



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 (Proskauere, 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 (safranin, orcein, carmine).
6. Familiarization 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 McGraw-Hill Education.
4. Mann, S. P. (2016). Introductory Statistics, 9th edition. Hoboken, NJ, John Wiley and Sons Inc.
5. Dannel, W.W. (1987). Biostatistics. New York, NY: John Wiley Sons.
6. Jones, A.M., Reed, R., Weyers, J. (2016). Practical Skills in Biology, 6th Edition, Pearson
7. 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 organelles.

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	$5 \times 1 = 5$
2	3	5	5	$3 \times 5 = 15$
3	2	4	10	$2 \times 10 = 20$

Examination	(Practical based Course)	Duration of Exams
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.**