

VIDYASAGAR UNIVERSITY

Midnapore, West Bengal



PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE (HONOURS) MAJOR IN BOTANY

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

**Curriculum & Credit Framework for Undergraduate Programmes
(CCFUP), 2023 & NEP, 2020**

VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE (HONOURS) MAJOR IN BOTANY
(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. (Hons.)	1 st	I	SEMESTER-I							
			Major-1	BOTHMJ101	T: Plants and Microbial Diversity and its Evolution P: Practical	4	3-0-1	15	60	75
			SEC	BOTSEC01	P: Biofertilizers	3	0-0-3	10	40	50
			AEC	AEC01	Communicative English -1 (<i>common for all programmes</i>)	2	2-0-0	10	40	50
			MDC	MDC01	Multidisciplinary Course -1 (<i>to be chosen from the list</i>)	3	3-0-0	10	40	50
			VAC	VAC01	ENVS (<i>common for all programmes</i>)	4	2-0-2	50	50	100
			Minor (Disc.-I)	BOTMI01	T: Plant Science-I (<i>To be taken by students of other Disciplines</i>) P: Practical	4	3-0-1	15	60	75
		Semester-I Total				20				400
		II	SEMESTER-II							
			Major-2	BOTHMJ102	T: Morphology, Anatomy and Plant Taxonomy P: Practical	4	3-0-1	15	60	75
			SEC	BOTSEC02	P: Floriculture	3	0-0-3	10	40	50
			AEC	AEC02	MIL-1 (<i>common for all programmes</i>)	2	2-0-0	10	40	50
			MDC	MDC02	Multi Disciplinary Course-02 (<i>to be chosen from the list</i>)	3	3-0-0	10	40	50
			VAC	VAC02	Value Added Course-02 (<i>to be chosen from the list</i>)	4	4-0-0	10	40	50
			Minor (Disc.-II)	BOTMI02	T: Plant Science-II (<i>To be taken by students of other Disciplines</i>) P: Practical	4	3-0-1	15	60	75
			Summer Intern.	CS	Community Service	4	0-0-4	-	-	50
		Semester-II Total				24				400
		TOTAL of YEAR-1				44				800

MJ = Major, MI = Minor Course, SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, VAC = Value Added Course; CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language, ENVS = Environmental Studies

VIDYASAGAR UNIVERSITY, PASCHIM MIDNAPORE, WEST BENGAL

MAJOR (MJ)

MJ-1: Plants and Microbial Diversity and its Evolution

Credits 04 (Full Marks: 75)

MJ-1T: Plants and Microbial Diversity and its Evolution

Credits 03

Course contents:

UNIT	Topic	No. of Lectures
1	Introduction to microbial diversity; Whittaker's five-kingdom system and Carl Richard Woese's three-domain system.	3
2	Virus: General characteristics; classification (Baltimore), idea about viroids and prions; detailed structure T4-phage and SARS-COV2, lytic and lysogenic cycle; Economic importance of viruses.	7
3	Bacteria: General characteristics; Types-archaeobacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Bergey's classification, Cell structure; Nutritional types; vegetative and Reproductive structure - asexual and recombination (conjugation, transformation and transduction). Economic importance of bacteria.	8
4	Algae: General characteristics; Ecology and distribution; range of thallus organization; Classification (Van Den Hoek, 1995), reproduction and life cycles of <i>Nostoc</i> , <i>Oedogonium</i> , <i>Chara</i> , and <i>Polysiphonia</i> .	8
5	Fungi: General characteristics; Affinities with plants and animals; Thallus organization; Heterothallism and parasexuality. Classification Ainsworth (up to Order). Life cycles of <i>Synchytrium</i> , <i>Saccharomyces</i> , <i>Ascobolus</i> , <i>Agaricus</i> . Symbiotic associations: Lichen and Mycorrhiza. Economic importance.	8
6	Archegoniate: Unifying features of archegoniates, Bryophytes: General characteristics; Adaptations to land habit; Range of thallus organization. Idea about different orders. Outline classification (Mishler), Morphology, anatomy and reproduction of <i>Marchantia</i> , <i>Porella</i> , <i>Anthoceros</i> , <i>Notothylas</i> and <i>Funaria</i> ; Economic importance with special reference to <i>Sphagnum</i> .	7
7	Pteridophytes: General characteristics; Idea about different orders. Classification (Sporne, 1975), Early land plants (<i>Rhynia</i> and <i>Asteroxylon</i>) Morphology, anatomy and reproduction of <i>Lycopodium</i> , <i>Selaginella</i> , <i>Equisetum</i> and <i>Pteris</i> . Economic importance.	7
8	Gymnosperms: General characteristics, idea about different orders, Classification (Sporne, 1965), morphology, anatomy and reproduction of <i>Cycas</i> , <i>Pinus</i> and <i>Gnetum</i> ; Economic importance.	7
9	Palaeobotany: Geological time scale and important events, Types of plant fossils - impressions, compressions, petrification. Stromatolites, Factors for fossilization.	5

MJ-1P: Plants and Microbial Diversity and its Evolution (Practical)

Credits 01

Course contents:

1. Electron micrographs/Models of viruses – T-Phage and Sars-CoV2,
2. Sketches of Lytic and Lysogenic Cycle.
3. Study of curd organisms curd through Gram staining.

4. Endospore staining.
5. Study of vegetative and reproductive structures of *Nostoc*, *Oedogonium* and *Polysiphonia*.
6. Study of reproductive structures of *Ascobolus*, and *Agaricus*.
7. Study of reproductive structure of *Saccharomyces* and *Penicillium*.
8. Lichens: Photomicrographs of different types of Lichens.
9. *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).
10. *Anthoceros*- Morphology of thallus, dissection of sporophyte (to show spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).
11. *Pogonatum*- Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); Permanent slides showing antheridial and archegonial heads, longitudinal section of capsule and protonema.
12. *Selaginella*- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).
13. *Equisetum*- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores, transverse section of rhizome (all permanent slide).
14. *Pteris*- Morphology, transverse section of rachis, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).
15. *Cycas*- Morphology (leaf), vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide).
16. *Pinus*- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle (temporary slide), transverse section of stem, longitudinal section of / transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), longitudinal section of female cone, tangential longitudinal section & radial longitudinal sections stem (permanent slide).
17. *Gnetum*- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (all permanent slide)
18. Study of fossil genera - *Rhynia*, *Cooksonia*, *Lepidodendron* and *Lepidocarpon* through photographs.

MJ-2: Morphology, Anatomy and Plant Taxonomy**Credits 04 (Full Marks: 75)****MJ-2T: Morphology, Anatomy and Plant Taxonomy****Credits 03****Course contents:**

UNIT	Topic	No. of Lectures
1	Vegetative morphology - A general account of root, stem & leaves with different types of modifications; Different types of stipules and modifications along with phyllotaxy and diversity of leaves.	5
2	Flower - different types of inflorescences; Floral morphology, aestivation with special reference to adhesion and cohesion of the floral parts, Placentation - types; Floral formula, Floral diagram.	5
3	Fruits & seeds-types and dispersal mechanisms	3
4	Structure and Development of Plant Body : internal organization of plant body: The three tissue systems, types of cells and tissues. Root stem transition. Apical meristems, types of stomata, Types of vascular bundles; Stele and its evolution.	5
5	Vascular Cambium and Wood Structure, function and seasonal activity of cambium; Secondary growth in root and stem, Types of Anomalous secondary growth with special emphasis on <i>Boerhavia</i> and <i>Dracaena</i> . Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Annual ring; composition of periderm, rhytidome and lenticels.	5
6	Significance of Plant systematics ; 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.	5
7	Taxonomic hierarchy , Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary). Botanical nomenclature, Principles and rules (ICN); Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.	7
8	Systems of classification , Overview of artificial, natural and phylogenetic classification; Classification system of Bentham and Hooker (up to series). Brief reference of Angiosperm Phylogeny Group (APG IV) classification.	6
9	Taximetrics : numerical taxonomy and cladistics Characters; OTUs, Cluster analysis; Phenograms, cladograms (definitions and differences).	4
10	Phylogeny of Angiosperms : Terms and concepts (homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of angiosperms. Concept of Basal Angiosperms and Eudicots.	7
11	General descriptions of the given families : Magnoliaceae, Malvaceae, Acanthaceae, Verbenaceae, Scrophulariaceae, Fabaceae, Caesalpiniaceae, Asteraceae, Euphorbiaceae, Lamiaceae, Poaceae, Orchidaceae.	8

1. Study of phyllotaxy and stipules.
2. Study of Inflorescence types- Racemose, Cymose, Special types (Capitulum, Verticillaster, and Hypanthodium)
3. Study of floral morphology with special reference to adhesion and cohesion of the floral parts, placentation types.
4. Study of different fruit types.
5. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification):
 - Malvaceae – *Sida* sp. / *Abutilon* sp.
 - Acanthaceae – *Ruellia* sp./*Barleria* sp.
 - Fabaceae – *Tephrosia* sp./*Crotalaria* sp.
 - Verbenaceae – *Lantana* sp./*Duranta* sp.
 - Asteraceae - *Vernonia* sp./*Ageratum* sp., *Eclipta* sp./*Tridax* sp.
 - Lamiaceae – *Leucas* sp./*Ocimum* sp.
 - Euphorbiaceae – *Euphorbia* sp. / *Jatropha* sp.
 - Poaceae – *Triticum* sp./*Chrysopogon* sp. or any local common grass
 - Orchidaceae- *Vanda* sp.
6. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book – At least 25 nos.).
7. Root: monocot, dicot, secondary growth.
8. Stem: monocot, dicot - primary and secondary growth
9. Anatomy of Leaf: isobilateral, dorsiventral
10. Anomalous secondary growth (Through permanent slides).
11. Study of Stomata and its types
12. Field visit (two) at least one to study the local flora

MINOR (MI)

MI – 1: Plant Science-I

Credits 04 (Full Marks: 75)

MI – 1T: Plant Science-I

Credits 03

[45L]

Course contents:

UNIT	Topic	No. of Lectures
1	Introduction to microbial world- Whittaker's five-kingdom system Virus: General characteristics, classification (Baltimore), Economic importance. Bacteria: General characteristics, Bergey's Classification, Economic importance. Algae: General characteristics; habitat, classification (Van Den Hoek, 1995), lifecycle patterns of <i>Volvox</i> and <i>Batrachospermum</i> , Economic importance. Fungi: General characteristics, Classification (Ainsworth, up to Order), life cycle patterns of <i>Rhizopus</i> and <i>Agaricus</i> , economic importance. Brief account of lichen and mycorrhiza.	15
2	Bryophytes: General characteristics, classification (Proskauer, 1957), morphology, anatomy and reproduction of <i>Riccia</i> , <i>Anthoceros</i> and <i>Funaria</i> , economic importance of bryophytes. Pteridophytes: General characteristics, Classification (Sporne, 1975), morphology, anatomy and reproduction of <i>Lycopodium</i> , <i>Adiantum</i> and <i>Marsilea</i> . Economic importance	15
3	Gymnosperms: General characteristics, Classification (Sporne, 1965), morphology, anatomy and reproduction of <i>Cycas</i> and <i>Pinus</i> . Economic importance. Paleobotany: Geological time scale and important events, Types of plant fossils.	15

MI – 1P: Plant Science-I (Practical)

Credits 01

Course Outline

1. Electron micrographs/Models of viruses – T-Phage and Sars-CoV2.
2. Study of Curd organisms through Gram staining.
3. Study of vegetative and reproductive structure of *Volvox*, and *Batrachospermum*.
4. Study of morphology and reproductive structure of *Rhizopus* and *Agaricus*.
5. Study of morphology of thallus and reproductive structure of *Riccia*, *Anthoceros* and *Funaria*.
6. Study of morphology vegetative and reproductive structure of *Lycopodium*, *Adiantum* and *Marsilea*.
7. Study of morphology and vegetative structure of *Cycas* and *Pinus*.
8. Study of fossil types (impressions, compressions, petrification).

MI-2: Plant Science II**Credits 04 (Full Marks: 75)****MI-2T: Plant Science II****Credits 03****[45L]****Course contents:**

UNIT	Topic	No. of Lectures
1	Plant morphology - A general account of root, stem & leaves of monocot and dicot; phyllotaxy.	3
2	Flower - different types of inflorescences, Aestivation, Placentation - types; Floral formula, Floral diagram.	4
3	Fruits and Seeds-types	2
4	Structure and Development of Plant Body : The three tissue systems, primary structure of root, stem, and leaf; types of stomata, Types of vascular bundles; Secondary growth in root and stem, Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood; Annual ring; peridermand lenticels.	5
5	Significance of Plant systematics ; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Brief concept about Flora, Monographs; Keys:Single access and Multi-access.	4
6	Taxonomic hierarchy , Concept of taxa (family, genus, species); Species concept (taxonomic, biological, evolutionary). Botanical nomenclature, Principles and rules (ICN); author citation, valid publication.	4
7	Systems of classification , Overview of artificial, natural and phylogenetic classification; Classification system of Bentham and Hooker (up to series). Brief account of Angiosperm Phylogeny Group classification. Concept of primitive and Advance angiosperms (basal angiosperm and eudicots).	4
8	General descriptions of the given families : Malvaceae, Papilionaceae, Acanthaceae, Verbenaceae, Asteraceae, Poaceae.	4

MI-2P: Plant Science II (Practical)**Credits 01****Course Outline:**

- Study of leaf types (Simple and Compounds).
- Study of inflorescence types(recemose and cymose)
- Study of floral diversity with special reference to adhesion and cohesion.
- Study of fruit types:
Berry: *Cucumis sativus*, *Capsicum annum*, *Solanum melongena*
Drupe: *Mangifera indica*, *Borassus flaballifer*
Hesperidium: *Citrus*
Nut: *Arachis hypogea*
- Study of vegetative and floral characters of the following families
Malvaceae – *Sida* sp. / *Abutilon* sp.
Acanthaceae – *Ruellia* sp./*Barleria* sp.
Papilionaceae – *Tephrosia* sp./*Crotalaria* sp.
Verbenaceae – *Lantana* sp./*Duranta* sp.

SKILL ENHANCEMENT COURSE (SEC)

SEC 1: Biofertilizers

Credits 03

SEC1P: Biofertilizers

Full Marks: 50

Course Outline:

Unit- 1: General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.

Unit- 2: *Azospirillum*: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. *Azotobacter*: classification, characteristics – crop response to *Azotobacter* inoculum, maintenance and mass multiplication.

Unit- 3: Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.

Unit- 4: Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

Unit-5: Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.

Suggested Readings:

1. Dubey, R.C., 2005 A Text book 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.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New _Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic _Farming Akta Prakashan, Nadiad

SEC 2: Floriculture

Credits 03

SEC 2P: Floriculture

Full Marks: 50

Course Outline:

UNIT-1: Introduction: History of gardening; Importance and scope of floriculture and landscape gardening.

UNIT-2: Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.

UNIT-3: Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai.

UNIT-4: Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India.

UNIT-5: Landscaping Places of Public Importance: Landscaping highways and Educational institutions.

UNIT-6: Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Lilium, Orchids).

UNIT-7: Diseases and Pests of Ornamental Plants.

Suggested Readings:

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

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(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks				
								CA	ESE	TOTAL		
B.Sc. (Hons.)	2 nd	III	SEMESTER-III									
			Major-3	BOTHMJ03	T: Cell Biology; P: Practical			4	3-0-1	15	60	75
			Major-4	BOTHMJ04	T: Economic Botany and Pharmacognosy; P: Practical			4	3-0-1	15	60	75
			SEC	BOTSEC03	P: Mushroom Cultivation Technology			3	0-0-3	10	40	50
			AEC	AEC03	Communicative English -2 (<i>common for all programmes</i>)			2	2-0-0	10	40	50
			MDC	MDC03	Multidisciplinary Course -3 (<i>to be chosen from the list</i>)			3	3-0-0	10	40	50
			Minor-3 (Disc.-I)	BOTMIN03	T: Plant Science-III; P: Practical			4	3-0-1	15	60	75
		Semester-III Total					20				375	
		IV	SEMESTER-II									
			Major-5	BOTHMJ05	T: Biochemistry and Metabolism; P: Practical			4	3-0-1	15	60	75
			Major-6	BOTHMJ06	T: Plant Pathology and Plant Health Science; P: Practical			4	3-0-1	15	60	75
			Major-7	BOTHMJ07	T: Ecology, Phytogeography and Evolution; P: Practical			4	3-0-1	15	60	75
			AEC	AEC04	MIL-2 (<i>common for all programmes</i>)			2	2-0-0	10	40	50
			Minor-4 (Disc.-II)	BOTMNI04	T: Plant Science-III; P: Practical			4	3-0-1	15	60	75
			Summer Intern.	INT	Internship/ Apprenticeship - activities to be decided by the Colleges following the guidelines to be given later			4	0-0-4	-	-	50
		Semester-IV Total					24				400	
		TOTAL of YEAR-2					44				775	

MJ = Major, MI = Minor Course, SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language

MAJOR (MJ)

MJ-3: Cell Biology

Credits 04 (Full Marks: 75)

MJ-3T: Cell Biology (Theory)

Credits 03

Course contents:

Unit	Topic
Unit- 1	Cell: Cell as a unit of structure and function; Origin of Eukaryotic cell (Endosymbiotic theory). Chemistry, structure and function of Plant cell wall. Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.
Unit-2	Organelles: Structural organization and function of membrane; fluid mosaic model; intracellular organelles (nucleus, mitochondria, GERL system, Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility).
Unit-3	Cell division and cell cycle: Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases.
Unit-4	Chromosome: General features, chromatin, nucleosome structure, higher order structure of chromatin, euchromatin and heterochromatin; Structure and significance of polytene and lampbrush chromosomes; brief knowledge of chromosome banding (only definitions of C-, G- and Q-bands) and its applications.
Unit-5	Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. Cell signaling Hormones and their receptors, cell surface receptor, second messengers.

MJ-3P: Cell Biology (Practical)

Credits 01

Course contents:

1. Study of plant cell structure with the help of epidermal peel mount of *Onion/Rhoeo*.
2. Study the phenomenon of plasmolysis and deplasmolysis.
3. Study of cell and its organelles with the help of electron micrographs.
4. Study different stages of mitosis (onion root tip) and meiosis .
5. Preparation of normal, molar solutions and percent solutions (using NaCl and Sucrose).
6. Measurement of cell size by the technique of micrometry.
7. Study the effect of organic solvent and temperature on membrane permeability.

Suggested Readings:

1. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
2. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
3. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

MJ-4: Economic Botany and Pharmacognosy**Credits 04 (Full Marks: 75)****MJ-4T: Economic Botany and Pharmacognosy (Theory)****Credits 03****Course contents:**

Unit	Topic
Unit- 1	Origin of Cultivated Plants; Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.
Unit-2	Study of the following economically important plants (Scientific names, families, parts used and importance; Spices-Ginger, cumin, Beverages- Tea, coffee, Medicinal plants-, neem, Vasaka, Vegetables- Potato, raddish, bottle, Fibre yielding plants- jute, Timber yielding plants- Sal, Lac Culture, Fruits- Mango, Sugar yielding plant- Sugarcane. Medicinal Plants : Serpentine root (Rauvolfia), Creat (Andrographis), Ipecac, Aljun, Yew (Taxus), Red periwinkle (Catharanthus), Margosa.
Unit-3	Medicinal botany: History, scope and importance of medicinal plant, a brief idea about indigenous medicinal sciences- ayurveda, siddha and unani. Polyherbal formulations.
Unit-4	Methods of cultivation : Rice, Tea, Cashew nut.; cultivation of Lemon grass and oil extraction method.
Unit-5	Pharmacognosy- General account : Pharmacognosy and its importance in modern medicine, Crude drugs, Classification of drugs- chemical and pharmacological, Drug; evaluation– organoleptic, microscopic, chemical, physical and biological, . Major pharmacological groups of plant drugs and their uses.

Unit-6	Secondary metabolites: Definition of secondary metabolites and difference with primary metabolites , Major types–terpenoids, phenolics, flavonoids, alkaloids and their protective action against pathogenic microbes and herbivores.
Unit-7	Pharmacologically active constituents: Source plants (one example) parts used and uses of: Steroids (Solasodin, Diosgenin, Digitoxin), Tannin (Catechin), Resins (Gingerol, Curcuminoids), Alkaloids (Quinine, Atropine. Pilocarpine, Strychnine, Reserpine, Vinblastine), .Phenols (Sennocide and Capsaicin).

MJ-4P: Economic Botany and Pharmacognosy (Practical)

Credits 01

1. Study of local economically important plants and submission of report with photographs
2. Study of cultivation practices in the field and submission of report.
3. Chemical tests for (a) Tannin (*Camellia sinensis* / *Terminalia chebula*), (b) Alkaloid (*Catharanthus roseus*).
4. Powder microscopy – Zingiber and Holarrhena.
5. Histochemical tests of (a) Curcumin (*Curcuma longa*), (b) Starch in non-lignified vessels (Zingiber), (c) Alkaloid (stem of *Catharanthus* and bark of *Holarrhena*).

Suggested Readings:

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture. Jones & Bartlett_Publishers.

MJ-5: Biochemistry and Metabolism**Credits 04 (Full Marks: 75)****MJ-5T: Biochemistry and Metabolism (Theory)****Credits 03****Course contents:**

Unit	Topic
Unit- 1	Bioenergetics: Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as an energy currency molecule.
Unit-2	Forces stabilizing atomic and molecular interactions: Formation, properties and biological significance of Van der Waals force, hydrogen bond, ionic bond, covalent bond and hydrophobic interaction, free radicals. pH and buffer: biological significance of pH, Characteristics of buffer.
Unit-3	Carbohydrate chemistry: Classification and properties of carbohydrates with emphasis on glycosidic bond, stereoisomerism, optical isomerism, epimerization, mutarotation and reducing action of sugars.
Unit-4	Protein chemistry: Classification of proteins, primary, secondary, tertiary and quaternary structure of proteins; Properties of proteins with emphasis on isoelectric pH, biuret test and heat coagulation.
Unit-5	Lipid Chemistry: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacylglycerols structure, functions and properties; Phosphoglycerides.
Unit-6	Nucleic acid chemistry: Elementary concept of nucleoside, nucleotide, polynucleotide, elementary concept of RNA, chemical properties of DNA and comparison of A, B, Z.
Unit-7	Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; isoenzymes; Features of active site, substrate specificity, mechanism of action (activation energy), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity. enzyme inhibition.
Unit-8	Metabolism: Synthesis and catabolism of sucrose and starch. β -oxidation of fat, Synthesis and breakdown of triglycerides,

MJ-5P: Biochemistry and Metabolism (Practical)**Credits 01**

1. Qualitative tests for carbohydrates - reducing and non-reducing sugars, glucose, fructose, sucrose, starch and lipids.
2. Qualitative tests for detection of proteins, amino acids and organic acids (citric, tartaric, oxalic and malic acids).
3. Estimation of glucose by Benedict's quantitative reagent.
4. Qualitative tests for carbohydrate, protein, lipid, alkaloids, tannins, phenols, and flavonoids using polar and nonpolar solvents of plant samples.

Suggested Readings:

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., 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.

MJ-6: Plant Pathology and Plant Health Science**Credits 04 (Full Marks: 75)****MJ-6T: Plant Pathology and Plant Health Science (Theory)****Credits 03****Course contents:**

Unit	Topic
Unit- 1	Definitions - disease, pathogen, inoculum, infection, resistance, incubation period, Disease cycle, Koch's postulates. Symptoms- necrotic, hypoplastic and hyperplastic.
Unit-2	Plant Pathogens and Diseases - Types of plant pathogens (viruses, bacteria, fungi, nematodes); Life cycle of pathogens; Mode of transmission; Plant-pathogen interactions- pathogenicity factors; Phytoalexins in defense mechanism; Systemic and Local acquired resistance.
Unit-3	Common plant diseases and their symptoms- Late blight of potato, Black stem rust of wheat, Stem rot of jute, Brown spot of rice; Epidemiology of plant diseases; Disease development and progression; Symptomology; Symptoms variability;

Unit-4	Plant Disease and Health Management - Principles of integrated pest management; Cultural practices of disease prevention, biological and chemical control methods
Unit-5	Plant Health in Agriculture:–Disease management in the agricultural system; Role of plant health in sustainable agriculture; Food safety and plant health.
Unit-6	Plant Health and the Environment–Impacts of plant health in ecosystems; Plant health and climate change; Bio-security and plant health; Plant quarantine; Plant Variety Protection (PVP) rights, Plant Breeder's rights.

MJ-6P: Plant Pathology and Plant Health Science (Practical)

Credits 01

1. Visual diagnosis of common diseased plant symptoms and signs–Fungal leaf spots, Bacterial leaf spots, Vein banding, Mosaic and ring spot, Leaf distortion, Powdery mildew, Leaf tip death, Cankers, Fruit discoloration, Wilts, Blights, Damping off.
2. Laboratory testing of plant pathogens by microscopy and pathogen-selective media plates.
3. A field visit and assessment of plant disease incidence and severity.

Suggested Readings:

1. Agrios, G. N. 1997. Introductory Plant Pathology. 4th ed. Academic Press, New York, NY.
2. Hansen, M. A. and R. L. Wick. 1993. Plant disease diagnosis: present and future prospects. *Advances in Plant Pathology* 10:65-126.
3. Hansen, M. A. and R. L. Wick. 1993. Plant disease diagnosis: present and future prospects. *Advances in Plant Pathology* 10:65-126.

MJ-7: Ecology, Phytogeography and Evolution**Credits 04 (Full Marks: 75)****MJ-7T: Ecology, Phytogeography and Evolution (Theory)****Credits 03****Course contents:**

Unit	Topic
Unit- 1	Introduction: Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, Carrying capacity, homeostasis.
Unit-2	Edaphic factors : Soil Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development; Water ; States of water in the environment
Unit-3	Plant communities: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.
Unit-4	Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection).
Unit-5	Biotic interactions: Trophic organization, basic source of energy, autotrophy, heterotrophy; symbiosis, commensalism, parasitism;
Unit-6	Phytogeography : Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Local Vegetation.
Unit-7	The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multicellular organisms; Major groups of plants.

MJ-7P: Ecology, Phytogeography and Evolution (Practical)**Credits 01**

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper)
3. Study of morphological adaptations of hydrophytes and xerophytes. Comparative study of ecologically significant anatomy in plants: Aquatic (*Eichhornia crassipes* root, *Ipomoea carnea* stem); Xerophytic (*Peperomia pellucida* leaf, *Bambusa* sp. leaf).

4. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
5. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
6. Determination of organic carbon content of soil sample.
7. Field visit to familiarise students with ecology & Sustainability of different sites.

Suggested Readings:

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
5. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

MINOR (MI)

MI – 3: Plant Science-III

Credits 04 (Full Marks: 75)

MI – 3T: Plant Science-III

Credits 03

[45L]

Cell Biology

Course contents:

UNIT	Topic	No. of Lectures
1	Cell as a unit of Life- The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components.	15
2	Cell Organelles- Structure and function of cell organelles: Chloroplast, Mitochondria, Ribosomes, Endoplasmic reticulum. Cell Membrane and Cell Wall- The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall.	15
3	Cell Cycle- Overview of Cell cycle, Mitosis and Meiosis. Fundamental differences between mitosis and meiosis. Synaptonemal complex, mitotic spindle, significance of meiosis.	15

MI – 3P: Plant Science-III (Practical)

Credits 01

Course Outline

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles.
3. To study the structure of plant cell through temporary mounts.
4. Study of mitosis and meiosis (temporary mounts and permanent slides).
5. Study the effect of temperature, organic solvent on semi permeable membrane.
6. Demonstration of dialysis of starch and simple sugar.
7. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
8. Measure the cell size (either length or breadth/diameter) by micrometry.

MI-4: Plant Science IV

Credits 04 (Full Marks: 75)

MI-4T: Plant Science IV

Credits 03

[45L]

Economic Botany and Pharmacognosy

Course contents:

UNIT	Topic	No. of Lectures
1	Origin of Cultivated Plants- Concept of centres of origin, their importance with reference to Vavilov's work.	15
2	Cereals- Wheat -Origin, morphology, uses. Legumes- General account with special reference to Gram and soybean. Spices- General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses). Beverages- Tea (morphology, processing, uses). Oils and Fats- General description with special reference to groundnut. Fibre Yielding Plants- General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)	15
3	Pharmacognosy: Definition, Importance, Classification of drug - Chemical and Pharmacological, Drug evaluation. Organoleptic and microscopic studies with reference to nature of active principles and common adulterants of <i>Alstonia</i> (bark), <i>Adhatoda</i> (leaf), <i>Strychnos</i> (seed), <i>Rauvolfia</i> (root), and <i>Zinziber</i> (rhizome). Secondary Metabolites: Definition of primary and secondary metabolites and their differences, major types - terpenes, phenolics and alkaloids. A brief idea about extraction of alkaloids.	15

MI-4P: Plant Science IV (Practical)

Credits 01

Course Outline:

1. Study of economically important plant: Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests.
2. Organoleptic and powder microscopy of *Alstonia* bark, *Adhatoda* leaf, *Strychnos* seed and *Zinziber* rhizome.
3. Chemical tests for Tannin (*Terminalia chebula*) and Alkaloid (*Catharanthus roseus*).

SKILL ENHANCEMENT COURSE (SEC)

SEC 3: Mushroom Cultivation Technology

Credits 03

SEC3P: Mushroom Cultivation Technology

Full Marks: 50

Course Outline:

Unit 1: Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - *Volvariella volvacea*, *Pleurotus citrinopileatus*, *Agaricus bisporus*.

Unit 2: Cultivation Technology: Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.

Unit 3: Storage and nutrition: Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.

Unit 4: Food Preparation: Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

Suggested Readings:

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

VIDYASAGAR UNIVERSITY

Midnapore, West Bengal



PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE (HONOURS) MAJOR IN BOTANY

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE (HONOURS) MAJOR IN BOTANY
(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks			
								CA	ESE	TOTAL	
B.Sc. (Hons.)	3 rd	V	SEMESTER-V								
			Major-8	BOTHMJ08	T: Genetics and Plant Breeding; P: Practical	4	3-0-1	15	60	75	
			Major-9	BOTHMJ09	T: Molecular Biology and Plant Biotechnology; P: Practical	4	3-0-1	15	60	75	
			Major-10	BOTHMJ10	P: Palynology and Plant Reproductive Biology; P: Practical	4	3-1-0	15	60	75	
			Major Elective-01	BOTHDSE1	Stress Biology OR Industrial and Environmental Microbiology	4	3-1-0/ 3-0-1	15	60	75	
			Minor-5 (Disc.-I)	BOTMIN05	T: Plant Science-V; P: Practical (To be taken from other Discipline)	4	3-0-1	15	60	75	
						Semester-V Total	20				375
		VI	SEMESTER-VI								
			Major-11	BOTHMJ11	T: Plant Physiology and Metabolism; P: Practical	4	3-0-1	15	60	75	
			Major-12	BOTHMJ12	T: Immunology and Applied Microbiology; P: Practical	4	3-0-1	15	60	75	
			Major-13	BOTHMJ13	T: Bioprospecting and Natural Resource Management; P: Practical	4	3-0-1	15	60	75	
			Major Elective-02	BOTHDSE2	Biostatistics OR Basics of Forestry	4	3-1-0/ 3-0-1	15	60	75	
			Minor-6 (Disc.-II)	BOTMIN06	T: Plant Pathology and Plant Health Science; P: Practical (To be taken from other Discipline)	4	3-0-1	15	60	75	
						Semester-VI Total	20				375
						YEAR-3	40				750
						Eligible to be awarded Bachelor of Science in Botany on Exit	126	Marks (Year: I+II+III)		2325	

MJ = Major, MI = Minor Course, DSE = Discipline Specific Elective Course, CA= Continuous Assessment, ESE= End Semester Examination,
T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical

SEMESTER-V

MAJOR (MJ)

MJ-8: Genetics and Plant Breeding

Credits 04 (Full Marks: 75)

MJ-8T: Genetics and Plant Breeding (Theory)

Credits 03

Unit	Topic
Unit- 1	Mendelian genetics and its extension: Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; pedigree analysis; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance and Expressivity, Polygenic inheritance.
Unit-2	Extensions of Mendelian principles : dominant epistasis (12:3:1), supplementary gene action (9:3:4), polygenic action (9:6:1), complementary gene action (9:7), inhibitory gene action (13:3), duplicate gene action (15:1)
Unit-3	Extra-chromosomal Inheritance: Organelle effects- Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in Paramecium.
Unit-4	Linkage, crossing over and chromosome mapping: Linkage and crossing over- Cytological and molecular basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping.
Unit-5	Gene mutations: Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogues, deamination, and intercalating agents); DNA repair mechanisms. Transposable elements and its role; Retroposon.
Unit-6	Population and Evolutionary Genetics: Allele frequencies, Genotype frequencies, Hardy-Weinberg Law and Factors-, role of natural selection, mutation, bottle neck, genetic drift, and founder effect.
Unit-7	Plant Breeding: Introduction and objectives. Breeding methods: self-pollinated, cross pollinated and vegetative propagated plants; Distant hybridization and role of biotechnology in crop improvement. Heterosis and Inbreeding Depression

Course Outline:

1. Basic schedules for chromosome preparation: Pre-treatment, Fixation, Staining, and Smear preparations.
2. Study of Mitosis through smear preparation of root tip of *Allium cepa*,/ *Allium sativum*/ *Aloe vera*
3. Study of Meiosis through smear preparation of root tip of *Allium cepa*/ *Rhoeo sp.*
4. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
5. Incomplete dominance and gene interaction through plant samples (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
6. Demonstration of hybridization technique in a papilionaceous flower (*Cajanas cajan*) and in a graminaceous flower (*Oryza sativa*).
7. Demonstration of T-budding, I-budding in rose. Demonstration of grafting (Wedge grafting, V-grafting, tongue grafting, side grafting) and air layering (gootie) of plant specimens.

Recommended Readings

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
3. Kluge, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A. 9th edition.
4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
5. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
6. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford-IBH. 2ⁿ edition.
7. Acquah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

MJ-9: Molecular Biology and Plant Biotechnology**Credits 04 (Full Marks: 75)****MJ-9T: Molecular Biology and Plant Biotechnology (Theory)****Credits 03**

Unit	Topic
Unit- 1	Nucleic acids: Carriers of genetic information Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment. DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves; Organization of DNA in Prokaryotes, Viruses, and Eukaryotes. RNA Structure; Organelles DNA- mitochondria and chloroplast. Nucleosome structure; Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.
Unit 2	The replication of DNA Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semiconservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, θ (theta) mode of replication; Enzymes involved in DNA replication.
Unit 3	Central dogma and genetic code The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (salient features and deciphering)
Unit 4	Transcription Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in <i>E.coli</i> . Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing.
Unit 5	Processing and modification of RNA Split genes-concept of introns and exons, Splicing- mechanism and types, eukaryotic mRNA processing (5' cap, 3' polyA tail); Ribozymes; RNA editing and mRNA transport.
Unit 6	Translation Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Protein synthesis- mechanism in Prokaryotes and Eukaryotes; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.

Unit 7	Plant Tissue Culture Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Somatic Embryogenesis ; Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploid culture; Cryopreservation; Germplasm Conservation).
Unit 8	Recombinant DNA technology Restriction Endonucleases (Types, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pBR322, pUC18/19, Ti plasmid); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC) and expression vector
Unit 9	Gene Cloning Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR mediated gene cloning; Gene Construct; DNA library, construction of genomic and cDNA libraries; complementation, and colony hybridization.
Unit 10	Methods of gene transfer <i>Agrobacterium</i> -mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).
Unit 11	Applications of Biotechnology Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products– Humulin; Biosafety concerns.

MJ-9P: Molecular Biology and (Practical)

Credits 01

Molecular Biology:

1. Preparation of LB and MS medium and raising *E. coli*.
2. Isolation of plasmid DNA from *E. coli*; Restriction digestion and gel electrophoresis of plasmid DNA.
3. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
4. RNA estimation by Orcinol method.
5. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).
6. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.

Plant Biotechnology:

1. (a) Preparation of MS medium.
(b) Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of tobacco, *Datura*, *Brassica* etc.
2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
3. Isolation of protoplasts.
4. Construction of restriction map of circular and linear DNA from the data provided.
5. Study of methods of gene transfer through photographs: *Agrobacterium*-mediated, direct gene
6. transfer by electroporation, microinjection, microprojectile bombardment.
7. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.
8. Isolation of plasmid DNA.
9. Restriction digestion and gel electrophoresis of plasmid DNA.

Suggested Reading:

- a. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
 - b. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
 - c. Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
- a. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
 3. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
 4. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
 5. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
 6. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
 7. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
 8. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
 9. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
 10. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
 11. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

MJ-10: Palynology and Plant Reproductive Biology**Credits 04(Full Marks: 75)****MJ-10T: Palynology and Plant Reproductive Biology (Theory)****Credits 03**

Unit	Topic
Unit 1	Introduction History (contributions of G.B. Amici, W. Hofmeister, E. Strasburger, S.G. Nawaschin, P. Maheshwari, B.M. Johri, W.A. Jensen, J. Heslop-Harrison) and scope.
Unit 2	Reproductive development Induction of flowering; flower as a modified determinate shoot. Flower development: genetic and molecular aspects.
Unit 3	Anther and pollen biology Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. Microgametogenesis; Pollen wall structure, MGU (Male Germ Unit) structure, NPC system; Palynology and scope (a brief account); Pollen wall proteins; Pollen viability, storage and germination; Abnormal features: Pseudomonads, polyads, massulae, pollinia.
Unit 4	Ovule Structure; Types; Special structures—endothelium, obturator, aril, caruncle and hypostase; Female Gametophyte – megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of <i>Polygonum</i> type); Organization and ultrastructure of mature embryo sac.
Unit 5	Pollination and fertilization Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization.
Unit 6	Self-incompatibility Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self- incompatibility: mixed pollination, bud pollination, stub pollination; Intra-ovarian and <i>in vitro</i> pollination; Modification of stigma surface, parasexual hybridization; Cybrids, <i>in vitro</i> fertilization.
Unit 7	Embryo, Endosperm and Seed Structure and types; General pattern of development of dicot and monocot embryo and endosperm; Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of embryo; Unusual features; Embryo development in <i>Paeonia</i> . Seed structure, importance and dispersal mechanisms.
Units 8	Polyembryony and apomixis Introduction; Classification; Causes and applications.

1. Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bicelled and dehiscent anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.
2. Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, pseudomonads, polyads, pollinia (slides/photographs, fresh material), ultrastructure of pollen wall (micrograph); Pollen viability: Tetrazolium test, germination: Calculation of percentage germination in different media using hanging drop method.
3. Ovule: Types-anatropous, orthotropous, amphitropous/campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs).
4. Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.
5. Intra-ovarian pollination; Test tube pollination through photographs.
6. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria.
7. Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs.

Suggested readings:

1. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
2. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
3. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
4. Johri, B.M. (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.

MAJOR ELECTIVE (DSE)

Major Elective -1: Stress Biology

Credits 04(Full Marks: 75)

MJ DSE-1T: Stress Biology (Theory)

Credits 03

Unit	Course contents
Unit 1	Defining plant stress: Acclimation and adaptation
Unit 2	Environmental factors: Water stress; Salinity stress, High light stress; Temperature stress; Hypersensitive reaction; Pathogenesis– related (PR) proteins; Systemic acquired resistance; Mediation of insect and disease resistance by jasmonates
Unit 3	Stress sensing mechanisms in plants: Calcium modulation, Phospholipid signaling
Unit 4	Developmental and physiological mechanisms that protect plants against environmental stress: Adaptation in plants; Changes in root: shoot ratio; Aerenchyna development; Osmotic adjustment; Compatible solute production.
Unit 5	Reactive oxygen species –Production and scavenging mechanisms.

MJ DSE-1P: Stress Biology (Practical)

Credits 01

1. Quantitative estimation of peroxidase activity in the seedlings in the absence and presence of salt stress.
2. Superoxide activity in seedlings in the absence and presence of salt stress.
3. Zymographic analysis of peroxidase.
4. Zymographic analysis of superoxide dismutase activity.
5. Quantitative estimation and zymographic analysis of catalase.
6. Quantitative estimation and zymographic analysis of glutathione reductase.
7. Estimation of superoxide anions.

Suggested Readings:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John
2. Wiley and Sons. U.S.A. 4th edition.
3. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and

OR

Major Elective -1: Industrial and Environmental Microbiology**Credits 04(FM: 75)****MJ DSE-1T: Industrial and Environmental Microbiology (Theory)****Credits 03**

Unit	Course contents
Unit 1	Scope of microbes in industry and environment
Unit 2	Bioreactors / Fermenters and fermentation processes Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuous fermentations. Components of a typical bioreactor, Types of bioreactors-laboratory, pilotscale and production fermenters; Constantly stirred tank fermenter, tower fermenter, fixed bed and fluidized bed bioreactors and air-lift fermenter.
Unit 3	Microbial production of industrial products Microorganisms involved, media, fermentation conditions, downstream processing and uses; spray drying; Hands on microbial fermentations for the production and estimation (qualitative and quantitative) of Enzyme: amylase or lipase activity, Organic acid (citric acid or glutamic acid), alcohol (Ethanol) and antibiotic (Penicillin)
Unit 4	Microbial enzymes of industrial interest and enzyme immobilization: Microorganisms for industrial applications and hands on screening microorganisms for casein hydrolysis; starch hydrolysis; cellulose hydrolysis. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase).
Unit 5	Microbes and quality of environment. Distribution of microbes in air; Isolation of microorganisms from soil, air and water
Unit 6	Microbial flora of water. Water pollution, role of microbes in sewage and domestic waste water treatment systems. Determination of BOD, COD, TDS and TOC of water samples; Microorganisms as indicators of water quality, check coliform and fecal coliform in water samples.
Unit 7	Microbes in agriculture and remediation of contaminated soils Biological fixation; Mycorrhizae; Bioremediation of contaminated soils. Isolation of root nodulating bacteria, arbuscular mycorrhizal colonization in plant roots

MJ DSE-1T: Industrial and Environmental Microbiology (Practical)**Credits 01**

- Principles and functioning of instruments in microbiology laboratory. - Hands on sterilization techniques and preparation of culture media. - Isolation of microorganisms from soil. - Demonstration of filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, - A visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations.
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Suggested Readings:

1. Pelzer, M.J. Jr., Chen E.C. S., Krieg, N.R. (2010). Microbiology: An application based approach. Tata McGraw Hill Education Pvt. Ltd., Delhi.
2. Tortora, G.J., Funke, B.R., Case. C.L. (2007). Microbiology. Pearson Benjamin Cummings, San Francisco, U.S.A. 9th edition.

MINOR (MI)

Minor (MI)-5: Plant Science-V

Credits 04(Full Marks: 75)

Minor (MI)-5T: Plant Science-V (Biochemistry and Metabolism)

Credits 03

Unit	Topic
1.	Bioenergetics: Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as an energy currency molecule.
2.	Forces stabilizing atomic and molecular interactions: Formation, properties and biological significance of Van der Waals force, hydrogen bond, ionic bond, covalent bond and hydrophobic interaction, free radicals. pH and buffer: biological significance of pH, Characteristics of buffer.
3.	Carbohydrate chemistry: Classification and properties of carbohydrates with emphasis on glycosidic bond,
4.	Protein chemistry: Classification of proteins, primary, secondary, tertiary and quaternary structure of proteins; Properties of proteins.
5.	Lipid Chemistry: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacylglycerols structure, functions and properties; Phosphoglycerides.
6.	Nucleic acid chemistry: Elementary concept of nucleoside, nucleotide, polynucleotide, elementary concept of DNA and RNA.
7.	Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; isoenzymes; Features of active site, substrate specificity, mechanism of action (activation energy), Michaelis – Menten equation.

Minor (MI)-5P: Plant Science-V (Practical)

Credits 01

1. **Qualitative tests for-carbohydrates** of reducing and non-reducing sugars, glucose, fructose, sucrose, starch and **-lipids**.
2. Qualitative tests for detection of proteins, amino acids and organic acids (citric, oxalic. Qualitative tests for carbohydrate, protein, lipid.

Suggested Readings:

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company

SEMESTER-VI

MAJOR (MJ)

MJ-11: Plant Physiology and Metabolism

Credits 04 (Full Marks: 75)

MJ-11T: Plant Physiology and Metabolism (Theory)

Credits 03

Unit	Topic
Unit 1	Plant-water relations Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap – cohesion-tension theory. Transpiration and factors affecting transpiration, antitranspirants, mechanism of stomatal movement.
Unit 2	Mineral nutrition and nutrient uptake Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents, soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, facilitated diffusion, active absorption, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.
Unit 3	Carbon assimilation Historical background, photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO ₂ reduction, photorespiration, C ₄ pathways; Crassulacean acid metabolism; Factors affecting CO ₂ reduction.
Unit 4	Translocation in the phloem Experimental evidence in support of phloem as the site of sugar translocation. Pressure–Flow Model; Phloem loading and unloading; Source–sink relationship.
Unit 5	Carbon Oxidation Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle, amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration.
Unit 6	ATP-Synthesis Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, Boyers conformational model, Racker's experiment, Jagendorf's experiment; role of uncouplers.
Unit 7	Nitrogen metabolism Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-

	legumes); Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination.
Unit 8	Plant growth regulators Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Absciscic acid, Ethylene, Brassinosteroids and Jasmonic acid.
Unit 9	Physiology of flowering and photobiology Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy, Discovery, chemical nature, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.

MJ-11P: Plant Physiology and Metabolism (Practical)

Credits 01

Course Outline:

1. Chemical separation of photosynthetic pigments.
2. Experimental demonstration of Hill's reaction.
3. Determination of osmotic potential of plant cell sap by plasmolytic method.
4. Determination of water potential of given tissue (potato tuber) by weight method.
5. Study of the effect of wind and light on the rate of transpiration in excised twig/leaf.
6. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.
7. Study of seed viability test through TTC.
8. Effect of carbon dioxide on the rate of photosynthesis.
9. To compare the rate of respiration in different parts of a plant.

Demonstration experiments

1. To demonstrate suction due to transpiration.
2. Fruit ripening/Rooting from cuttings (Demonstration).
3. Bolting experiment/*Avena* coleoptile bioassay (demonstration).

Suggested Readings

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.

MJ-12: Immunology and Applied Microbiology**Credits 04 (Full Marks: 75)****MJ-12T: Immunology and Applied Microbiology (Theory)****Credits 03**

Unit	Topic
Unit 1	Innate and adaptive immune system, Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity.
Unit 2	B and T cell epitopes, structure and function of antibody molecules, monoclonal antibodies, antigen-antibody interactions, humoral and cell mediated immune responses, primary and secondary immune modulation, the complement system, inflammation, hypersensitivity and autoimmunity, congenital and acquired immunodeficiencies, vaccines types.
Unit 3	Immunotechniques: Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, FISH and GISH.
Unit 4	Bioreactors/Fermenters and fermentation processes, Solid-state and liquid-state fermentations; Batch fed batch and continuous fermentations, Components of a typical bioreactor, Types of bioreactors-laboratory, Constantly stirred tank fermenter, fixed bed and fluidized bed bioreactors and air-lift fermenter.
Unit 5	Microbial production of industrial products in nutrition, healthcare and agriculture, Antimicrobial drugs; Antibiotics: Classification molecular mechanism of mode of action and resistance; Antifungal and antiviral drugs, Amino acids (glutamic acid), enzymes (amylase and protease), organic acids (citric acid), biofuel, bioplastic, waste water treatment.
Unit 6	Downstream processing and uses; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying
Unit 7	Microbial Ecology – Microbial interactions; role of microbes in carbon, sulphur, phosphorus and nitrogen cycles in forest soil and agriculture soil; Soil microorganisms associated with vascular plants (endophytes, epiphytes), Biological Nitrification Inhibition (BNI), Bioremediation, Uncultivable microorganisms, Process of making microbial inoculants, Challenge with the establishment of microbial inoculants.

MJ-12P: Immunology and Applied Microbiology (Practical)**Credits 01****Course Outline:**

1. Idea on microbial fermentations for the production of ethanol, organic acid and milk product.
2. Estimation of enzymes: amylase, urease, phosphatase, lipase activity.
3. Isolation and cultivation of nitrogen fixing microorganisms.
4. Demonstration of antigen-antibody interaction.
5. Demonstration/presentation of skin allergy.
6. Demonstrate the process of ELISA through photograph.

MJ-13: Bioprospecting and Natural Resource Management Credits 04 (Full Marks: 75)**MJ-13T: Bioprospecting and Natural Resource Management (Theory) Credits 03**

Unit	Topic
Unit 1	Bioprospecting: Definition, Introduction, Current practices in Bioprospecting for conservation of Biodiversity and Genetic resources. Bioprospecting Act: Introduction, Phases of Bioprospecting, Exemption to Act. Fields of Bioprospecting.
Unit 2	Medicinal Plants Bioprospecting/ Pharmaceutical Bioprospecting: for new drugs, assays in Bioprospecting. Antioxidant assay – NO free radical scavenging assay, Antigenotoxicity assay – MTT assay, Antiviral activities of plants – SRB assay.
Unit 3	Marine Bioprospecting: Sources of marine planktons and their Bioprospecting, Isolation and cultivation of Marine bioresources, Isolation of Marine Yeast and its industrial applications, Bioactive chemicals from Seaweeds and their applications.
Unit 4	Microbial Bioprospecting: Isolation of Microbial metabolites and their bio-activity. Endophytic microbial products as Antibiotics.
Unit 5	Origin, evolution, botany, cultivation and uses of Food (wheat, sugarcane and potato), Fodder, Fibers (jute), Oil yielding crops (mustard), wood and timber (Sal and Mahua), Non-wood forest products (NWFPS): Bamboos, Gums, Dyes, Resins, Fruits etc.
Unit 6	Botany, Chemistry and uses of Medicinal and Aromatic plants.

MJ-13P: Bioprospecting and Natural Resource Management (Practical)**Credits 01****Course Outline:**

1. Study of economically important plants (rice/jute/ tea) through herbarium specimens and field study.
2. Study of cultivation practices in field and submission of report.
3. Study and collection of Non-wood forest products (NWFPS).
4. Study on handicrafts using plant parts.
5. Visit to small industries/museum/institutions related to NWFPS studies.

Suggested Reading:

1. Bole, P.V. and Vaghani, Y. (1986). Field guide to common Indian trees, Oxford University Press, Mumbai.
2. Thakur, R.S., Puri, H.S. and Husain, A. (1969). Major medicinal plants of India, Central Institute of medicinal and aromatic plants, Lucknow.
3. Swaminathan, M.S. and Kocchar, S.L. (Es.) (1989). Plants and Society, MacMillan Publication Ltd.,
4. Sharma, O.P. (1996). Hills Economic Botany, Tata McGraw Hill co., Ltd., New Delhi,
5. Kocchar, S.L. (1998). Economic Botany of the tropics, II Edn. MacMillan India Ltd.,
6. CSIR (1986), The useful plants of India Publication and Information directorate, CSIR^ New Delhi.
7. CSIR (1948 - 1976) The wealth of India, 53

MAJOR ELECTIVE (DSE)

Major Elective -2: Biostatistics

Credits 04(Full Marks: 75)

MJ DSE-2T: Biostatistics (Theory)

Credits 03

UNIT	TOPIC
Unit 1	Biostatistics Definition - statistical methods - basic principles. Variables - measurements, functions, limitations and uses of statistics.
Unit 2	Collection of data primary and secondary Types and methods of data collection procedures - merits and demerits. Classification - tabulation and presentation of data - sampling methods.
Unit 3	Measures of central tendency Mean, median, mode, geometric mean - merits & demerits. Measures of dispersion - range, standard deviation, mean deviation, quartile deviation - merits and demerits; Co-efficient of variations.
Unit 4	Correlation Types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression.
Unit 5	Statistical inference Hypothesis - simple hypothesis - student 't' test - chi square test.

MJ DSE-2P: Biostatistics (Practical)

Credits 01

1. Calculation of mean, standard deviation and standard error
2. Calculation of correlation coefficient values and finding out the probability
3. Calculation of 'F' value and finding out the probability value for the F value.
4. Determination of statistical parameters (studied in theory) paper using filed data.

Suggested Readings

1. Biostatistic, Danniel, W.W., 1987. New York, John Wiley Sons.
2. An introduction to Biostatistics, 3rd edition, Sundarrao, P.S.S and Richards, J. Christian Medical College, Vellore
3. Statistical Analysis of epidemiological data, Selvin, S., 1991. New York University Press. Statistics for Biology, Boston, Bishop, O.N. Houghton, Mifflin.
4. The Principles of scientific research, Freedman, P. New York, Pergamon Press.
5. Statistics for Biologists, Campbell, R.C., 1998. Cambridge University Press.

OR

VIDYASAGAR UNIVERSITY, PASCHIM MIDNAPORE, WEST BENGAL

Major Elective -2: Basics of Forestry**Credits 04(Full Marks: 75)****MJ DSE-2T: Basics of Forestry (Theory)****Credits 03**

UNIT	TOPIC
1	Forestry: Definition, Scope; Forest as natural Resources; Man and forestry; Sustainability & forestry; Importance of Forest in sustainable ecology and green house controlling
2	Forest resources, Forest classification, 2. Classification of Forest, Farm Forestry, Social Forestry & Agro-forestry; Different Forest related products- Major & Minor; Forest as a source of sustainable economy; Indian Forest & Forestry: Regional and Local Forest resources; Social forestry
3	Silviculture: Definition, scope & objective. Factors of locality: climatic (Light, temperature & Frost). Topographic (Affect of Altitude, Aspect & Exposure. Edaphic: General, Parental rock influence on vegetation, Pan formation. Biotic: Influence of plants, insects, wild animals, man and his animals; Concept of regeneration of forest.
4	Mensuration: definition, object and scope; Measurement of diameter and girth; Breast height - Rules of diameter measurement, diameter and girth class. Measurement of height of tree: Principles of height measurement (similar triangle, trigonometric). Volume: Measurement of volume of standing and felled trees, volume table.
5	Silviculture: Classification and objective, Clear felling system: clear strip and alternate strip system. Regeneration by Taungya and /or departmental plantation, Uniform system: Shelter wood system, kinds and pattern of felling, Periodic Block, Indian Irregular shelter wood system, Selection system, Coppice - System: Simple, Coppice with Standard
6	Principles and objective of Forest conservation and management, Reserve, Protected and un-classed forest. Sustained yield and progressive yield, joint Forest Management: Concept, working and sustainability; Role of JFM in the environmental restoration and biodiversity conservation. CAI, MAI, sustainable forest.
7	Idea on forest of South West Bengal; Forest products, Livelihood of Forest dwellers; Role of Forest in eco-tourism, Forest & future, NTFP.

MJ DSE-2P: Basics of Forestry (Practical)**Credits 01**

1. Measurement of height of a standing tree using Abney's level.
2. Measurement of diameter and girth of a standing tree using tape/callipers.
3. Measurement of volume of fallen logs.
4. Visit to local forest office.
5. Study of defects in wood.
6. Idea about forest fire.

MINOR (MI)

Minor (MI)-6: Plant Pathology and Plant Health Science

Credits 04(Full Marks: 75)

Minor (MI)-6T: Plant Pathology and Plant Health Science (Theory)

Credits 03

UNIT	TOPIC
Unit- 1	Definitions - disease, pathogen, inoculum, infection, resistance, incubation period, Disease cycle, Koch's postulates. Symptoms- necrotic, hypoplastic and hyperplastic.
Unit-2	Plant Pathogens and Diseases - Types of plant pathogens (viruses, bacteria, fungi); Life cycle of pathogens; Mode of transmission; Phytoalexins in defense mechanism; Systemic and Local acquired resistance.
Unit-3	Common plant diseases and their symptoms- Late blight of potato, Black stem rust of wheat, Disease development and progression.
Unit-4	Plant Disease and Health Management - Principles of integrated pest management.
Unit-5	Plant Health in Agriculture :-Disease management in the agricultural system; Role of plant health in sustainable agriculture; Food safety and plant health.

Minor (MI)-6P: Plant Pathology and Plant Health Science (Practical)

Credits 01

1. Visual diagnosis of common diseased plant symptoms and signs–Bacterial leaf spots, Mosaic and ring spot, Leaf distortion, Powdery mildew, Fruit discoloration, Wilts, Blights, Damping off.
2. Laboratory testing of plant pathogens by microscopy and pathogen-selective media plates.
3. A field visit and assessment of plant disease incidence and severity.

Suggested Readings

1. Agrios, G. N. 1997. Introductory Plant Pathology. 4th ed. Academic Press, New York, NY.
2. Hansen, M. A. and R. L. Wick. 1993. Plant disease diagnosis: present and future prospects. Advances in Plant Pathology 10:65-126.
3. Hansen, M. A. and R. L. Wick. 1993. Plant disease diagnosis: present and future prospects. Advances in Plant Pathology 10:65-126.