	4	3	1
		Skill enhancement course	UBOTSEC11001	Basic Laboratory Techniques and Management	3	2	1
	2	Major	UBOTMAJ12002	Biomolecules and Cell Biology	4	3	1
		Minor	UBOTMIN10001	Biodiversity of Plant Kingdom	4	3	1
		Skill enhancement course	UBOTSEC12002	Nursery, Gardening and Floriculture	3	2	1

***NUMBER OF TEACHING HOURS/WEEK**

THEORY: 1 credit = 1 Lecture/week = 1 hour/week

PRACTICAL: 1 credit = 1 Class/week = 2 hour/week

SEMESTER - I

Course Type: Major
Course Code: UBOTMAJ11001

Course Name: Origin of Life and Plant Diversity

Credits: 4 (Theory-3, Practical-1)
Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description:
UBOTMAJ11001 deals with the Origin and Evolution of life and imparts basic knowledge about plants and related life forms. It thoroughly establishes the relationship of plants with other kingdoms of life. Also, it emphasizes the huge diversity of known plant life, along with an idea of the fossil record and geological time scale.

Prerequisite(s) and/or Note(s):
(1) High School Biology.
(2) Note(s): Syllabus may be modified after and not during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

Knowledge acquired:
(1) Origin and evolution of Life
(2) Introduction to plant and other life forms
(3) Different groups of plants.

Skills gained:
(1) Handling microscopy, staining and mounting of plant specimens, and,
(2) Methods of collection, identification and preservation of plant specimens.

Competency Developed:
(1)Schematic knowledge of collection and subsequent plant specimens.
(2)Proper arrangement of preserved plant specimens.
(3)Choosing suitable staining and mounting protocols for study of plant specimens.

THEORY

Total Lectures: 45

Unit-1: Origin of life **(8 lectures)**
Origin of life: Oparin's hypothesis, Haldane's hypothesis, Miller-Urey experiment, Panspermia, origin of cells and the first organisms: the concept of prebiotic soup and coacervates.

Unit-2: Evolution (7 lectures)

Fossil records; Geological time scale – major events in each era; Evidences of evolution; theories of evolution - Lamarck, Wallace, Charles Darwin, Hugo De Vries; Neo-Darwinism – major postulates - isolation, mutation, genetic drift, and speciation; the role of extinction in evolution.

Unit-3: Classification of life forms (10 lectures)

Diversity of life: Prokaryotes and eukaryotes; unicellularity and multicellularity; Two kingdom classification (Carolus Linnaeus, 1735); phylogenetic classification (August W Eichler, 1878); Three kingdom classification (Ernst Haeckel, 1866); Four kingdom classification (H F Copeland, 1938); Five kingdom classification (R H Whittaker, 1969); Six kingdom classification (Thomas Cavalier-Smith, 1998); Seven kingdom classification (M A Ruggiero, 2015); Three domains (Carl Woese, 1990) – criteria for classification, general characters.

Unit-4: Introduction to plant kingdom (10 lectures)

General features of plants; Basic knowledge of thallophytes, archegoniates, and spermatophytes; Basic structure and function of plant organs - roots, stem and leaves, vascular bundle; Introduction to mesophytes, hydrophytes, and xerophytes; Concept of alternation of generations; colonization of land by plants; origin of embryophytes and flowering plants.

Unit-5: Plant diversity (10 lectures)

Introduction to ICN and the status of algae and fungi; Diversity of plants: study of the salient features and economic importance of algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms; Encyclopaedia of Life.

Practical

1. Study of light microscope: simple and compound.
2. Preparation of specimens for light microscopy – Collection, fixation, and preservation of plant specimens; Whole mounts and sections – hand sectioning.
3. Study of prokaryotic and eukaryotic cells.
4. Demonstration of basic staining techniques of plant tissues.
5. Study and demonstration of mounting techniques.
6. Collection and identification of plant specimens from diverse groups.
7. Morphological variations in roots, stems, leaves /equivalent organs across different plant groups.
8. Study of conducting elements in different plant groups through photographs/permanent slides.
9. Study of reproductive structures in different plant groups through photographs/ permanent slides.

Suggested Readings

1. Brian K. Hall and Benedikt Hallgrímsson, 2013. Strickberger's Evolution (Fifth Edition). Jones and Bartlett Publishers.

2. Eldon D Enger, Frederick C Ross, David B Bailey, 2011. Concepts in Biology (Fourteenth Edition). Tata McGraw Hill.
3. Gerald Audesirk, Teresa Audesirk, Bruce E Byers, 2019. Biology: Life on earth. (Twelfth Edition). Pearson.
4. James D Mauseth, 2019. Botany: An Introduction to Plant Biology. Jones & Bartlett.
5. Kenneth A Mason, Jonathan B Losos, Tod Duncan, 2017. Biology (Twelfth Edition). McGraw Hill.
6. Lisa A Urry, Michael L Cain, Steven A Wasserman, Peter V Minorsky, Rebecca B Orr, 2021. Campbell Biology (Twelfth Edition). Pearson.
7. Michael G Simpson, 2019. Plant Systematics (Third Edition). Academic Press.
8. Peter Raven, George Johnson, Kenneth Mason, Jonathan Losos and Tod Duncan, 2023. Biology (Thirteenth Edition). McGraw Hill.
9. Prasad M K, Krishna Prasad M, 2000. Outlines of Microtechnique. Emkay Publishers, New Delhi.
10. Scott Freeman, Kim Quillin, Lizabeth Allison, Michael Black, Greg Podgorski, Emily Taylor, and Jeff Carmichael, 2019. Biological Science. Pearson.
11. Sylvia S Mader and Michael Windelspecht, 2022. Biology (Fourteenth Edition). McGraw Hill.
12. Timothy Walker, 2012. Plants: A Very Short Introduction. Oxford.

SEMESTER – I / SEMESTER – II

Course type: Minor
Course code: UBOTMIN10001

Course Name: Biodiversity of Plant Kingdom

Credits: 4 (Theory-3, Practical-1)
Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description:
UBOTMIN10001 deals with the topic Biodiversity of Plant Kingdom. In particular, the course will cover general characteristics, classification, mode of reproduction of Virus, Bacteria, Algae, Fungi, Bryophyte, Pteridophytes, Gymnosperm, Angiosperm and their economic importance that are present in different life forms in the plant kingdom. Life cycle of few members of Algae, fungi, Bryophyte, and Pteridophyte. Reproductive and vegetative structure of three important Gymnosperms.

Prerequisite(s) and/or Note(s):
(1) Science at school level.
(2) Note(s): Syllabus changes yearly and may be modified during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

Knowledge acquired:

(1) Concept of biodiversity.
(2) Economic and ecological Importance of different plant groups.
(3) Diversity in habits, habitats, and organization of plants.
(4) Evolutionary trends within plants groups.

Skills gained:

(1) Identification of microbes.
(2) Identification of Algae and Fungi through microscopic or morphological study.
(3) Identification of Higher group of plants through anatomical or morphological study.

Competency developed:

(1) Applying the concept of Identification of microbes, students can identify beneficial and pathogenic microbes.
(2) With the concept and identification skill plant group identification students culture and propagate that plants.

Theory

Total Lectures: 45

Unit 1: Bacteria and Viruses **(7 lectures)**

Introduction to biodiversity, The three domains of life: Archaea, Bacteria, Eukarya; Bacteria –General characteristics, and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation, and transduction); Economic importance; Virus-General account of viruses; Lytic and lysogenic cycle; Viroids and Prions.

Unit 2: Algae **(7 lectures)**

General characteristics; Range of thallus organization; Classification of algae (Fritsch classification); Diagnostic characters of Cyanophyceae, Rhodophyceae, Chlorophyceae, Charophyceae and Phaeophyceae; Life cycles of *Nostoc, Chara, Ectocarpus,* and *Polysiphonia* with special reference to alternation of generation; Role of algae in the environment, agriculture, biotechnology, and industry.

Unit 3: Fungi **(7 lectures)**

General characteristics; Range of hyphal form and organization, cell wall composition; Diagnostic characters of Oomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina (Ainsworth, 1973); Life cycle of *Rhizopus, Ascobolus, Agaricus*; Symbiotic associations-Lichens: General account, significance; Mycorrhiza and their role in agriculture and forestry; Economic importance of fungi.

Unit 4: Bryophytes **(7 lectures)**

General characteristics, Classification up to class (Proskaure, 1957); Life history of *Marchantia, Anthoceros* and *Funaria*; Role of bryophytes in ecological succession, pollution monitoring, and economic importance of bryophytes with special mention of *Sphagnum*.

Unit 5: Pteridophytes (**7 lectures)**

General characteristics, Classification of vascular plants by Gifford & Foster (1989) up to division, Life history of *Selaginella*, *Equisetum,* and *Pteris*; Heterospory and seed habit, telome concept and its significance stelar evolution; Ecological and economic importance of pteridophytes.

Unit 6: Spermatophytes (Gymnosperms and Angiosperms) (10 lectures)

General characteristics of seed plants (Gymnosperms and angiosperms); Morphology of vegetative and reproductive parts; anatomy of root, leaf, and life cycle of *Cycas Pinus* and *Gnetum*; Ecological and economic importance of gymnosperms; General features of dicotyledons and monocotyledons; Diversity and importance of angiosperms.

Practical

1. EMs/Models of Viruses-T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM of bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining.
4. Preparation of temporary mount of vegetative and reproductive structures
   Algae: *Nostoc, Chara, Ectocarpus, Polysiphonia.*
   Fungi: *Rhizopus, Ascobolus, Agaricus*
   Bryophyta : *Marchantia, Anthoceros, Funaria*
   Pteridophyte : *Selaginella, Equisetum, Pteris*
5. Lichens: Study of growth forms of lichens (crustose, foliose, and fruticose)
6. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
7. *Cycas* and *Pinus* -morphological identification of megasporophyll and microsporophyll, T.S. of *Cycas* leaflet and *Pinus* needle (permanent slide).
8. Collection and identification of plant samples from all the groups. Submit preserved specimens (in bottles and/or herbarium) belonging to diverse groups.

Suggested Readings

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Textbook of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.

8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
9. Hait, Bhattacharya , Ghosh (2007). A Textbook of Botany Vol-1, Vol-II and Vol-III, New Central Book Agency (P) Ltd. Kolkata, India

SEMESTER - I

Course Type: Skill Enhancement Course
Course Code: UBOTSEC11001
Course Name: Basic Laboratory Techniques and Management

Credits: 3 (Theory-2, Practical-1)
Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description:
UBOTSEC11001 deals with basic fundamental skills for laboratory techniques and management. The course also deals with familiarization with laboratory safety equipment's, hazardous chemicals and their symbols.

Prerequisite(s) and/or Note(s):

(1) High School biology.

(2) Note(s): Syllabus changes yearly and may be modified during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

Knowledge acquired:

(1) Good laboratory practices, Operation, and maintenance of basic laboratory instruments
(2) Basics of measurements
(3) Understanding hazards and risks to ensure a safe laboratory environment.
(4) Management of laboratory waste

Skills gained:

(1) Setting up a laboratory
(2) Chemical preparation and labeling of chemicals
(3) Safety measures in the laboratory

Competency developed:

(1) Ability to establish a laboratory setting
(2) Maintaining laboratory chemicals and their preparation
(3) Learn to work with different instruments

Theory

Total Lectures: 30

Unit 1: Lab safety and good lab practices (5 lectures)

General laboratory safety, good laboratory practices, biosafety measures (first-aid practices to be followed in case of burn, acid spills and injury), safety symbols, lab safety equipments (fire extinguisher, fume hood, safety glasses); laboratory waste management and disposal.

Unit 2: Laboratory equipments (8 lectures)

Working principles, use and maintenance of instruments; Weighing balance, pH meter, pipettes and micropipettes, autoclave, laminar airflow, incubator/incubator shaker, colorimeter and spectrophotometer, gel electrophoresis unit (DNA & Protein), centrifuge, distillation unit.

Unit 3: Microscopy, sample and slide preparation (6 lectures)

Microscopes (light and electron microscopes), Fixation and preservation (for light and electron microscopy); staining, mounting; basic introduction to other types of microscopes (Confocal; Fluorescence; Phase contrast).

Unit 4: Measurement units and introduction to solutions and buffers (5 lectures)

Units of measurements and conversion from one unit to another, measurement of volumes of liquids, chemical weighing; Molarity, Molality, Normality, percent solution, stock solution, standard solution, dilution, dilution series; pH, acids and bases, importance of buffers.

Unit 5: Basic computer skills for biology (6 lectures)

Understanding MS-Word (Preparation of word document, formatting, printing); MS-PowerPoint (Preparation of slides, figures, clip arts, data, tables, slide show formatting, printing); MS-Excel (Preparation of spreadsheet; data entry, cell selection, basic formula and functions, formatting, printing), Use of G-mail, Google drive and cloud storage; Introduction to biological databases.

Practical

1. Preparation of solutions - molar, molal, normal, percentage, stock, standard.
2. Determining pH of solutions (pH paper, Universal indicator, pH meter).
3. Preparation of buffers (Phosphate, Tris-Cl, Electrophoresis buffers-TBE/TAE).
4. Demonstration of instruments - Light microscope, autoclave, laminar air flow, spectrophotometer, centrifuge, gel electrophoresis unit (Agarose & Poly acrylamide).
5. Temporary peel mount slide preparation and preparation of stains (safranine, orcein, carmine).
6. Familarization to chemicals /laboratory hazards symbols.
7. Laboratory safety equipments through photographs (Fire extinguisher, Fume hood, personal protective equipments/kits).
8. Preparation of report/assignment using MS-word; make slides using MS-powerpoint, prepare an excel sheet showing the application of basic functions (sum/average/standard deviation/mean) in MS-Excel.

Suggested Readings:

1. Evert, R. F., Eichhorn, S. E., Perry, J.B. (2012). Laboratory Topics in Botany. W.H. Freeman and Company.
2. Mesh, M.S., Kebede-Westhead, E. (2012). Essential Laboratory Skills for Biosciences. John Wiley & Sons, Ltd.
3. Mu, P., Plummer, D. T. (2001). Introduction to practical biochemistry. Tata
4. McGraw-Hill Education.
5. Mann, S. P. (2016). Introductory Statistics, 9th edition. Hoboken, NJ, John Wiley and Sons Inc.
6. Danniel, W.W. (1987). Biostatistics. New York, NY: John Wiley Sons.
7. Jones, A.M., Reed, R., Weyers, J. (2016). Practical Skills in Biology, 6th Edition, Pearson
8. Bisen, P.S. (2014). Laboratory Protocols in Applied Life Sciences, 1st edition. CRC Press.

SEMESTER-II

Course Type: Major
Course Code: UBOTMAJ12002
Course Name: Biomolecules and Cell Biology

Credits: 4 (Theory-3, Practical-1)
Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description:
UBOTMAJ12002 deals with topics in Biomolecules and Cell Biology. In particular, the course will cover the study of different biomolecules such as carbohydrates, proteins, and lipids. The cover will also provide information cell and its organalles.

Prerequisite(s) and/or Note(s):

(1) High School Biology.

(2) Note(s): Syllabus changes yearly and may be modified during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

Knowledge acquired:

(1) Clear idea about the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.

(2) Detailed knowledge of different types of biomolecules and the importance in cellular composition.

Skills gained:

(1) Qualitative test of macromolecules.

(2) Measurement of cell size.

(3) Technique of Chromosome study.

Competency Developed:

(1) Students learn to distinguish different biomolecules and can check their presence in different samples

(2) Student learn the structure and function of different parts of cell and its importance.

(3) Able to investigate protein, carbohydrate and lipid with their active role in cellular function.

THEORY

Total Lectures: 45

Unit 1: Biomolecules (15 lectures)

Types and significance of chemical bonds; Structure and properties of water; Carbohydrates- Nomenclature, classification and properties of monosaccharides, disaccharides, oligosaccharides and polysaccharides; Lipids - Definition and importance, classification; Fatty acids - structure and functions; Proteins - Structure of amino acids, peptide bond,

properties and biological role of proteins, levels of protein structure; Properties and function of enzymes; Nucleic acids - Structure and types.

Unit 2: The cell **(3 lectures)**

Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Endosymbiotic theory.

Unit 3: Cell wall and plasma membrane **(4 lectures)**

Chemistry, structure and function of plant cell wall; Plasma membrane - Chemical composition and function, Fluid mosaic model; Membrane transport - Diffusion, Osmosis, Passive, active and Facilitated.

Unit 4: Cell organelles **(18 lectures)**

Nucleus – Structure of nuclear envelope, nuclear pore complex, nuclear lamina, structure of chromatin, nucleolus; Cytoskeleton - Role and structure of microtubules, microfilaments and intermediate filament; Chloroplast, mitochondria and peroxisomes - Structural organization and functions; Endomembrane system; Endoplasmic reticulum - Structure, function and targeting and insertion of proteins in the ER; Golgi apparatus - Organization, function, and protein sorting and export from Golgi apparatus; Lysosomes - Structure and function.

Unit 5: Cell division **(5 lectures)**

Mitosis and meiosis: Different stages and significance; Phases of eukaryotic cell cycle.

Practical

1. Qualitative tests for reducing sugars, non-reducing sugars, lipids and proteins.
2. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.
3. Measurement of cell size by the technique of micrometry.
4. Counting the cells per unit volume with the help of haemocytometer (pollen/spore).
5. Study of cell and its organelles with the help of electron micrographs.
6. Study the phenomenon of plasmolysis and deplasmolysis.
7. Study the effect of organic solvents (ethanol/acetone) on membrane permeability through absorbance.
8. Study the effect of temperature on membrane permeability through absorbance.
9. Study of different stages of mitosis by squash technique.

Suggested Readings

1. Campbell MK (2012) Biochemistry, 7th edition, Published by Cengage Learning.
2. Campbell PN and Smith AD (2011) Biochemistry Illustrated, 4th edition, Published by Churchill Livingstone.
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd edition, W.H.Freeman.
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company.
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th edition, W.H. Freeman and Company.
6. Karp G (2010). Cell Biology, 6th edition, John Wiley & Sons, U.S.A.
7. Hardin J, Becker G, Skliensmith LJ (2012) 8th edition Becker's World of the Cell, Pearson Education Inc. U.S.A.

8. Cooper GM and Hausman RE (2009) The Cell: A Molecular Approach. 5th edition ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
9. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
10. Jain JL, Jain S and Jain N (2008) Fundamental of biochemistry, 6th edition, S. Chand and company.

SEMESTER-II

Course Type: Skill Enhancement Course
Course Code: UBOTSEC12002
Course Name: Nursery, Gardening and Floriculture

Credits: 3 (Theory-2, Practical-1)
Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description:
UBOTSEC12002 deals with topics in basic principles and techniques of nursery, gardening, floriculture, plant propagation, handling and harvesting, disease management etc.

Prerequisite(s) and/or Note(s):

(1) High School Biology.
(2) Note(s): Syllabus changes yearly and may be modified during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

Knowledge acquired:

(1) History and significance of nursery and gardening.
(2) Importance of floriculture in commercial sector.
(3) Different types of gardening and their characteristic features.
(4) Methods of cultivation, processing and marketing of crops.

Skills gained:

(1) Basic nursery and gardening operations.
(2) Plant propagation techniques-their advantages and disadvantages.
(3) Cultivation, harvesting and post-harvesting techniques of economically important flower crops.

Competency developed:

(1) Applying the concept to develop nursery and garden designing.
(2) Training of cultivation of commercially important flower and ornamental crops.
(3) Dealing with common plant diseases and their management.

Theory

Total Lectures: 30

Unit-1: Nursery (5 lectures)

Definition & objectives of nursery, site plan and design of a nursery; soil management, seed sowing, pricking, potting and transplanting, shading, stopping or pinching, defoliation, wintering, mulching, topiary; glasshouses, greenhouses, shadehouses, mist chamber.

Unit-2: Gardening (8 lectures)

History of gardening; types of gardening (landscape and home gardening); principles of gardening design (English, Italian, French, Persian, Mughal and Japanese gardens); characteristic features of a garden; indoor gardening; bonsai; some famous gardens in India.

Unit-3: Floriculture (8 lectures)

Scope and importance of floriculture; Factors affecting flower production; cultivation techniques of some important cut flowers- Rose, Carnation, Gerbera, Gladiolus, Orchids, Marigold, Tuberose, Aster, Chrysanthemum and Dahlia; drying of flowers-techniques and advantages.

Unit-4: Plant propagation (3 lectures)

Plant propagation techniques - sexual and asexual, micropropagation, their advantages and disadvantages; role of plant growth regulators; organic farming.

Unit-5: Post-harvest processing and management (6 lectures)

Harvesting and handling of ornamental crops, vegetables, and cut flowers; processing and preservation techniques; marketing; identification of common diseases; disease management strategies- IPM (physical, chemical and biological control), quarantine practices, nutritional remedies, crop sanitation, weed control.

Practical

1. Tools and equipments used in nursery and gardening using photographs.
2. Demonstration of cutting, grafting and layering.
3. Study of seed germination and seed viability.
4. Demonstration of nursery bed/ seed bed preparation.
5. Study of potting, depotting, and repotting.
6. Study of the process flower drying - air drying, oven drying, using desiccant (silica gel), pressing.
7. Demonstration of flower colouring experiment.
8. Study of soil moisture content, porosity, bulk and tapped density, pH.
9. Study of micropropagation technique through photographs.
10. Visit to local nursery and submission of report.

Suggested Readings:

1. Mason, J. 2004.Nursery Management, 2nd Edition, Landlinks Press, Australia.
2. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

3. Bose, T.K. & Mukherjee, D. 1972. Gardening in India, Oxford & IBH Publishing Co., New Delhi.
4. Arteca, R.N. 2006. Introduction to Horticultural Science, 2nd Edition, Cengage Learning, India.
5. NIIR Board (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research Board, Delhi.
6. Kader, A.A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, USA.

QUESTION PATTERN & TOTAL MARKS DISTRIBUTION FOR MAJOR, MINOR & SEC PAPERS

Total Marks = 40 (Theory), 20 (Practical)

Sl. No.	Questions to be answered	Out of	Marks of each question	Total Marks
1	5	8	1	5 × 1 = 5
2	3	5	5	3 × 5 = 15
3	2	4	10	2 × 10 = 20

Examination	(Practical based Course)	Duration ofExams
Semester End Examination (Theoretical)	40	2 hours
Semester End Examination (Practical)	20	Up to 5 hours
Continuing Evaluation/Internal Assessment/Mid Semester Exams (By the Colleges)	10	
Attendance	5	
Total:	**75**	

*** Practical Guidelines and Question pattern will be communicated before the semester end examination as per the decision of UGBOS Botany.**

**** The modalities of the continuing evaluation will be decided and communicated by UGBOS Botany.**

UNIVERSITY OF NORTH BENGAL

PROPOSED COURSE STRUCTURE

FOUR YEAR UNDERGRADUATE PROGRAM (FYUGP) WITH SINGLE MAJOR

BOTANY

UNDER THE NEW CURRICULUM AND CREDIT FRAMEWORK, 2022

2023

COURSE STRUCTURE FOR IInd Year

Year	Semester	Course type	Course code	Course name	Credits	Credit distribution	
						Theory	Practical
II	3	Major	UBOTMAJ23003	Microbiology	4	3	1
		Major	UBOTMAJ23004	Mycology and Plant Pathology	4	3	1
		Major	UBOTMAJ23005	Phycology and Bryology	4	3	1
		Minor	UBOTMIN20002	Morphology, Anatomy and Taxonomy of Flowering Plants	4	3	1
		Skill enhancement course	UBOTSEC23003	Biofertilizers and Mushroom Cultivation	3	2	1
	4	Major	UBOTMAJ24006	Pteridology, Gymnology and Palaeobotany	4	3	1
		Major	UBOTMAJ24007	Morphology and Anatomy	4	3	1
		Major	UBOTMAJ24008	Taxonomy of Angiosperms	4	3	1
		Minor	UBOTMIN20002	Morphology, Anatomy and Taxonomy	4	3	1

***<u>NUMBER OF TEACHING HOURS/WEEK</u>**

THEORY: 1 credit = 1 Lecture/week = 1 hour/week

PRACTICAL: 1 credit = 1 Class/week = 2 hour/week

UGBOS members –

Dr. Chandrani Choudhuri

Dr. Rakhi Chakraborty

Dr. Protip Basu

Dr. Bikram Saha

Dr. Swarenendu Roy

Dr. Piyush Mathur

Dr. Jyotsna Das.

TEMPLATE FOR COURSE SYLLABUS FOR NEP IMPLEMENTATION

Discipline: Science √ Arts, Humanities & Social Science ☐

Commerce ☐ BBA ☐ BCA ☐

Subject Name: **Botany**

Subject Code: (Will be provided by the University)

Semester: Semester I ☐ Semester II ☐ Semester III √ Semester IV ☐

Semester V ☐ Semester VI ☐ Semester VII ☐ Semester VIII ☐

Course Name: **Microbiology**

Course Code: **UBOTMAJ23003** (Will be provided by the University)

Course Credit: Theoretical **3** Practical/Tutorial **1**

Marks Allotted: Theoretical **40** Practical/Tutorial **20**

Continuing Evaluation **10** Attendance **5**

Course Type (tick the correct alternatives):

Major Core	√	AEC	☐
Interdisciplinary/ DSE	☐	SEC	☐
Minor / Generic Elective	☐	VAC	☐
Research Project/Dissertation	☐	Vocational	☐

Is the course focused on employability / entrepreneurship? YES √ NO ☐

Is the course focused on imparting life skill? YES ☐ NO √

Is the course based on Activity ? YES √ NO ☐

Remarks by Chairman, UG BOS, if any

Syllabus finalized and approved by all the UGBOS Botany members

UG BOS Meeting Reference Number: **450 /UG-23** Date: **09-10-2023**

Prepared by CIRM

SEMESTER - III

Semester- III

Course Type: MAJOR

Course Code: UBOTMAJ23003

Course Name: Microbiology

(Credits: Theory=3, Practical=1)

Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description: UBOTMAJ23003 deals with the history and scope of Microbiology along with the diversity of microbial world. It emphasizes the structural organization, growth, metabolism and reproduction of bacteria, viruses and other microbial forms. It also highlights the techniques practised in microbial laboratories and the application of microorganisms in agricultural and industrial sectors.

Prerequisite(s) and/or Note(s):

(1) High School Biology.

(2) Note(s): Syllabus may be modified after and not during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

Knowledge acquired:

(1) Diversity of microbial world.

(2) Introduction to the laboratory techniques in Microbiology.

(3) Agricultural and industrial application of microorganisms.

Skills gained:

(1) Media preparation, culturing and preservation of microbial cells.

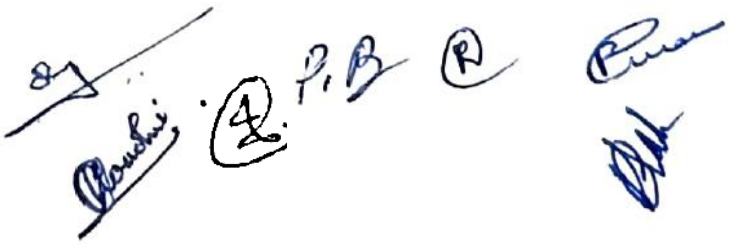
(2) Basic sterilization techniques.

Competency Developed:

(1) Selection of suitable media for growth and reproduction for microbes.

(2) Choosing proper sterilization techniques.

(3) Collection and preservation of specific microorganisms.



THEORY

Total Lectures:45

Unit 1: Microbial diversity (7 Lectures)

Introduction to microbial diversity; Hierarchical organization and positions of microbes in the living world: Distribution of microbes in soil, air, food and water. Significance of microbial diversity in nature. History and development of microbiology - Microbiologists and contributions of - Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Flemming, Joseph Lister, Dmitri Ivanovsky, Sergei Winogradsky, and M.W. Beijerinck and Paul Ehrlich. Contributions of Indian microbiologists.

Unit 2: Bacteria (12 Lectures)

Discovery, General characteristics; Types - Archaebacteria, Eubacteria, Wall less forms (Mycoplasma, Phytoplasma and Spheroplasts); Cell structure with special emphasis on cell wall, membrane, flagella, pili, endospore; nucleoid; Growth curve; Nutritional types of Microbes- autotrophs and heterotrophs, phototrophs, and chemotrophs; lithotrophs and organotrophs; the concept of aerobic and anaerobic respiration, fermentation- lactic acid fermentation (homolactic and heterolactic), alcohol fermentation, Pasteur effect; Reproduction-vegetative, asexual and recombination (conjugation, transformation, and transduction). Economic importance of bacteria.

Unit. 3: Viruses (8 lectures)

General characteristics; classification (Baltimore), brief outline of ICTV system of classification; structure and multiplication of DNA virus (T-phage) and RNA virus (TMV, SARS-COV-2); viroids and prions - general characteristics and diseases; replication (general account), lytic cycle and lysogenic cycle; economic importance.

Unit. 4: Techniques in microbiology (10 Lectures)

Culture media for microbes - Natural and synthetic media, Routine media - basal media, enriched media, selective media, indicator media, transport media, and storage media. Microbial cultures. Pure culture and axenic cultures, subculturing. Sterilization methods - Methods of disinfection: antiseptic, tyndallisation, and Pasteurization. Sterilization-Physical methods: dry heat, moist heat, UV light, ionization radiation, filtration. Preservation methods-overlaying cultures with mineral oils, lyophilisation. Microbial culture collections and their importance. A brief account of ITCC, MTCC, and ATCC.

Unit 5: Applied microbiology (8 Lectures)

Scope of microbiology, Introduction to bioreactors, Basic structure & components; Role of microbes in industry (cheese, food, alcohol, wine, enzymes, organic acids); agriculture (PGPRs, biofertilizers); Bioremediation.

PRACTICALS

1. Electron micrographs of bacterial cell; Study of different types of Bacteria from temporary/permanent slides; Endospore, Binary fission, Conjugation.
2. Study of Viruses: Electron micrographs / Models - T-Bacteriophage and TMV; specimens/digital resources/ Line drawings of Lytic and Lysogenic Cycle.
3. Single staining using curd.
4. Gram staining to differentiate between Gram-positive and Gram-negative bacteria.
5. Demonstration of serial dilution technique for the isolation of pure culture of bacteria.
6. Study of *Rhizobium* from root nodules of a leguminous plant.
7. Study of Plant Growth Promoting Rhizobacteria (PGPR) and their role as biofertlizers through specimens/digital resources
8. Study of bioreactors/fermentors through photographs/video.

Suggested Readings:

1. Pelczar, M.J. (2001). Microbiology, 5th edition. New Delhi, Delhi, Tata McGrawHill Co.

2. Tortora, G.J., Funke, B.R., Case, C.L. (2016). Microbiology: An Introduction, Indian

3. Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, 6th edition: McGraw Hill, New Delhi.

4. Gupta, R., Chugh, G. (2022). Plants, Microbes and Diseases 1st Edition, I.K. International Pvt. Ltd., Delhi.

5. Subba Rao, N.S. (2000). Soil Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

6. Talaro, K.P., Talaro, A. (2006). Foundations in Microbiology. McGraw Hill, New Delhi

TEMPLATE FOR COURSE SYLLABUS FOR NEP IMPLEMENTATION

Discipline: Science √ Arts, Humanities & Social Science ☐

Commerce ☐ BBA ☐ BCA ☐

Subject Name: **Botany**

Subject Code: (Will be provided by the University)

Semester: Semester I ☐ Semester II ☐ Semester III √ Semester IV ☐

Semester V ☐ Semester VI ☐ Semester VII ☐ Semester VIII ☐

Course Name: **Mycology and Plant Pathology**

Course Code: **UBOTMAJ23004** (Will be provided by the University)

Course Credit: Theoretical **3** Practical/Tutorial **1**

Marks Allotted: Theoretical **40** Practical/Tutorial **20**

Continuing Evaluation **10** Attendance **5**

Course Type (tick the correct alternatives):

Major Core	√	AEC	☐
Interdisciplinary/ DSE	☐	SEC	☐
Minor / Generic Elective	☐	VAC	☐
Research Project/Dissertation	☐	Vocational	☐

Is the course focused on employability / entrepreneurship? YES √ NO ☐

Is the course focused on imparting life skill? YES ☐ NO √

Is the course based on Activity ? YES √ NO ☐

Remarks by Chairman, UG BOS, if any

Syllabus finalized and approved by all the UGBOS Botany members

UG BOS Meeting Reference Number: **450 /UG-23** Date: **09-10-2023**

Prepared by CIRM

SEMESTER - III

Course Type: MAJOR

Course Code: UBOTMAJ23004

Course Name: Mycology and Plant Pathology

Credits:4 (Theory=3, Practical=1)

Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description: UBOTMAJ23004 deals with the general account, nature, distribution, classification of true and allied fungi. Life cycle of fungal members representing different important phyla, symbiotic associations, application of fungi in different fields are discussed. Different terms of pathology, important plant pathogens, disease cycles, disease management are also emphasised.

Prerequisite(s) and/or Note(s):

(1) High School Biology.

(2) Note(s): Syllabus may be modified after and not during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

Knowledge acquired:

(1) Structure and modifications of fungal thallus

(2) Classification of Fungi and allied fungi

(3) Life cycles of representative fungi and allied fungi

(4) Symbiotic association and applications of fungi

(5) Mechanism of infection and defense in plant pathogenesis

(6) Disease cycles and disease management of representative fungal, bacterial and viral plant pathogens

Skills gained:

(1) Identification and structure of fungi and allied fungi

(2) Methods of collection and preservation of micro- and macrofungi.

(3) Collection, preservation and study of diseased plant specimens

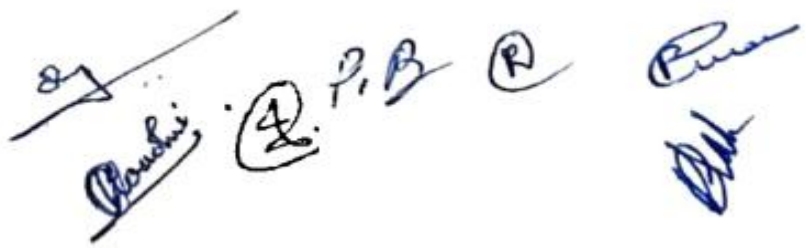
(4) Isolation and culture of any one fungal plant pathogen.

Competency Developed:

(1) Collection, identification and preservation of different fungal and lichen specimens.

(2) Knowledge of etiology of some representative plant pathogenic fungi, bacteria and virus

(3) Media preparation and isolation of fungal plant pathogen.



THEORY

Total Lectures: 45

Unit:1 General account and classification of true and allied fungi (8 lectures)

General characteristics-True and Allied Fungi; Thallus organization; Cell wall composition; Nutrition and lifestyle; Hyphal forms or modifications of thallus; classification of fungi and allied fungi by Kirk *et al* (2008) with characters of the phyla (especially Ascomycota, Basidiomycota, Zygomycota, Oomycota, Chytridiomycota) along with examples. Introduction to phylogenetic classification.; Slime moulds and mitosporic fungi – general idea.

Unit: 2 Fungal Reproduction and life cycle (8 lectures)

Types of life cycles; Reproduction in Fungi - Asexual and Sexual, Fungal spore forms; Life cycles of S*ynchytrium, Rhizopus,* Yeast *(Saccharomyces* and *Schizosaccharomyces), Penicillium, Ascobolus, Agaricus, Puccinia.* Degeneration of sex in fungi. Fruiting bodies in Ascomycota. Development of ascus and ascospore; development of basidium and basidiospore. Parasexuality and heterothallism.

Unit 3: Symbiotic associations and applied mycology (7 lectures)

Lichen – Occurrence; General characteristics; types; Nature of associations of algal and fungal partners; Economic and ecological importance Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their role in Agriculture and forestry. Medical mycology - Mycoses, Mycotoxicosis and mycetismus. Application of fungi in Food industry – baking, important alcoholic beverages, acids, Mycoprotein. Edible mushrooms; Fungi in Medicine - important enzymes, vitamins, Antibiotics. Fungi based Biocontrol and Biofertilizer in brief with example. Bioluminescence.

Unit 4: Introduction to plant pathology (6 lectures)

Disease, disease cycle, symptom and syndrome, etiology and causal complex, primary and secondary inoculum, penetration, infection, pathogenicity and pathogenesis, necrotroph, biotroph, endophyte; resistance, susceptibility, immunity, hypersensitive response; Koch's postulates, Endemic, Epidemic, Pandemic and Sporadic disease, disease pyramid and plant quarantine.

Unit 5: Host-pathogen interactions and disease management (9 lectures)

Mechanism of infection (Brief idea about Pre-penetration, Penetration and Post-penetration). Basic concept of defense-structural and biochemical. Phytoalexin, Systemic Acquired Resistance (SAR); Induced systemic resistance (ISR), Plant Disease Management: Chemical, Biological and Integrated. Introduction to MAMPs, PAMPs.

Unit: 6 Disease cycles (7 lectures)

Symptoms, Causal organism, Disease cycle and Control measures of - Late blight of Potato, Brown spot of rice, Blister blight of tea, Citrus canker, Mosaic diseases. Vein clearing, Angular leaf spot of cotton.

PRACTICAL

1. Work out the following fungi with microscopic measurement of reproductive structure: *Rhizopus, Penicillium/Aspergillus, Peziza/Ascobolus, Agaricus*.
2. Morphological identification of Macrofungi: *Pycnoporus*/*Polyporus*, *Auricularia*, *Ganoderma*.
3. Study of growth forms of lichens (crustose, foliose, and fruticose) through specimens available or through photographs.
4. Study of Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
5. Preparation of PDA media and demonstration of fungal culture.
6. Isolation of pathogens from infected plant parts and subculturing.
7. Identification of - Late blight potato, blister blight of tea, downy mildew of cucurbits, *Alternaria* spot, *Helminthosporium* spot, *Cercospora* leaf spot, *Stemphyllium* leaf blight of onion or garlic, Stem rot of jute, Citrus canker, Leaf mosaic/vein clearing.
8. Work out of late blight of potato and brown spot of rice.

Suggested Readings:

1. Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.

2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.

3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.

4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.

5. Sharma, O. P. (2023).Text Book of Fungi and Allied Microorganisms, Medtech Publisher.

6. Sharma, P.D. (2016). Plant Pathology, 2nd EditionRastogi Publication, Meerut, India.

TEMPLATE FOR COURSE SYLLABUS FOR NEP IMPLEMENTATION

Discipline: Science √ Arts, Humanities & Social Science ☐

Commerce ☐ BBA ☐ BCA ☐

Subject Name: **Botany**

Subject Code: (Will be provided by the University)

Semester: Semester I ☐ Semester II ☐ Semester III √ Semester IV ☐

Semester V ☐ Semester VI ☐ Semester VII ☐ Semester VIII ☐

Course Name: **Phycology and Bryology**

Course Code: **UBOTMAJ23005** (Will be provided by the University)

Course Credit: Theoretical **3** Practical/Tutorial **1**

Marks Allotted: Theoretical **40** Practical/Tutorial **20**

Continuing Evaluation **10** Attendance **5**

Course Type (tick the correct alternatives):

Major Core	√	AEC	☐
Interdisciplinary/ DSE	☐	SEC	☐
Minor / Generic Elective	☐	VAC	☐
Research Project/Dissertation	☐	Vocational	☐

Is the course focused on employability / entrepreneurship? YES ☐ NO √

Is the course focused on imparting life skill? YES ☐ NO √

Is the course based on Activity ? YES √ NO ☐

Remarks by Chairman, UG BOS, if any

Syllabus finalized and approved by all the UGBOS Botany members

UG BOS Meeting Reference Number: **450 /UG-23** Date: **09-10-2023**

Prepared by CIRM

SEMESTER - III

Course Type: MAJOR

Course Code: UBOTMAJ23005

Course Name: Phycology and Bryology

Credits:4 (Theory=3, Practical=1)

Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description: UBOTMAJ23005 deals with topic Phycology and Bryology. In particular, the course will cover general characteristics, classification, and economic importance of algae and bryophyte. Applied side of phycology. Type study of few algae and bryophyte with Life cycle. Ecological importance of Bryophytes**.**

Prerequisite(s) and/or Note(s):

(1) High School Biology.

(2) Note(s): Syllabus may be modified after and not during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

Knowledge acquired:

(1) Concept of algae and bryophyte

(2) Economic and ecological Importance of algae and bryophyte

(3) Application of phycology in different field.

(3) Diversity in habits, habitats, morphology internal structure and reproduction of different types of algae and bryophytes.

(4) Evolutionary trends within different types of algae and bryophytes.

Skills gained:

(1) Identification of few algae and bryophytes with the study of vegetative and reproductive structures.

(2) Familiarization with the technique of algal collection preservation.

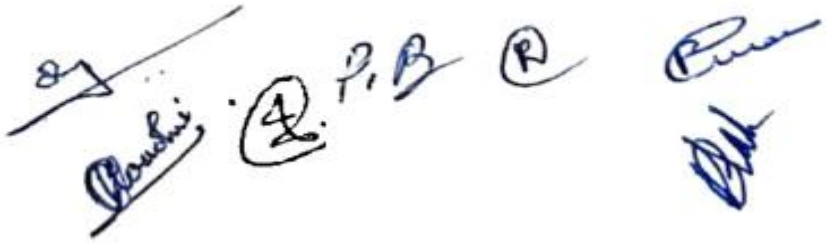
(3) Preparation and study of temporary and permanent slides for the identification of algae and bryophytes through anatomical or morphological study.

(4) Study of ecosystem and report writing.

Competency Developed:

(1) Applying the concept of Identification students can identify of algae and bryophytes.

(2) With the understanding of role of algae in ecosystem during field visit, students will be able to analyze the algal diversity and predict their effect on the particular ecosystem.



THEORY

Total Lectures: 45

Unit-1: **Introduction to phycology and classification of algae (7 Lectures)**

General characters, Habit and Habitat, Organization of thallus, Algal pigments, Food reserves (of only groups represented in the syllabus), methods of reproduction; structure of algal flagella. Different types of life cycle and alternation of generations in algae. Classification: by Fritsch (1945); brief introduction to the modern classification by Lee (2009) [up to divisions], Economic importance of algae.

Unit-2: Type study (13 lectures)

Salient features, thallus structure and reproduction of algae in the following groups with special reference to the type(s) mentioned: Cyanophyceae - Nostoc; Chlorophyceae - *Volvox, Oedogonium, Coleochaete, Chara*; Xanthophyceae – *Vaucheria*; Bacillariophyceae - *Pinnularia;* Phaeophyceae – *Ectocarpus, Fucus;* Rhodophyceae – *Polysiphonia*. Evolutionary significance of *Prochloron*.

Unit-3: Applied Phycology (5 Lectures)

Economic importance of algae: algae as food, single cell protein (SCR), fodder, green manure, role in N2 fixation, medicine and biofuels. Commercial products from Algae - carrageenin, agar-agar, alginates and diatomaceous earth. Role of algae in pollution studies: as indicators of pollution and as bioremediation agents. Role of algae in Biotechnology, Algae and space travel, Eutrophication – algal bloom; harmful and toxic algal blooms – neurotoxins and parasitic algae. Photobioreactor.

Unit-4: General Introduction and Classification of Bryophytes (5 Lectures)

Introduction, general characters, and classification of bryophytes (Rothmaler 1951, Proskaure 1957), Introduction to phylogenetic classification system, Adaptations to land habit; Alternation of generations.

Unit-5: Type study (12 Lectures)

Distribution, morphology, anatomy, reproduction and life cycle and evolutionary trends in the following types (developmental details are not required): Hepaticopsida - *Riccia, Marchantia*; *Pellia* (Jungermanniales); Anthocerotopsida - *Anthoceros;* Bryopsida - *Funaria.* Evolution of gametophyte and sporophyte among Bryophytes, Peristome teeth – Types and function.

Unit 6: Applied Bryology (3 Lectures)

Ecological and Economic importance of Bryophytes – biological, ecological, medicinal with special reference to *Sphagnum*.

PRACTICAL

1. Study of vegetative and reproductive structures of *Nostoc*, *Volvox*, *Oedogonium*, *Coleochaete*, *Chara*, *Vaucheria*, *Ectocarpus*, and *Polysiphonia*, through temporary preparations and permanent slides
2. Demonstration of techniques of algal specimen collection and preservation.
3. Conduct a field visit to any one of the ecosystems rich in Algae to experience algal diversity. Submit a report with photographs.
4. *Riccia* – Morphology of thallus.
5. *Marchantia*- Morphology of thallus, whole mount of rhizoids & Scales, vertical section of thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).
6. *Anthoceros*- Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).
7. *Funaria*- Morphology of thallus, longitudinal section of Sporophyte (permanent slides).
8. Demonstration of techniques of bryophyte specimen collection and preservation.

Suggested Readings

1. Anand N, 1989. Culturing and cultivation of BGA. Handbook of Blue Green Algae.
2. Fritsch F E, 1935. The structure and reproduction of the algae, Vol. 1 and II. Uni. Press. Cambridge.
3. Morris I, 1967. An Introduction to the Algae. Hutchinson and Co. London.
4. Robert Edward Lee, 2008. Phycology. Cambridge University Press,
5. Singh V, Pandey P C, Jain D K. A textbook of botany.
6. Vashishta B R. Textbook of Algae. New Delhi.
7. Gangulee Das and Dutta. College Botany Vol. I. Central Book Depot. Calcutta. 8. Ganguly, Kar A K. College Botany Vol. II. New Central Book Agency, Calcutta.
9. Khan M, 1983. Fundamentals of Phycology. Bishen Singh Mahendra Pal Singh, Dehradun.
10. Campbell H D, 1940. The Evolution of land plants (Embryophyta). Univ. Press, Stanford.
11. Chopra R N, P K Kumar, 1988. Biology of Bryophytes. Wiley Eastern Ltd. New Delhi. 12. Parihar N S, 1965. An Introduction to Bryophyta. Central Book Depot, Allhabad.
12. Shaw J A, Goffinet B, 2000. Bryophyte Biology. Cambridge UniversityPress.
13. Smith G M, 1938. Crytogramic Botany Vol. II. Bryophytes and pteridophytes. McGraw Hill Book Company, London.
15. Sporne K R, 1967. The Morphology of Bryophytes. Hutchinson University Library, London. 16. Vasishta B R. Bryophyta. S Chand and Co. New Delhi.
17. Watson E V, 1971. The structure and life of Bryophytes. Hutchinson University Library, London. 18. Bower F O, 1935. Primitive Land Plants. Cambridge, London.

TEMPLATE FOR COURSE SYLLABUS FOR NEP IMPLEMENTATION

Discipline: Science √ Arts, Humanities & Social Science ☐

Commerce ☐ BBA ☐ BCA ☐

Subject Name: **Botany**

Subject Code: (Will be provided by the University)

Semester: Semester I ☐ Semester II ☐ Semester III √ Semester IV √

Semester V ☐ Semester VI ☐ Semester VII ☐ Semester VIII ☐

Course Name: **Morphology, Anatomy and Taxonomy of Flowering Plants**

Course Code: **UBOTMIN20002** (Will be provided by the University)

Course Credit: Theoretical **3** Practical/Tutorial **1**

Marks Allotted: Theoretical **40** Practical/Tutorial **20**

Continuing Evaluation **10** Attendance **5**

Course Type (tick the correct alternatives):

Major Core	☐	AEC	☐
Interdisciplinary/ DSE	☐	SEC	☐
Minor / Generic Elective	√	VAC	☐
Research Project/Dissertation	☐	Vocational	☐

Is the course focused on employability / entrepreneurship? YES ☐ NO √

Is the course focused on imparting life skill? YES ☐ NO √

Is the course based on Activity ? YES √ NO ☐

Remarks by Chairman, UG BOS, if any

Syllabus finalized and approved by all the UGBOS Botany members

UG BOS Meeting Reference Number: **450 /UG-23** Date: **09-10-2023**

Prepared by CIRM

SEMESTER – III/IV

Course Type: MINOR

Course Code: UBOTMIN20002

Course Name: Morphology, Anatomy and Taxonomy of Flowering Plants

Credits: 4 (Theory-3, Practical-1)

Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description: UBOTMIN20002 deals with the morphology, anatomy, and taxonomy of the angiospermic plants. It emphasizes the structural organization of vegetative and reproductive organs, their functions, the origin and distribution of plant tissues, and the process of secondary growth. It also discusses the history and development of plant taxonomy, focusing on the nomenclature, classification, and identification criteria of the angiospermic families.

Prerequisite(s) and/or Note(s):

(1) High School Biology.

(2) Note(s): Syllabus may be modified after and not during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

Knowledge acquired:

(1) Structure and function of plant organs.

(2) Concept of secondary growth and its types.

(3) Concept and importance of plant taxonomy.

Skills gained:

(1) Practical identification of plant parts and their modifications.

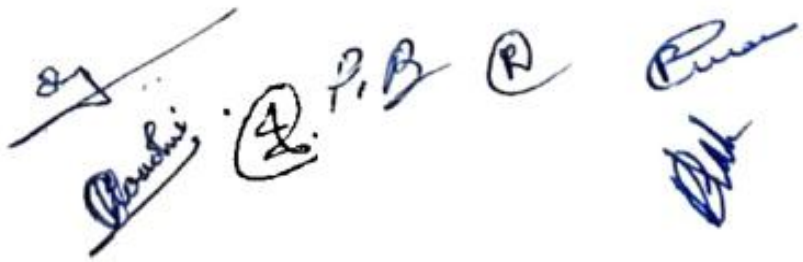
(2) Understanding of plant classification systems with their merits and demerits.

Competency Developed:

(1) Structural and functional differences between dicot and monocot.

(2) Dissection, description, and identification of representative plants of angiospermic families for proper identification using keys.

(3) Preparation and preservation of herbariums.



THEORY

Total Lectures:45

Unit-I: Morphology **(8 lectures)**

Structure, function and types of root, stem and leaf; Concept of Flower as a Modified Shoot; types of flower, inflorescence, Cohesion and Adhesion; Ovule Types; Placentation; Floral Formula; Floral Diagram; Fruits and Seeds - Types and Dispersal.

Unit-II: Tissues **(8 lectures)**

Internal organization of plant body: The three tissue system, types of cells and tissues; Shoot apical meristem; Root Apical Meristem; Lateral Meristem and their functions; Theories of Origin and their limitations; types of vascular bundles; Structure of Dicot and Monocot stem, root and leaf; Quiescent Centre, Root Cap.

Unit-III: Secondary Growth and Wood **(6 lectures)**

Structure, function and seasonal activity of cambium; secondary growth in root and stem, different types of wood (Sap wood and heart wood, ring and diffuse porous wood, early and late wood); tyloses and its importance.

Unit-IV: Introduction to Plant Taxonomy **(10 lectures)**

History; Identification, Classification, Nomenclature. ICN – Principles, rules and recommendations; ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations. Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access.

Unit-V: Classification **(6 lectures)**

Types of classification - artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series) with merits and demerits; Introduction to APG IV system.

Unit-VI: Diagnostic Features and Economic Importance of Families **(7 lectures)**

Brassicaceae, Solanaceae, Lamiaceae, Fabaceae, Asteraceae, Poaceae, and Orchidaceae.

Practical

1. Study of cohesion and adhesion of stamen.
2. Study of different types of ovule and placentas through photograph/living specimen.
3. Study of dicot and monocot stem, root and leaf by temporary slide preparation.
4. Study of vegetative and floral characters of the families (any three) mentioned in theory syllabus (Description, V.S. of flower, section of ovary, floral diagram, floral formula and their identification up to family)
5. Submission of properly dried and pressed specimen of wild plant (5 in number) with herbarium label.

TEMPLATE FOR COURSE SYLLABUS FOR NEP IMPLEMENTATION

Discipline: Science √ Arts, Humanities & Social Science ☐

Commerce ☐ BBA ☐ BCA ☐

Subject Name: **Botany**

Subject Code: (Will be provided by the University)

Semester: Semester I ☐ Semester II ☐ Semester III √ Semester IV ☐

Semester V ☐ Semester VI ☐ Semester VII ☐ Semester VIII ☐

Course Name: **Biofertilizers and Mushroom Cultivation**

Course Code: **UBOTSEC23003** (Will be provided by the University)

Course Credit: Theoretical **3** Practical/Tutorial **1**

Marks Allotted: Theoretical **40** Practical/Tutorial **20**

Continuing Evaluation **10** Attendance **5**

Course Type (tick the correct alternatives):

Major Core	☐	AEC	☐
Interdisciplinary/ DSE	☐	SEC	√
Minor / Generic Elective	☐	VAC	☐
Research Project/Dissertation	☐	Vocational	☐

Is the course focused on employability / entrepreneurship? YES √ NO ☐

Is the course focused on imparting life skill? YES ☐ NO ☐

Is the course based on Activity ? YES √ NO ☐

Remarks by Chairman, UG BOS, if any

Syllabus finalized and approved by all the UGBOS Botany members

UG BOS Meeting Reference Number: **450 /UG-23** Date: **09-10-2023**

Prepared by CIRM

SEMESTER - III

Course Type: SKILL ENHANCEMENT COURSE

Course Code: UBOTSEC23003

Course Name: Biofertilizers and Mushroom Cultivation

(Credits: Theory=2, Practical=1)

Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description:

UBOTSEC23003 deals with the study of various bio-fertilizers used in agriculture during organic farming. The course will help the students to learn the process of isolation, characterization, and production of bio-fertilizer for commercial value. The course also emphasizes on basic concepts and techniques of mushroom cultivation. This course will help in the development of good entrepreneurial skills.

Prerequisite(s) and/or Note(s):

(1) High School Biology.

(2) Note(s): Syllabus may be modified after and not during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

Knowledge acquired:

(1) Role of bio-fertilizers and its mechanism of action in agriculture.

(2) Students will learn about the morphology and types of Mushrooms

(3) Students will understand various edible mushrooms and their cultivation status

Skills gained:

(1) Isolation, characterization, mass inoculum production and field application of bio-fertilizers

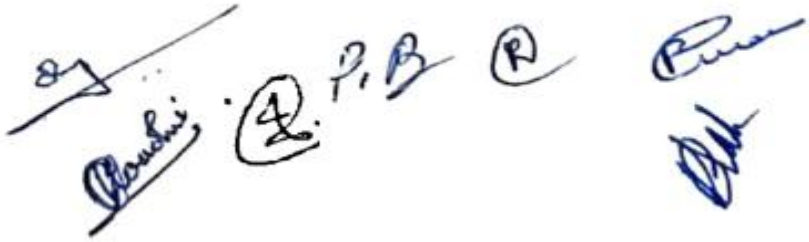
.(2) Students will familiarize themselves with the spawn production technique.

Competency Developed:

(1) Students will be acquiring technical knowledge in Biofertilizer production technology.

(2) Hands on practice of different processes related to mushroom farming and its management.

(3) Apply the knowledge gained to generate opportunities of self-employability.



THEORY

Lectures: 45

Unit 1: Bio-fertilizers (6 Lectures)

N_2-fixing microbes; General account about the microbes used as biofertilizers – *Rhizobium, Azotobacter Azosprillum*. Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, *Azolla cultivation,* and their role in agriculture. Commercial production of *Rhizobium*.

Unit 2: AM fungi (4 Lectures)

Mycorrhizal association, types of mycorrhizal association, occurrence and distribution, AM, and its influence on growth and yield of crop plants.

Unit 3: Organic farming (6 lectures)

Green manuring and organic fertilizers, bio composting and method of vermicomposting – field Application. Recycling of bio-degradable municipal, agricultural and Industrial wastes, FYMs, PGPRs.

Unit 4: Introduction to mushrooms (6 Lectures)

Introduction, Types of edible mushrooms available in India. Nutrition and medicinal value of edible mushrooms; Poisonous mushrooms. Research Centres - National level and regional level. Types of food prepared from mushrooms.

Unit 5: Mushroom cultivation technology (8 Lectures)

Equipment, pure culture medium, and sterilization techniques, spawn production technology, multiplication. Mushroom bed preparation, Factors affecting the mushroom bed preparation: Cultivation of Oyster and White Button Mushroom. Storage and Cost-benefit ratio: Short-term storage, long-term storage, drying, storage in salt solutions, low-cost technology- Marketing in India and abroad, Export value.

PRACTICAL

1. Study of *Rhizobium* from root nodules of leguminous plants.

2. Spots, Specimens/photographs of earthworm, *Azolla* and *Anabaena azollae* association, arbuscules vesicles.

3. Demonstration of bio-compost methods and vermicomposting using photographs.

4. Photographs/ live specimens - Different parts of a typical mushroom & and variations in mushroom morphology.

5. Preparation of culture media: Potato Dextrose medium, Richard's medium.

6. Preparation of spawn: Grain spawn, Straw spawn, Sawdust spawn.

Suggested Readings

1. Dubey, R.C., 2005 A Textbook of Biotechnology S.Chand & Co, New Delhi.

2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi. 3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.

3. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.

4. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.

5. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

6. Kannaiyan, S. Ramasamy, K. (1980). A handbook of edible mushroom, Today & Tomorrows Printers & Publishers, New Delhi.

7. Pandey. B. P. (1996). A textbook of fungi. Chand and Company N Delhi. 3. Subrata Biswas, M. Datta, S. V. Ngachan. (2012) Mushrooms: A Manual for Cultivation. PHI Learning Pvt Ltd.

8. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.

9. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.

10. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.

11. Nita Bahl (1984-1988) Handbook of Mushrooms, II Edition, Vol. I & Vol. II.

TEMPLATE FOR COURSE SYLLABUS FOR NEP IMPLEMENTATION

Discipline: Science √ Arts, Humanities & Social Science ☐

Commerce ☐ BBA ☐ BCA ☐

Subject Name: **Botany**

Subject Code: (Will be provided by the University)

Semester: Semester I ☐ Semester II ☐ Semester III √ Semester IV ☐

Semester V ☐ Semester VI ☐ Semester VII ☐ Semester VIII ☐

Course Name: **Pteridology, Gymnology & Palaeobotany**

Course Code: **UBOTMAJ23006** (Will be provided by the University)

Course Credit: Theoretical **3** Practical/Tutorial **1**

Marks Allotted: Theoretical **40** Practical/Tutorial **20**

Continuing Evaluation **10** Attendance **5**

Course Type (tick the correct alternatives):

Major Core	√	AEC	☐
Interdisciplinary/ DSE	☐	SEC	☐
Minor / Generic Elective	☐	VAC	☐
Research Project/Dissertation	☐	Vocational	☐

Is the course focused on employability / entrepreneurship? YES ☐ NO √

Is the course focused on imparting life skill? YES ☐ NO √

Is the course based on Activity ? YES √ NO ☐

Remarks by Chairman, UG BOS, if any

Syllabus finalized and approved by all the UGBOS Botany members

UG BOS Meeting Reference Number: **450 /UG-23** Date: **09-10-2023**

Prepared by CIRM

SEMESTER - IV

Semester- IV

Course Type: MAJOR

Course Code: UBOTMAJ24006

Course Name: Pteridology, Gymnology & Palaeobotany

(Credits: Theory=3, Practical=1)

Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description: UBOTMAJ24006 deals with the various types of earlier vascular plants viz. pteridophytes and gymnosperms, along with their fossil forms. It discusses and also emphasizes the characteristics and classification of these plant groups, along with the fossil record of the extinct members of these groups. It also includes a primary idea on the field of palaeobotany.

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Prerequisite(s) and/or Note(s):

(1) High School Biology.

(2) Note(s): Syllabus may be modified after and not during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

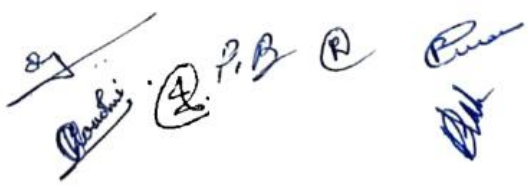
Knowledge acquired:
(1) Basic and Applied Concepts of Pteridophytes
(2) Basic and Applied Concepts of Gymnosperms, and,
(3) Different groups of fossils and working knowledge of paleobotany.

Skills gained:

(1) Handling Microscopy, Staining and Mounting of pteridophytic and gymnospermic specimens, and,
(2) Methods of Collection, Identification and Preservation of plant specimens of these plant groups.
(3) Study of natural ecological systems and writing of reports.
(4) Evolutionary trends of pteridophytes, gymnosperms and allied plants (both extant and extinct).

Competency Developed:

(1) Schematic knowledge of collection and subsequent plant specimens.
(2) Proper arrangement of preserved plant specimens.
(3) Choosing suitable staining and mounting protocols for study of plant specimens.



THEORY

Total Lectures: 45

Unit 1: Introduction **(7 Lectures)**

Unifying features of archegoniates; Similarities & dissimilarities between Bryophytes, Pteridophytes and Gymnosperms; Paleobotany – General account of fossil groups and their importance.

Unit 2: Pteridophytes **(15 Lectures)**

Classification (Gifford & Foster, 1989 – up to Divisions), distribution, morphology, anatomy, reproduction and life cycle of *Psilotum, Lycopodium, Selaginella, Equisetum* and *Pteris* (Developmental details not to be included).; Ecological and economic importance; Stelar evolution; Telome theory; Heterospory & Seed Habit.

Unit. 3: Gymnosperms **(15 lectures)**

Classification (Gifford & Foster, 1989 – up to Divisions), distribution, morphology, anatomy, reproduction and life cycle of *Cycas, Pinus, Ginkgo* and *Gnetum* (Developmental details not to be included); Ecological and economic importance; Ontogeny & structure of Seed; Apogamy, and apospory.

Unit. 4: Progymnosperms and other fossil plants **(4 Lectures)**

General Features of Progymnosperms, Characteristic features of different relevant Form Genera like Rhynia, Lepidodendron, Calamites, Archaeopteris, Williamsonia, Cordaites, Glossopteris.

Unit 5: Paleobotany **(7 Lectures)**

Nomenclature; Taphonomy and the process of fossilization, Methods of determination of age of fossils; Geological time scale, TimeTree 5 (2022), Tree of Life Web Project, The Open Tree of Life; and major events of plant life through geological times.

PRACTICALS

1. *Psilotum*- Study of specimen, transverse section of synangium (permanent slide).
2. *Selaginella*- Study of specimen, transverse section of stem, longitudinal section of strobilus.
3. *Equisetum*- Study of specimen, longitudinal section of strobilus, transverse section of strobilus, transverse section of rhizome.
4. *Pteris*- Study of specimen, transverse section of rachis, vertical section of sporophyll, transverse section of rhizome.
5. *Cycas*- Study of specimen (coralloid roots, leaf), vertical section of leaflet, vertical section of microsporophyll, longitudinal section of ovule, transverse section of root.
6. *Pinus*- Study of specimen (long and dwarf shoots, male and female cones), transverse section of Needle, longitudinal section of / transverse section of male cone, longitudinal section of female cone, tangential longitudinal section & radial longitudinal sections.
7. *Ginkgo*- Study of specimen, longitudinal section of ovule.
8. *Gnetum*- Study of specimen (stem, male & female cones), transverse section of stem, vertical section of ovule.
9. Paleobotany – Study of (at least two) fossil slides of *Lepidodendron, Lepidocarpon, Sphenophyllum, Lyginopteris, Medullosa* & *Glossopteris*.
10. Botanical Excursion and preparation of field note book.

Suggested Readings

1. Gerald Audesirk, Teresa Audesirk, Bruce E Byers, 2019. Biology: Life on earth. (Twelfth Edition). Pearson.
2. James D Mauseth, 2019. Botany: An Introduction to Plant Biology. Jones & Bartlett.
3. Michael G Simpson, 2019. Plant Systematics (Third Edition). Academic Press.
4. P.C Vashistha, A.K Sinha, & Anil Kumar. Gymnosperms. S. Chand. Delhi, India.
5. P.C Vashistha, A.K Sinha, & Anil Kumar. Pteridophyta. S. Chand. Delhi, India.
6. Peter Raven, George Johnson, Kenneth Mason, Jonathan Losos and Tod Duncan, 2023. Biology (Thirteenth Edition). McGraw Hill.
7. Timothy Walker, 2012. Plants: A Very Short Introduction. Oxford.

TEMPLATE FOR COURSE SYLLABUS FOR NEP IMPLEMENTATION

Discipline: Science √ Arts, Humanities & Social Science ☐

Commerce ☐ BBA ☐ BCA ☐

Subject Name: **Botany**

Subject Code: (Will be provided by the University)

Semester: Semester I ☐ Semester II ☐ Semester III ☐ Semester IV √

Semester V ☐ Semester VI ☐ Semester VII ☐ Semester VIII ☐

Course Name: **Morphology and Anatomy**

Course Code: **UBOTMAJ23007** (Will be provided by the University)

Course Credit: Theoretical **3** Practical/Tutorial **1**

Marks Allotted: Theoretical **40** Practical/Tutorial **20**

Continuing Evaluation **10** Attendance **5**

Course Type (tick the correct alternatives):

Major Core	√	AEC	☐
Interdisciplinary/ DSE	☐	SEC	☐
Minor / Generic Elective	☐	VAC	☐
Research Project/Dissertation	☐	Vocational	☐

Is the course focused on employability / entrepreneurship? YES ☐ NO √

Is the course focused on imparting life skill? YES ☐ NO √

Is the course based on Activity ? YES √ NO ☐

Remarks by Chairman, UG BOS, if any

Syllabus finalized and approved by all the UGBOS Botany members

UG BOS Meeting Reference Number: **450 /UG-23** Date: **09-10-2023**

Prepared by CIRM

SEMESTER - IV

Semester- IV

Course Type: MAJOR

Course Code: UBOTMAJ24007

Course Name: Morphology and Anatomy

(Credits: Theory=3, Practical=1)

Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description: UBOTMAJ24007 deals with the morphology and anatomy of the flowering plants. It focuses on the external and internal organization of the plants and plant organs, tissues and tissue systems. It also highlights the origin, distribution patterns and specific structural and functional modifications of the vegetative and reproductive organs of the plant body.

Prerequisite(s) and/or Note(s):

(1) High School Biology.

(2) Note(s): Syllabus may be modified after and not during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

Knowledge acquired:

(1) Organization of the flowering plant body

(2) Introduction to the structure and functions of vegetative and reproductive organs

(3) Origin, development and distribution of plant tissues and organs

Skills gained:

(1) Practical knowledge of the morphological and anatomical features of plant tissues and organs

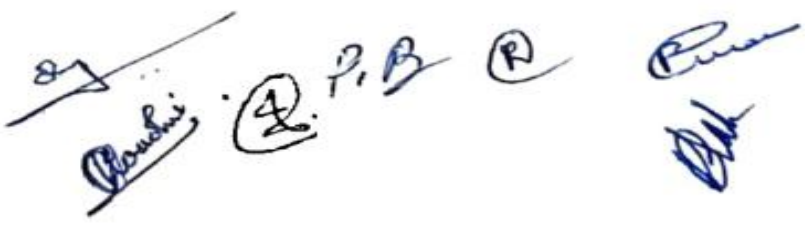
(2) Tissue-specific staining techniques.

Competency Developed:

(1) Structural and functional differentiation between dicots and monocots

(2) Understanding the process of secondary growth and its anomalies in plants.

(3) Practical knowledge about the modifications of vegetative and reproductive plant organs.



THEORY

Total Lectures: 45

Unit-1: Introduction (8 Lectures)

Organization of vascular plant body – root, stem, leaf, flower, and fruit: their characteristic features, types, and modifications; Concept of phyllotaxy; Inflorescence types, Concept of "Flower as a modified shoot", Aestivation, cohesion and adhesion of floral parts; Types of ovule and placentation.

Unit-2: Internal Organization of Plant Body (5 Lectures)

Development of plant body – Polarity, cytodifferentiation, and organogenesis; Structures, functions, and modifications of different types of plant cells and tissues - simple and complex (no phylogeny); Structure of dicot and monocot root, stem, and leaf.

Unit-3: Apical Meristems (5 Lectures)

Structure and Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, Continuing meristematic residue, Cytohistological zonation); Structure and Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory), structure and function of root cap and quiescent center.

Unit-4: Tissue System (14 Lectures)

Epidermal tissue system - Structural organization and function, multiple epidermis, epiblema, bulliform cells, cuticle, epicuticular waxes, epidermal outgrowths – trichomes - types and functions, root hairs, stomata- classification and ontogeny, hydathodes, lithocysts, adcrustations and incrustations. Ground Tissue System - Structural organization and function, endodermis and exodermis, passage cell, origin of lateral roots, mesophyll tissue, laticifers and cavities. Vascular Tissue System - Xylem and phloem - structure and function, cytodifferentiation of tracheary elements and sieve elements, root-stem transition. Principles governing the construction and distribution of mechanical tissues.

Unit-5: Secondary Growth (10 lectures)

Secondary growth in root and stem; Anomalous secondary growth; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses and tylosoids; Structure, function, and seasonal activity of cambium, Development and composition of periderm, rhytidome and lenticels.

Unit-6: Scope of Plant Morphology and Anatomy (3 lectures)

Applications in systematics, forensics, and pharmacognosy; Dendrochronology.

PRACTICAL

1. Study of cohesion and adhesion of floral parts through photographs/ fresh specimens.
2. Study of phyllotaxy and aestivation through photographs/ fresh specimens.
3. Study of inflorescence and fruit types through photographs/ fresh specimens.
4. Study of anatomical features of dicot and monocot root, stem, and leaf through temporary slide preparations.
5. Study of distribution of parenchyma, sclerenchyma, and collenchyma through photographs/ fresh or preserved specimens.
6. Study of stomatal types through temporary slides.
7. Study of trichomes, lithocyst, and laticifers through temporary/permanent slides.
8. Study of apical meristems of root and shoot through photographs/permanent slides.
9. Study of normal and anomalous secondary growth through temporary slide preparations.
10. Study of xylem and phloem elements through temporary/permanent slides.

Suggested Readings

1. Kaplan, D., Specht, C.D. Kaplan's Principles of Plant Morphology. CRC Press.
2. Bell, A.D. Plant Form: An Illustrated Guide to Flowering Plant Morphology. Timber Press.
3. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
4. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
5. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
6. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

TEMPLATE FOR COURSE SYLLABUS FOR NEP IMPLEMENTATION

Discipline: Science √ Arts, Humanities & Social Science ☐

Commerce ☐ BBA ☐ BCA ☐

Subject Name: **Botany**

Subject Code: (Will be provided by the University)

Semester: Semester I ☐ Semester II ☐ Semester III ☐ Semester IV √

Semester V ☐ Semester VI ☐ Semester VII ☐ Semester VIII ☐

Course Name: **Taxonomy of Angiosperms**

Course Code: **UBOTMAJ23008** (Will be provided by the University)

Course Credit: Theoretical **3** Practical/Tutorial **1**

Marks Allotted: Theoretical **40** Practical/Tutorial **20**

Continuing Evaluation **10** Attendance **5**

Course Type (tick the correct alternatives):

Major Core	√	AEC	☐
Interdisciplinary/ DSE	☐	SEC	☐
Minor / Generic Elective	☐	VAC	☐
Research Project/Dissertation	☐	Vocational	☐

Is the course focused on employability / entrepreneurship? YES ☐ NO √

Is the course focused on imparting life skill? YES ☐ NO √

Is the course based on Activity ? YES √ NO ☐

Remarks by Chairman, UG BOS, if any

Syllabus finalized and approved by all the UGBOS Botany members

UG BOS Meeting Reference Number: **450 /UG-23** Date: **09-10-2023**

Prepared by CIRM

SEMESTER - IV

Semester- IV

Course Type: MAJOR

Course Code: UBOTMAJ24008

Course Name: Taxonomy of Angiosperms

(Credits: Theory=3, Practical=1)

Full Marks: 75 (Theory-40, Practical-20, Continuing Evaluation-10, Attendance-5)

Brief Course Description:

Prerequisite(s) and/or Note(s):

(1) High School Biology.

(2) Note(s): Syllabus may be modified after and not during the term itself, depending on the circumstances. However, students will be evaluated only on the basis of topics covered in the course.

Course Objectives:

1. To realize the position of angiosperms in plant kingdom.
2. To make understand the features to identify plants.
2. To make them understand how naming of plants done.
3. To know various angiosperm families emphasizing their morphology, distinctive features and importance.
4. To realize the origin and evolution of Angiosperms.
5. To know various system of classification.

Knowledge acquired:

1. Clear idea about the identification, classification and analysis of different group of plants and their origin and evolution and terminologies related to them.

2. Detail knowledge of different classification system from past to recent for categorisation of plants.

Skills gained:

1. Identification of plant species by using different keys.

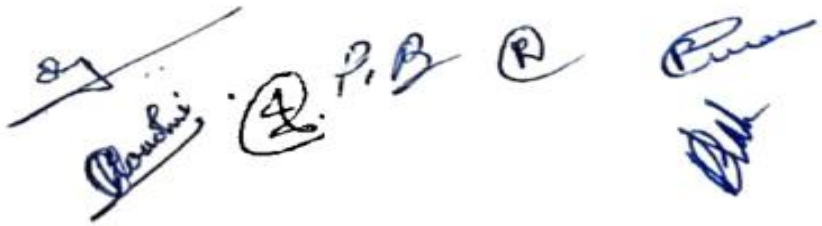
2. Preparation of plant specimen for identification.

Competency Developed:

1. Come to know about different key to identify and positioning of plants.

2. Come to know about method of work out and preparation of specimen for identification.

3. Come to know about ancient and present system of classification of plants.



THEORY

Lecture:45

Unit 1: Introduction **(8 lectures)**

Plant identification, Classification, Nomenclature; alpha and omega taxonomy; Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary). Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: Single access and Multi-access.

Unit 2: Botanical nomenclature **(10 lectures)**

History of botanical nomenclature; Brief outline, ICN-Principles; Rules & recommendations; Typification, Author Citation, Valid & effective publications, Rejection of Names, Principle of Priority and its Limitations; Names of hybrids.

Unit 3: Classification systems **(10 lectures)**

Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (1862-1883) (upto series) and Takhatajan (1997) with merits and demerits; Brief reference of Angiosperm Phylogeny Group (APG IV) classification (Major clades)

Unit 4: Diagnostic features, exceptional characters and economic importance of Families

(10 lectures)

Magnoliaceae, Brassicaceae, Solanaceae, Lamiaceae, Fabaceae, Euphorbiaceae, Cucurbitaceae, Asteraceae, Poaceae, Araceae, Zingiberaceae, Liliaceae, Verbenaceae, Orchidaceae.

Unit 6: Phylogeny of Angiosperms **(7 lectures)**

Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of angiosperms; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).

PRACTICAL

1. Study of vegetative and floral characters of the families mentioned in the theory syllabus (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and their identification up to genus by following published keys in Bengal Plants by David Prain/Flora of Bhutan)
2. Spot identification up to genera, mentioning families of all locally available plants included under the theoretical syllabus,
3. Field visit (local/outside) – Enlistment of plants observed in the field and submission of field note book with 10-25 photographs.
4. Submission of properly dried and pressed specimen of wild plant (not less than 10 and not more than 25) with herbarium label.

Suggested Readings

1. Singh G. (2012). *Plant Systematics:* Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rdedition.

2. Jeffrey C. (1982). An Introduction to *Plant Taxonomy.* Cambridge University Press, Cambridge.

3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.

4. Maheshwari, J. K. (1963). *Flora* of Delhi. CSIR, New Delhi.

5. Radford, A. E. (1986). Fundamentals of *Plant Systematics*. Harper and Row, New York.

6. Singh G. (2021) Plant systematics: An Integrated approach. CRC Press. 4th Edition.

7. Sharma O. P. (2017) Plant Taxonomy. Mc Graw Hill. 2nd Edition.

8. Mitra J. N., Mitra D. Chaudhuri S. K. Studies in Botany. Moulik Library. Vol-1.

9. Datta S. C. (2018) Systematic Botany. New Age International Publisher. 5th Edition.