VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE WITH BOTANY

(MULTIDISCIPLINARY STUDIES)

3-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 IN LIFE SCIENCES with BOTANY
(*under CCFUP, 2023*)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. in Life Sc. with Botany	1st	I	**SEMESTER-I**							
			Major (Disc.-A1)	BOTPMJ101	**T: Plant Groups and Texa; P: Practical** ***(To be studied by the students taken Botany as Discipline-A)***	4	3-0-1	15	60	75
			SEC	SEC01	***To be chosen from SEC-01 of Discipline A/B/C of their Hons. prog.***	3	0-0-3	10	40	50
			AEC	AEC01	Communicative English-1 (***common for all programmes***)	2	2-0-0	10	40	50
			MDC	MDC01	Multidisciplinary Course-1 (***to be chosen from the list***)	3	3-0-0	10	40	50
			VAC	VAC01	VAC-01: ENVS (***common for all programmes***)	4	2-0-2	50	50	100
			Minor (Disc.-C1)	BOT MI 01/C1	**T: Plant Science-I; P: Practical** ***(To be studied by the students taken Botany as Discipline-C)***	4	3-0-1	15	60	75
			Semester-I Total			20				400
		II	**SEMESTER-II**							
			Major (Disc.-B1)		***To be decided*** ***(Same as like A1 for students taken Botany as Discipline-B)***	4	3-0-1	15	60	75
			SEC	SEC02	***To be chosen from SEC-02 of Discipline A/B/C of their Hons. prog.***	3	0-0-3	10	40	50
			AEC	AEC02	MIL-1 (***common for all programmes***)	2	2-0-0	10	40	50
			MDC	MDC02	Multi Disciplinary Course-02 (***to be chosen from the list***)	3	3-0-0	10	40	50
			VAC	VAC02	VAC-02 (***to be chosen from the list***)	4	4-0-0	10	40	50
			Minor (Disc.-C2)	BOT MI 02/C2	**T: Plant Science-II; P: Practical** ***(To be studied by the students taken Botany as Discipline-C)***	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

P MJ= Major Programme (Multidisciplinary), MI = Minor, A/B = Choice of Major Discipline; C= Choice of Minor Discipline; 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

MAJOR (MJ)

MJ A1/B1: Plant Groups and Texa **Credits 04 (FM: 75)**

MJ A1/B1T: Plant Groups and Texa **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 *Volvox* and *Batrachospermum*, Economic importance. **Fungi:** General characteristics,Classification (Ainsworth, up to Order), life cycle patterns of *Rhizopus* and *Agaricus*, economic importance. Brief account of lichen and mycorrhiza.	15
2	**Bryophytes:** General characteristics, classification (Proskauer, 1957), morphology, anatomy and reproduction of *Riccia*, *Anthoceros* and *Funaria*, economic importance of bryophytes. **Pteridophytes:** General characteristics, Classification (Sporne, 1975), morphology, anatomy and reproduction of *Lycopodium*, *Adiantum* and *Marsilea*. Economic importance	15
3	**Gymnosperms:** General characteristics, Classification (Sporne, 1965), morphology, anatomy and reproduction of *Cycas* and *Pinus.* Economic importance. **Paleobotany:** Geological time scale and important events, Types of plant fossils.	15

MJ A1/B1P: 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, petrifaction).

MINOR (MI)

MI-1/C1: Same as Minor-1 (BOTMI01) of Botany (Hons) programme — **Credits 04**, **Full Marks: 75**

MI-2/C2: Same as Minor-2 (BOTMI02) of Botany (Hons) programme — **Credits 04**, **Full Marks: 75**

SKILL ENHANCEMENT COURSE (SEC)

TO BE CHOSEN FROM THE BUCKET OF SECs OF SELECTED DISCIPLINE A/B/C
(As per A/B/C Hons. Prog. Syllabus)

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VIDYASAGAR UNIVERSITY
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Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. in Life Sc. with Botany	2nd	III	**SEMESTER-III**							
			Major-A2	BOTPMJ02	**T: Morpho-Anatomy and Taxonomy of Plants; P: Practical** ***(To be studied by students taken Botany as Discipline- A)***	4	3-0-1	15	60	75
			Major-A3	BOTPMJ03	**T: Cell Biology; P: Practical** ***(To be studied by students taken Botany as Discipline- A)***	4	3-0-1	15	60	75
			SEC	SEC03	***To be taken from SEC-03 of Discipline C.***	3	0-0-3	10	40	50
			AEC	AEC03	Communicative English-2 (***common for all programmes***)	2	2-0-0	10	40	50
			MDC	MDC03	Multidisciplinary Course-3 (***to be chosen from the list***)	3	3-0-0	10	40	50
			Minor-3 (Disc.-C3)	BOTMIN03	**T: Plant Science-III; P: Practical** ***(To be studied by students taken Botany as Discipline- C)***	4	3-0-1	15	60	75
					Semester-III Total	20				375
		IV	**SEMESTER-IV**							
			Major-B2		***To be decided*** ***(Same as MajorA2 for Botany taken as Discipline-B)***	4	3-0-1	15	60	75
			Major-B3		***To be decided*** ***(Same as Major–A3 for Botany taken as Discipline-B)***	4	3-0-1	15	60	75
			Major (Elective) -1	BOTMJE-01	**To be chosen from the given options** ***(To be studied by students taken Botany as Discipline- A)***	4	3-0-1	15	60	75
			AEC	AEC04	MIL-2 (***common for all programmes***)	2	2-0-0	10	40	50
			Minor -4 (Disc.-C4)	BOTMIN04	**T: T: Plant Science-III; P: Practical** ***(To be studied by students taken Botany as Discipline- C)***	4	3-0-1	15	60	75
			Summer Intern.	IA	Internship / Apprenticeship- **activities to be decided by the Colleges following the guidelines to be given later**	4	0-0-4	-	-	50
					Semester-IV Total	22				400
					TOTAL of YEAR-2	42	-	-	-	775

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MAJOR (MJ)

MJ A2/B2: Morpho-Anatomy and Taxonomy of Plants **Credits 04 (FM: 75)**

MJ A2/B2T: Morpho-Anatomy and Taxonomy of Plants **Credits 03 [45L]**

Course contents:

Unit	Topic	Lectures/ Hrs
1	**Plant morphology**- A general account of root, stem & leaves of monocot and dicot; phyllotaxy.	4
2	**Flower**- different types of inflorescences, **Aestivation**, Placentation - types; Floral formula, Floral diagram.	5
3	**Fruits & seeds**-types	4
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; periderm and lenticels.	8
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.	6
6	**Taxonomic hierarchy**, Concept of taxa (family, genus, species); Species concept (taxonomic, biological, evolutionary). Botanical nomenclature, Principles and rules (ICN); author citation, valid publication.	6
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).	6
8	**General descriptions of the given families**: Malvaceae, Papilionaceae, Acanthaceae, Verbenaceae, Asteraceae, Poaceae.	6

MJ A2/B2P: Practical **Credits 01**

Course Outline:

1. Study of leaf types (Simple and Compounds).
2. Study of inflorescence types (recemose and cymose)
3. Study of floral diversity with special reference to adhesion and cohesion.
4. Study of fruit types:
   Berry: Cucumber, Capsicum, Brinjal
   Drupe: Mango, Borasus
   Hesperidium: Citrus
   Nut: ground nut
5. 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.

MJ A3/B3: Cell Biology **Credits 04 (FM: 75)**

MJ A3/B3T: Cell Biology **Credits 03 [45L]**

Course contents:

Unit	Topic	lectures /Hours
1	**Cell as a unit of Life-** The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components.	10
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.	20
3	**Cell Cycle-** Overview of Cell cycle, Mitosis and Meiosis.Fundamental differences between mitosis and meiosis. Synaptonemal complex, mitotic spindle, significance of meiosis.	15

MJ A2/B2P: 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).
6. Study the effect of temperature, organic solvent on semi permeable membrane.
7. Demonstration of dialysis of starch and simple sugar.
8. Study of plasmolysis and deplasmolysis on Rhoeo leaf.
9. Measure the cell size (either length or breadth/diameter) by micrometry.

MJ Elective-1: Herbal Technology **Credits 04 (FM: 75)**

MJE-1T: Herbal Technology **Credits 03 [45L]**

Course contents:

Unit	Topic	lectures /Hours
1	**Herbal medicines:** history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants.	10
2	**Pharmacognosy** - systematic position m edicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.	15
3	**Phytochemistry** - active principles and methods of their testing - identification andutilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster).	15
4	**Analytical pharmacognosy:** Drug adulteration - types, methods of drug evaluation -Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds)	20

MJE-1P: Practical **Credits 01**

Course Outline:

Medicinal plant banks micro propagation of important species (Withania somnifera, neem and tulsi-Herbal foods-future of pharmacognosy).

MINOR (MI)

(To be studied by students taken Botany as Discipline- C)

MI-3/C3: Same as Minor-3 (BOTMIN03) of Botany (Hons) programme — **Credits 04**, **Full Marks: 75**

MI-4/C4: Same as Minor-4 (BOTMIN04) of Botany (Hons) programme — **Credits 04**, **Full Marks: 75**

SKILL ENHANCEMENT COURSE (SEC)

(To be studied by students taken Botany as Discipline- C)

SEC-03 P: Same as SEC-03 (BOTSEC03) of Botany (Hons) programme — **Credits 03**, **Full Marks: 50**

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Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. in Life Sc. with Botany	3rd	V	**SEMESTER-V**							
			Major-A4	BOTPMJ04	T: Economic Botany and Pharmacognosy; P: Practical *(To be studied by students taken Botany as Discipline- A)*	4	3-0-1	15	60	75
			Major-A5	BOTPMJ05	T: Biochemistry and Metabolism; P: Practical *(To be studied by students taken Botany as Discipline- A)*	4	3-0-1	15	60	75
			Major-A6	BOTPMJ06	T: Plant Pathology and Plant Health Science; P: Practical *(To be studied by students taken Botany. as Discipline- A)*	4	3-0-1	15	60	75
			Major (Elective) -1	BOTMJE-02	Ecology, Ethology, and Wildlife Biology *(To be studied by students taken Botany as Discipline- A)*	4	3-1-0/ 3-0-1	15	60	75
			Minor-5 (Disc.-C5)	BOTMIN05	T: Plant Science-V; P: Practical *(To be studied by students taken Botany as Discipline- C)*	4	3-0-1	15	60	75
			Semester-V Total			**20**				**375**
		VI	**SEMESTER-VI**							
			Major-B4		*To be decided (Same as MajorA4 fo* Zoology *Botany. taken as Discipline-B)*	4	3-0-1	15	60	75
			Major-B4		*To be decided (Same as Major–A5 for Botany taken as Discipline-B)*	4	3-0-1	15	60	75
			Major-B4		*To be decided (Same as Major–A6 for Botany taken as Discipline-B)*	4	3-0-1	15	60	75
			Major (Elective) -2	BOTMJE-02	T: Nursery and Gardening; P: Practical *(To be studied by students taken Botany as Discipline- A)*	4	3-0-1	15	60	75
			Minor -6 (Disc.-C6)	BOTMIN06	T: Plant Science-VI; P: Practical *(To be studied by students taken Botany as Discipline- C)*	4	3-0-1	15	60	75
			Semester-VI Total			**20**				**375**
			TOTAL of YEAR-3			**40**	**-**	**-**	**-**	**700**
			Eligible to be awarded Bachelor of Science in Multidisciplinary Studies with *Botany on Exit*			**126**	**Marks (Year: I+II+III)**			**2325**

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MAJOR (MJ)

Paper-MJ A4/B4: Economic Botany and Pharmacognosy **Credits 04 (FM: 75)**

MJ-A4T/B4T: Economic Botany and Pharmacognosy (Theory) **Credits 03 (45L)**

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 Phannacological, Drug evaluation. Organoleptic and microscopic studies with reference to nature of active principles and common adulterants of *Alstonia* (bark), *Adhatoda*(leaf), *Strychnos*(seed), *Rauvolfia* (root), and *Zinziber* (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

MJ-A4P/B4P: Economic Botany and Pharmacognosy (Practical) **Credits 01 (30Hr.)**

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*).

Suggested Readings

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

MJ A5/B5: Biochemistry and Metabolism **Credits 04 (FM: 75)**

MJ-A5T/B5T: Biochemistry and Metabolism (Theory) **Credits 03(45L)**

Course Content:

Unit	Topic	No. of Lectures
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.	7
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.	8
3.	**Carbohydrate chemistry:** Classification and properties ofcarbohydrates with emphasis on glycosidic bond,	5
4.	**Protein chemistry:** Classification of proteins, primary, secondary, tertiary and quaternary structure of proteins; Properties of proteins.	6
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.	7
6.	**Nucleic acid chemistry:** Elementary concept of nucleoside, nucleotide, polynucleotide, elementary concept of DNA and RNA.	5
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.	7

MJ-A5P/B5P: Biochemistry and Metabolism (Practical) **Credits 01(30H)**

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 and 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

MJ A6/B6: Plant Pathology and Plant Health Science **Credits 04 (FM: 75)**

MJ A6/B6 T: Plant Pathology and Plant Health Science (Theory) **Credits 03 (45L)**

Course contents:

Unit	Topic	No. of Lectures
1.	**Definitions:** disease, pathogen, inoculum, infection, resistance, incubation period, Disease cycle, Koch's postulates. Symptoms- necrotic, hypoplastic and hyperplastic.	7
2.	**Plant Pathogens and Diseases:** Types of plant pathogens (viruses, bacteria, fungi, nematodes); Life cycle of pathogens; Mode of transmission.	8
3.	**Common plant diseases and their symptoms:** Late blight of potato, Stem rot of jute, Brown spot of rice.	8
4.	**Plant Disease and Health Management:** Principles of integrated pest management; Cultural practices of disease prevention, biological and chemical control methods	7
5.	**Plant Health in Agriculture:** Disease management in the agricultural system; Role of plant health in sustainable agriculture; Food safety.	8
6.	**Plant Health and the Environment:** Impacts of plant health in ecosystems; Plant health and climate change; Plant quarantine.	7

MJ A6/B6 P: Plant Pathology and Plant Health Science (Practical) **Credits 01(30Hr)**

1. Visual diagnosis of common diseased plant symptoms and signs–Fungal leaf spots, Bacterial leaf spots, Mosaic and ring spot, Leaf distortion, Powdery mildew, Cankers, Fruit discoloration, Wilts, Blights.
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.

Major Elective

(To be studied by students taken Botany as Discipline- A)

Major Elective -2: Ecology, Ethology, and Wildlife Biology Credits 04 (Full Marks: 75)

MJE-2T: Ecology, Ethology, and Wildlife Biology (Theory) Credits 03 (45L)

Course Contents	Hours
Unit 1: Introduction to Ecology, Ecosystem, and Biome Definition of ecology and ecosystem: Types, components, and function of ecosystem; Concept of food chain, food web, ecological pyramids & energy flow, concept of Biome; Concept of habitat & Niche.	8hrs
Unit 2: Population Ecology Unique and group attributes of population: Density, natality, mortality, life tables, fecundity schedule, survivorship curves; age distribution, Exponential and logistic growth; biotic potential; dispersal & dispersion. Population regulation: density-dependent and independent factors.	10 hrs
Unit 3: Biotic Community: Community characteristics: stratification; dominance, diversity, species richness, abundance; Ecotone and edge effect; Ecological succession; Gause's Principle with laboratory and field examples.	9 hrs
Unit 4: Animal Behavior Patterns of behavior: Instinct Behavior, Learned Behavior - Habituation, sensitization & imprinting; Sexual behavior: Intra-sexual selection (male rivalry in Red Deer) and inter-sexual selection (female choice in peacock); Social behavior: Eusociality; Altruism; Reciprocal altruism; Types and characteristics of biological rhythms.	10 hrs
Unit 5: Wildlife Biology Definition and categories of wildlife; Values of wildlife; Causes of extinction of wildlife; Fundamental process of wildlife management; The Wildlife Protection Act (1972); Wildlife corridors; Human-wildlife conflict.	8 hrs

MJE-2P: Ecology, Ethology, and Wildlife Biology (Practical) Credits 01 (30Hrs)

1. Estimation of free carbon dioxide, dissolved oxygen & transparency of any water body
2. Estimation of any terrestrial ecosystem/biome through ecological methods like quadrat sampling, determination of the minimum size of the quadrat. Calculation of density, abundance & frequency of any suitable population/community/ecosystem through field work or a hypothetical community.
3. Demonstration of nests and nesting behavior of the bird through photographs (Pigeon, Crow, Tailor bird, Weaver Bird) and social insects through photographs (Termite, Ant, and Honey bee).
4. To study circadian functions in humans (daily eating, sleep, and temperature patterns).
5. Identification and study of selective wild flora and wild fauna from the field.
6. Identification of animals through pug marks, hoof marks, scats, pellet groups, nests, antlers, etc.
7. Submission of a field report after studying any ecosystem/zoological garden/National Park/Sanctuary/Biosphere Reserve.

Recommended Readings

1. Odum, E.P. (1983) Basic Ecology. Saunders College Publishing.
2. Odum, E.P., (2008) Fundamentals of Ecology. Indian Edition. Brooks/Cole.
3. Ricklefs, R.E. (2000) Ecology (5th edition) Chiron Press.
4. Kormondy, E.J. (2000) Concepts of Ecology (4th edition) Prentice Hall of India Pvt. Ltd.
5. Chapman, J.L. and Reiss, M. J. (2002) Ecology Principles & Applications (2nd edition) Cambridge University Press.
6. Sharma, P.D. (2011) Ecology and Environment. Rastogi Publication.
7. Cain M L, Bowman W D and Hacker S D. 2013. Ecology. 3rd ed. Sinauer associates.
8. Smith TM, Smith R L. 2006. Elements of Ecology. 6th Ed. Pearson Education.
9. Odum EP, Barret GW. 2017. Fundamentals of Ecology. 15th Indian reprint. Cengage learning India Pvt. Ltd.
10. Alcock J. 2013. Animal Behavior, Sinauer Associate Inc., USA.
11. Drickamer LC, Vessey SH. 2001. Animal Behavior. McGraw-Hill.
12. Dujatkin LA. 2014. Principles of Animal Behavior. 3rd Edn. W.W.Norton and Co.
13. Macfarland, D. 1999. Animal Behavior (3rd Edition), Addission Wesley Longman Ltd. England.
14. Mandal F. 2010. A Text Book of Animal Behavior. Pentice Hall India.
15. Mathur R. 2005. Animal Behavior. Rastogi Pub.
16. Caughley, G., and Sinclair, A.R.E. (1994) Wildlife Ecology and Management. Blackwell Science.
17. Saha, G. and Mazumar S. (2017). Wildlife Biology: An Indian Perspective. PHI. Learning Pvt. Ltd. Delhi.

Major Elective -3: Nursery and Gardening **Credits 04(Full Marks: 75)**

MJE-3T: Nursery and Gardening (Theory) **Credits 03 (45 L)**

Course contents:

Course Contents	Hours
Unit 1: Nursery: definition, objectives and scope and building up of infrastructure fornursery, planning and seasonal activities - Planting - direct seeding and transplants.	8 hrs
Unit 2: Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion – Seed production technology - seed testing and certification.	10 hrs
Unit 3: Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants – green house - mist chamber, shed root, shade house and glass house.	9 hrs
Unit 4: Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.	10 hrs
Unit 5: Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.	8 hrs.

MJE-3P: Field work (Practical) **Credits 01 (30Hrs)**

4. Methods of preparation of nursery beds and sowing of seeds. Media for propagation of plants in Nursery Beds, Pots and Mist chamber.
5. Study and practice of different propagation methods viz., cutting, layering, division, grafting and budding.
6. Introduction and practicing Bonsai training, pruning and wiring.
7. Demonstration of different types of gardens (indoor and outdoor) and key features of gardens (Paths & Avenues, Hedges & Edges, Lawn, Flowerbeds, Arches & Pergolas, Fencing, Water bodies, Rock garden)- Project / Assignment.

Recommended Readings

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH PublishingCo., New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.

4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co.,New Delhi.
5. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture andCooperation, National _Seed Corporation Ltd., NewDelhi.
6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., SanFrancisco, USA.

MINOR (MI)

(To be studied by students taken Botany as Discipline- C)

MI-5/C5: Same as Minor-5 (BOTMIN05) of Botany (Hons.) programme — **Credits 04**, **Full Marks: 75**

MI-6/C6: Same as Minor-6 (BOTMIN06) of Botany (Hons.) programme — **Credits 04**, **Full Marks: 75**