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.)	1st	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 (***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	ENVS (***common for all programmes***)	4	2-0-2	50	50	100
			Minor (Disc.-I)	BOTMI01	**T: Plant Science-I *(To be taken by students of other Disciplines)*** **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 (***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	Value Added Course-02 (***to be chosen from the list***)	4	4-0-0	10	40	50
			Minor (Disc.-II)	BOTMI02	**T: Plant Science-II *(To be taken by students of other Disciplines)*** **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

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 aboutviroids and prions; detailed structure T4-phage and SARS-COV2, lytic and lysogenic cycle; Economic importance of viruses.	**7**
3	Bacteria: General characteristics; Types-archaebacteria, 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 *Nostoc*, *Oedogonium, Chara*, and *Polysiphonia*.	**8**
5	Fungi: General characteristics; Affinities with plants and animals; Thallus organization; Heterothallism and parasexuality. Classification Ainsworth (up to Order). Life cycles of *Synchitrium, Saccharomyces*, *Ascobolus*, *Agaricus*. 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 *Marchantia, Porella, Anthoceros*, *Notothylas and Funaria*; Economic importance with special reference to *Sphagnum.*	**7**
7	Pteridophytes: General characteristics; Idea about different orders. Classification (Sporne, 1975), Early land plants (*Rhynia* and *Asteroxylon*)Morphology, anatomy and reproduction of *Lycopodium, Selaginella, Equisetum* and *Pteris. E*conomic importance.	**7**
8	Gymnosperms: General characteristics, idea about different orders, Classification (Sporne, 1965), morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum*; Economic importance.	**7**
9	Palaeobotany: Geological time scale and important events, Types of plant fossils - impressions, compressions, petrifaction. 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 ofcurd 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. *Anthocero*s- Morphology of thallus, dissection of sporophyte (to show spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).
11. *Pogonetum*- 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, wholemount 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, Placentaion - 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 *Boerhavia and Dracaena*. 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	**Taximatrics**: 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, Caesalpinioideae, Asteraceae, Euphorbiaceae, Lamiaceae, Poaceae, Orchidaceae.	**8**

MJ-2P: Morphology, Anatomy and Plant Taxonomy (Practical) Credits 01

1. Study of phyllotaxy and stipules.
2. Study of Inflorescence types- Racemose, Cymose, Special types (Capitulum, Verticellaster, 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., *Ecliptas*p./*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 *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

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, petrifaction).

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:

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: *Cucumis sativus*, *Capsicum annuum*, *Solanum melongena*
   Drupe: *Mangifera indica*, *Borasus flaballifer*
   Hesperidium: *Citrus*
   Nut: *Arachis hypogea*
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.

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.

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)

VIDYASAGAR UNIVERSITY

Paschim Midnapore, West Bengal

PROPOSED (DRAFT) SYLLABUS OF

COMMON COURSES UNDER CCFUP, 2023

FOR SEMESTER – I & II

Based on

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

FOR ALL UNDERGRADUATE PROGRAMMES

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

COMMON COURSES FOR UNDERGRADUATE PROGRAMMES (UNDER CCFUP, 2023)

SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
						CA	ESE	TOTAL
1	**SEMESTER-I**							
	AEC	**AEC01**	Communicative English -1	**2**	**2-0-0**	**10**	**40**	**50**
	MDC	**MDC-01** ***(Any one to be chosen)***	Indian Constitution	**3**	**3-0-0**	**10**	**40**	**50**
			Social value and Ethics	**3**	**3-0-0**	**10**	**40**	**50**
			Sports and fitness	**3**	**3-0-0**	**10**	**40**	**50**
			Basics of information technology (IT)	**3**	**3-0-0**	**10**	**40**	**50**
			Basics of Accounting	**3**	**3-0-0**	**10**	**40**	**50**
			NGO & its Operations	**3**	**3-0-0**	**10**	**40**	**50**
			Business Organization	**3**	**3-0-0**	**10**	**40**	**50**
	VAC	**VAC01**	Environment Studies (ENVS)	**4**	**2-0-2**	**50**	**50**	**100**
II	**SEMESTER-II**							
	AEC	**AEC02**	MIL-1 (***Bengali / Hindi***)	**2**	**2-0-0**	**10**	**40**	**50**
	MDC	**MDC02** ***(Any one to be chosen)***	Nation, Culture & India	**3**	**3-0-0**	**10**	**40**	**50**
			Gender Studies	**3**	**3-0-0**	**10**	**40**	**50**
			Community nutrition and Public health	**3**	**3-0-0**	**10**	**40**	**50**
			Physical and Cultural Geography of Bengal	**3**	**3-0-0**	**10**	**40**	**50**
			Natural Resource Management	**3**	**3-0-0**	**10**	**40**	**50**
			Digital Technologies	**3**	**3-0-0**	**10**	**40**	**50**
			Financial Literacy and Household Decision-Making	**3**	**3-0-0**	**10**	**40**	**50**
	VAC	**VAC02** ***(Any one to be chosen)***	Human Rights	**4**	**4-0-0**	**10**	**40**	**50**
			Yoga and Wellness	**4**	**4-0-0**	**10**	**40**	**50**
			Disaster Management	**4**	**4-0-0**	**10**	**40**	**50**
	Summer Intern.	**CS**	Community Service (activities to be decided by the Colleges)	**4**	**0-0-4**	**-**	**-**	**50**

Ability Enhancement Course (AEC)

Ability Enhancement Course (AEC) - 01

AEC-1T: Communicative English-01 **Credits 02 (Full Marks-50)**

Course Contents:

1. **Communication Skills**
   a) Types and Models of Communication
   b) Verbal and Non-verbal Communication
   c) Barriers and Strategies
   d) Inter-personal Communication

2. **Listening Skills:**
   a) Active and Passive Listening

3. **Speaking Skills:**
   a) Different forms of Speaking – Formal/Informal
   b) Group Discussion
   c) English in Situations: Greeting & Leave Taking, Making & Granting/Refusing Requests, Queries & Giving Information/Direction, Describing objects/process, Narrating events &Commentary, Persuasion & Motivation, Complaints &Apologies, Expressing disapproval, Alerting & Warning

4. **Reading Skills:**
   a) Different types of Reading
   b) Comprehension

Suggested Readings:

1. ***A Textbook of English and Communication Skills*.** Richa Mishra and Ratna Rao, New Delhi: Macmillan: 2019
2. ***Many Coloured Glass.*** Board of Editors, Department of English, Vidyasagar University, Delhi: Macmillan, 2013.
3. ***Connect: Course in Communicative English***, Debashis Bandyopadhyay & Malathi Krishnan, Cambridge University Press, New Delhi, 2018.

Ability Enhancement Course (AEC) - 02

AEC-2T: MIL-01 **Credits 02 (Full Marks-50)**

Bengali - 1: বাংলা ভাষা - প্রসঙ্গ ও অনুবাদ

Course Contents:

বিভাগ -ক

বাংলা ভাষা – প্রসঙ্গ

১. ভাষাপরিকল্পনা
২. বাংলা বানানবিধি
৩. ধর্ম, পেশা, লিঙ্গ ভিত্তিক বাংলা সমাজভাষা
৪. বতমান আদর্শ কথ্য-বাংলার প্রকৃতি (ব্যকরণগত বৈশিষ্ট্য, শব্দভাণ্ডার)

বিভাগ -খ

অনুবাদ

১. অনুবাদ (বাংলা থেকে ইংরেজি ও ইংরেজি থেকে বাংলা)

Suggested Readings:

১. Sociolinguistics Pattern –William Lebov
২. Sociolinguistic–R.H. Hudson
৩. ভাষা ও সমাজ–মৃণাল নাথ
৪. সমাজভাষা বিজ্ঞান –রাজীব হুমায়ুন
৫. Theories of translation– J. Williams

OR

AEC-2T: MIL-01 **Credits 02 (Full Marks-50)**

HINDI- 1: हिन्दी व्याकरण और सम्प्रेषण

Course Contents:

इकाई I: हिंदी व्याकरण–संज्ञा, सर्वनाम, विशेषण,वचन ,क्रिया , अव्यय ,उपसर्ग, प्रत्यय, संधि तथा समास। का परिचय।
हिंदी की वर्ण-व्यवस्था : स्वर एवं व्यंजन , प्रकार , उच्चारण स्थान।

इकाई II: हिंदी वाक्य रचना, वाक्य और उपवाक्य। वाक्य भेद। वाक्य का रूपांतर।

इकाई III: संप्रेषण की अवधारणा और महत्व
संप्रेषण के प्रकार , संप्रेषण माध्यम और तकनीक।

इकाई IV: भाषा संप्रेषण के चरण : श्रवण, अभिव्यक्ति, वाचन तथा लेखन।

सहायक ग्रंथ :

1. हिन्दी व्याकरण – कमताप्रसाद गुरु
2. हिन्दी शब्दानुशासन – किशोरीदास वाजपेयी
3. हिन्दी व्याकरण –एन. सी. ई. आर. टी.
4. आधुनिक हिन्दी व्याकरण और रचना – डॉ. वासुदेव नंदन प्रसाद
5. बेसिक हिन्दी – बद्रीनाथ कपूर
6. हिन्दी मुहावरे – श्री ब्रहमस्वरूप दिनकर शर्मा

Multidisciplinary Course (MDC)

Multidisciplinary Course (MDC)- 01

MDC-01T: Indian Constitution **Credits 03 (Full Marks-50)**

Course contents:

Unit-I: Historical Background – Constituent Assembly of India – Philosophical Foundations Of The Indian Constitution – Preamble – Fundamental Rights – Directive Principles Of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies For Citizens.

Unit-II: Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Lok Sabha – Composition and Powers - Rajya Sabha – Composition and Powers - Supreme Court of India – Judicial Review

Unit-III: State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

Suggested Readings:

1. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.
2. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.
3. Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi

OR

MDC-01T: Social Value and Ethics **Credits 03 (Full Marks-50)**

Course contents:

Unit-I: Philosophy of Life and Individual Qualities

Human Life on Earth - Purpose of Life, Meaning and Philosophy of Life. The Law of Nature – Protecting Nature /Universe. Basic Culture - Thought Analysis - Regulating desire - Guarding against anger - To get rid of Anxiety – The Rewards of Blessing - Benevolence of Friendship - Love and Charity - Self – tranquility/Peace.

Unit-II: Social Values (Individual and Social Welfare)

Family - Peace in Family, Society, The Law of Life Brotherhood - The Pride of Womanhood – Five responsibilities/duties of Man : - a) to himself, b) to his family, c) to his environment, d) to his society, e) to the Universe in his lives, Thriftiness (Thrift)/Economics. Health - Education - Governance - People's Responsibility / duties of the community, World peace.

Unit-III: Mind Culture & Tending Personal Health

Mind Culture - Life and Mind - Bio - magnetism, Universal Magnetism (God –Realization and Self Realization) - Genetic Centre – Thought Action – Short term Memory – Expansiveness – Thought – Waves, Channelizing the Mind, Stages - Meditation, Spiritual Value. Structure of the body - the three forces of the body- life body relation, natural causes and unnatural causes for diseases, Methods in Curing diseases.

Suggested Readings:

1. Value Education for Health, Happiness and Harmony, The World Community Service, Centre Vethathiri Publications (Unit 1 – III).
2. Thirukkural with English Translation of Rev. Dr. G.U. Pope, Uma Publication, 156,Serfoji Nagar, Medical College Road,Thanjavur 613 004 (for Units I - III).
3. R S Nagaarazan, Textbook on Professional Ethics And Human Values, New Age International Publishers, 2006 (for Units IV-V).
4. Bharatiya Dharmaneeti Edited by Amita Chatterjee, published by Jadavpur University; Dvitiya samskarana edition (2013)

OR

MDC-01T: Sports and fitness **Credits 03 (Full Marks-50)**

Course contents:

Unit -1: Introduction to Sports

1. Concept of Play, Games and Sports..
1. Objectives and importance of Play, Games and Sports.
2. Fundamental movements of Sports in relation to joints.
3. Warming up and Limbering down
    a) General warm up exercises
    b) Specific warm up exercises

Unit-2: Health and Performance Related Physical Fitness

1. Meaning and Definition of Fitness and Physical Fitness
2. Components of Health and Performance Related Physical Fitness
3. Importance of Physical Fitness in present society
4. Assessment of Health and Performance Related Physical Fitness

Unit-3: Rules & Regulations of the games:

a) Football,
b) Handball,
c) Volleyball,
d) Basketball,
e) Badminton,
f) Table Tennis,

g) Cricket,
h) Kabaddi,
i) Kho-kho.
j) Basic Techniques and Tactics of these games.

Suggested Readings:

1. Saha, A. K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
3. Atkins, J. R. (1872). The Book of Racquets. A Practical Guide to the Game and its History and to the different Courts in which it is played. London: Frederick Warne & Co. Lord Aberdare. The JT Faber Book of Tennis and Rackets. London: Quiller Press, 2001. ISBN 1-899163- 62-X.
4. Shekar, K.C. (3 0 August 2008). "Volleyball: Skills and Techniques" Khel Sahitya Kendra 10: 8175244100.
5. Dearing Joel, (August 24, 2018) Volleyball Fundamentals (Sports Fundamentals), Human Kinetics; 2 edition, ISBN-10: 1492567299.
6. Ray Power. (May 1, 2014), "Making the Ball Roll: A Complete Guide to Youth Football for the Aspiring Soccer Coach", Bennion Kearny Limited, ISBN-10: 1909125520.

OR

MDC-01T: Basics of information technology (IT) **Credits 03 (Full Marks-50)**

Course contents:

Unit-I: Introduction to Computers

Introduction, Definition, Characteristics of computer, Evolution of Computer, Block Diagram Of a computer, Generations of Computer, Classification Of Computers, Applications of Computer, Capabilities and limitations of computer.

Unit-II: Basic Computer Organization:

Role of I/O devices in a computer system. Input Units: Keyboard, Terminals and its types. Pointing Devices, Scanners and its types, Voice Recognition Systems, Vision Input System, Touch Screen, Output Units: Monitors and its types. Printers: Impact Printers and its types. Non Impact Printers and its types, Plotters, types of plotters, Sound cards, Speakers.

Unit-III: Software:

Software and its needs, Types of S/W. System Software: Operating System, Utility Programs Programming Language: Machine Language, Assembly Language, High Level Language their advantages & disadvantages. Application S/W and its types: Word Processing, Spread Sheets Presentation, Graphics, DBMS s/w.

Unit-IV: Operating System:

Functions, Measuring System Performance, Assemblers, Compilers and Interpreters. Batch Processing, Multiprogramming, Multi Tasking, Multiprocessing, Time Sharing, DOS, Windows, Unix/Linux.

Unit-VI: Data Communication:

Communication Process, Data Transmission speed, Communication Types (modes), Data Transmission Medias, Modem and its working, characteristics, Types of Networks, LAN Topologies, Computer Protocols, Concepts relating to networking.

Unit-VII: Business Data Processing:

Introduction, data storage hierarchy, Method of organizing data, File Types, File Organization, File Utilities.

Suggested Readings:

1. A. Goel, Computer Fundamentals, Pearson Education, 2010.
2. P. Aksoy, L. DeNardis, Introduction to Information Technology, Cengage Learning, 2006.
3. P. K.Sinha, P. Sinha, Fundamentals of Computers, BPB Publishers, 2007.

OR

MDC-01T: Basics of Accounting **Credits 03 (Full Marks-50)**

Course Contents: **(Total lecture hours: 45)**

Unit–I: Introduction to Financial Accounting: **(Lecture hours: 9)**

Meaning, Importance and objectives of Accounting; Concepts and Convention of Accounting. Meaning, Users, Sources of accounting information; Some Basic Terms –Transaction, Account, Asset, Liability, Capital, Expenditure, Income, Revenue, Profit, Loss, Concept of revenue and capital transactions, Accounting Year, Financial Year; Features of recordable transactions and events; Recording of Transactions; Types of Accounts - Personal account, Real Account and Nominal Account; Golden Rules and American Approach of Accounting-Rules for Debit and Credit; Double Entry System, Accounting Equation, Process of accounting – Business transactions – Journal entries – Ledger posting, Trial Balance

Unit-II: Accounting for Depreciation: **（Lecture hours: 6)**

Concept; Causes of Depreciation; Objectives of Providing Depreciation; Methods of providing depreciation: Fixed Instalment Method and Reducing Balance Method.

Unit-III: Accounting for Joint Venture: **(Lecture hours: 8)**

Meaning and features; Distinction between Partnership and Joint Venture; Accounting Treatment of Joint venture

Unit-IV: Single entry System of Book keeping and Conversion of Single Entry to Double Entry system of Book Keeping (Lecture hours: 5)

Unit-V: Final accounts of Non-Profit Organizations: (Lecture hours: 9)
Meaning and Features of Non-Profit Organization; Preparation of Receipt and Payment Account; Income & Expenditure Account and Balance Sheet.

Unit-VI: Final Accounts of Sole Trading Concern: (Lecture hours: 8)
Preparation of Trading and Profit and Loss account and Balance sheet.

Suggested Readings::

1. Mukherjee and Mukherjee, Financial Accounting, Vol. I, Oxford University Press
2. Hanif & Mukherjee, Financial Accounting Vol. I, McGraw Hill
3. Sukla, Grewal, Gupta: Advanced Accountancy Vol. I, S Chand
4. R. L.Gupta & Radheswamy, Advanced Accountancy, Vol. I, S. Chand
5. Basu and Das, Principles and Practices of Accounting, Rabindra library, Kolkata.
6. S.Kr. Paul & Chandrani Paul, Financial Accounting, Vol-I, New Central Book Agency (P) Ltd., Kolkata

OR

MDC-01T: NGO & its Operations Credits 03 (Full Marks-50)

Course contents:

Unit 1: Introduction: Concept and Functions of NGOs

1.1 Concept of NGOs:
Definition and meaning of NGOs, Historical evolution of NGOs, Role and significance of NGOs in society
1.2 Functions of NGOs:
Social welfare and development activities, Advocacy and awareness campaigns, Empowerment and capacity-building initiatives

Unit 2: Types and Characteristics of NGOs

2.1 Types of NGOs:
Charitable NGOs, Service NGOs, Advocacy NGOs, Operational NGOs, Networking NGOs International NGOs (INGOs), Community-Based Organizations (CBOs)
2.2 NGO Characteristics:
Non-profit nature, Voluntary participation, Private initiative, Independence and autonomy, Social objectives
2.3 Strengths and Weaknesses of NGOs
Advantages of NGOs in development work, Challenges and limitations faced by NGOs

Unit 3: Strategic Planning and Leadership in NGOs

3.1 Planning and Leading a Team:

Importance of strategic planning in NGOs, Setting goals and objectives, Formulating action plans, Effective team leadership and management

3.2 Conflict Resolution:

Understanding conflicts in NGO settings, Conflict resolution techniques, Promoting harmonious work environments

Unit 4: Issues Related to NGO Operations

4.1 Concentration of Power, Staff, and Accountability:

Power dynamics within NGOs, Ensuring transparency and accountability, Staff management and motivation

4.2 Fundraising:

Importance of fundraising for NGO sustainability, Fundraising strategies and techniques, Ethical considerations in fundraising activities

Unit 5: Funding Agencies and Schemes

5.1 National Bank for Agriculture and Rural Development (NABARD):

Overview of NABARD and its role, funding opportunities for rural development projects

5.2 National Human Rights Commission (NHRC)

Understanding the role of NHRC in protecting human rights, Collaboration opportunities for NGOs

5.3 Schemes for NGOs under the Government of India:

Introduction to various government schemes and programs, Eligibility criteria and application procedures for NGO participation

Suggested Readings:

1. Abebe, Desset., 2011, *Effects Of Regulatory Mechanisms On The Function Of Human Rights NGOs: Regulating The 'Right To Association'...To Foster Or To Tamper?* London: Lap Lambert Academic Publishing.
2. Alsop, Ruth., & Kurey, Bryan., 2005. *Local Organizations in Decentralized Development: Their Functions and Performance in India (Directions in Development)*, World Bank Publications.
3. Anita, Abraham. 2015. *Formation and Management of NGOs (Non-Governmental Organizations)*, 4th ed, Universal LexisNexis.
4. Baur, Dorothea., 2011. *NGOs as Legitimate Partners of Corporations: A Political Conceptualization: 36 (Issues in Business Ethics).* India: Springer.
5. Baviskar, B.S., 2001, "NGOs and Civil Society in India" in *Sociological Bulletin*, Vol 50, No 1.
6. Chandra, Snehlata., 2003. *Guidelines for NGOs Management in India*, Kanishka Publishers Distributers.
7. Chandra, Snehlata., 2007, *Non-Governmental Organisations: Structure, Relevance and Function*, Kanishka Publishers.
8. Dobriyal, N.C., 2009. *NGOs and Government Organisation: Role, Duties and Function*. Sumit Enterprises.

9. Elliot, C., 1987, "Some Aspect of Relations between the North and South in the NGO Practices", *Annual Review of Anthropology* 26:439-64.
10. Gangrade, K.D., & Sooryamoorthy, R., 2001, *NGOs in India: A Cross- Sectional Study: 136 (Contributions in Sociology)*, Jaipur-New Delhi: Rawat Publication.
11. Goel, O.P., 2004. *Strategic Management and Policy Issues of NGOs. India*: Isha Books.
12. Kohli, A., & Sharma, S.R, 1997, Organisation of Social Welfare, New Delhi: Anmol Publication.
13. Kumar, R., & Goel, S.L., 2005. *Administration and Management of NGOs: Text and Case Studies*, Deep & Deep Publications.
14. Latha, Kakumani Lavanya., & Prabhakar, Kotte., 2011, " Non-Government Organizations: Problems & Remedies in India", in Serbia Journal of Management, Vol 6, Issue 1.
15. Lawani, B.T., 1999. *Non-Government Organizations in Development*, Jaipur: Rawat Publications.
16. Lewis, David. 2014. *Non Governmental Organizations: Management and Development*, London: Routledge.
17. Mohanty, Ranjita. 2002, "Civil Society and NGOs", in *The Indian Journal of Political Science*, Vol 63, No 2/3.
18. Palekar, S.A., 2012, "Role of NGOs in Policy- Making in India", in *The Indian Journal of Political Science*, Vol 73, No 1.

OR

MDC-01T: Business Organisation **Credits 03 (Full Marks-50)**

Course contents: **(Total lecture hours: 45)**

Unit–I: Introduction: Business: Definition- Nature and Scope- Objectives of Business; Social responsibility of Business; Classification of Business: Industry, Trade & Commerce and their functions; Different economic systems: Socialistic economy, Capitalistic Economy and Mixed Economy

Lecture hours: 9

Unit –II: Forms of Business Organization: Sole Proprietorship, Partnership, Limited liability partnership, Joint Stock Company, One Person Company, Private limited Company: Features and economic significance. **Lecture hours: 8**

Unit–III: Business Combination and Concentration: Concept of Business Combination; Causes of combination; Types, advantages and disadvantages; Vertical and Horizontal Combination; Pool and Cartel. **Lecture hours: 10**

Unit-IV: Business intermediaries: Meaning; Concept of wholesalers, retailers and distributors; Role and significance **Lecture hours: 9**

Unit –V: Administrative Organization in Business: Concept; Different types of Organisation Structure: Formal and Informal Organisation, Line and Staff organization; Centralisation and Decentralisation: Advantages and disadvantages. **Lecture hours: 9**

Suggested readings

1. Bose, C.P., Business Organisation and Management.
2. Companies Act, 2013.
3. Maheshwari, K.L., Maheshwari, R.K. & Madhu Bhatia – Vyavsayik Sanghtan.
4. Maheshwari, K.L., Maheshwari, R.K. & Ram Milan - Business Organisation.
5. Padmakar Asthana – Business Organisation.
6. Sekhri, Arun, Organisation, MUMBAI, Himalaya Publishing House, 2014.
7. Talloo, Thelman J., Business Organisational and Management, TMH, New Delhi.
8. Tulsian, P.C., Business Organisation, Pearson Education, New Delhi.
9. Vasishth, Neeru, Business Organisation, Taxmann, New Delhi.
10. Y.K. Bhushan - Business Organisation.

Multidisciplinary Course (MDC)- 02

MDC-02T: Nation, Culture and India **Credits 03 (Full Marks-50)**

Course contents:

Unit-I: Introducing India

1. The Land of India: Geographical Setting; Physical and Natural Environment. The Names of our Country – Past and present: Jambudvipa, Sindhu (Indus), Inde, Hind, Hindustan, India, Bharat.
2. The Peopling of India from Pre-historic time with special reference to Indo-Aryans speaking people, the Persians, the Arabsetc., and their contribution to the making of Indian History and Culture. Nation and Nation-building in India.
3. Historical Background of India: Historical Background of India through the ages – Brief outline of Prehistoric, Protohistory, Iron Age and Mahajanapada. Brief history India'sFreedom Struggle with special reference to growth of Nationalism, Moderate and Extremist movements, Gandhian Movements.

Unit-II: Indian Literature, Culture, Tradition, and Practices:

1.Evolution of script and languages in India: Harappan Script, Brahmi Script and Devanagari Script. Sanskrit. Pali and Prakrit languages.
2. The Vedas – Vedic Culture and Society. Epics - the Ramayana and the Mahabharata, Puranas, Buddhist and Jain Literature. Outline of Sanskrit Literature, Telugu Literature,Kannada Literature, Malayalam Literature,Sangama Literature, Literature, Persian and Urdu,Hindi Literature.
3. Plural cultural traditions of India. Outline of religions in India – Hinduism, Buddhism, Jainism, Islam, Christian, Persian, Tribal.

Unit-III: Cultural Heritage and Performing Arts:

1.Indian Art and Architecture in Ancient time, Dance, Music, Theatre, Drama, Painting, Martial Arts Traditions, Fairs and Festivals,Indian Cinema, Folk and Tribal arts.
2. Indian Women in art, literature, freedom struggle.
3. Indian's Cultural Contribution to the World. Indian Medical Systems. History of Railways, Postal system, Currency and Banking System.

Suggested Readings:

1. L. Basham, ACultural History of India, Oxford UniversityPress,1997
2. L. Basham, A Wonder that was India, Rupa, NewDelhi, 1994
3. N. R. Ray, AnApproachtoIndianArt,Publication Bureau, Chandigarh,1974
4. Kanjiv Lochan: Medicines of Early India, Delhi
5. Hitendra Patel: Adhunik Bharat ka Aitihasik Yatharth
6. Nayanjot Lahiri, Marshalingthe Past:Ancient India and its Modern Histories, Permanent Black,2012
7. R.C. Majumdar (ed.), History and Culture of Indian People (Relevant Volumes and Chapters),
8. Bhartiya Vidya Bhawan, Bombay.
9. S. C. Ghosh, HistoryofEducationinModernIndia, 1758-1986, OrientLongman, Hyderabad, 1995
10. Tirthankar Ray, TheEconomicHistoryofIndia1857-1947, OUP, 2006
11. VijayJoshiand I.M.D. Little, India'sEconomicReforms, 1991-2001, OUP, 1996

OR

MDC-02T: Gender Studies **Credits 03 (Full Marks-50)**

Course contents:

1. **Gender as a Social Construct**
   1.1 Gender, Sex, and Sexuality
   1.2 Masculinity and Femininity
2. **Gender Discrimination and Stereotype:**
   2.1 Family
   2.2 Workspace
3. **Power and Resistance:**
   3.1 Women's Movement in India
4. **Gender and Intersectionality:**
   4.1 Caste, Class, Race, Sexuality
   4.2 Religion
   4.3 Ability and Disability
5. **Gender-Based Violence**
   5.1 Sexual Harassments
   5.2 Domestic Violence
   5.3 Rape
   5.4 Cyber Crime

Suggested Readings:

1. Ahuja, Ram., 1989. "Crime Against Women", in Lalita Parihar (ed.) *Journal of the Indian Law Institute*, Vol 31, No 1.
2. Ahuja, Ram., 2003. *Violence Against Women*. Delhi: Rawat Publications.
3. Banerjee, Supurna., & Ghosh, Nandini., 2018. *Caste and Gender in Contemporary India*, Taylor & Francis
4. Bhasin, Kamla., 1993. *What is Patriarchy?*,Kali for Women.
5. Geetha, V., 2006. *Gender*, Bhatkal & Sen.
6. Jackson, Stevi., & Scott, Sue., 2001, *Gender: A Sociological Reader*, London: Routledge.
7. Kandiyoti, Deniz., 1988, "Bargaining with Patriarchy." *Gender and Society*, vol. 2, no. 3.
8. Kumar, Radha., 1999, "From Chipko to sati: The Contemporary Indian Women's Movement", in Nivedita Menon (ed.) *Gender and Politics in India*, New Delhi: Oxford University Press.
9. Menon, Nivedita., 2012. *Seeing like a Feminist*, India: Penguin Zubaan.
10. Murthy, Laxmi., & Dasgupta, Rajashri., 2013. *Our Pictures, Our Words – A Visual Journey Through the Women's Movement*, New Delhi: Zubaan Books.
11. Ortner, Sherry. 1974, "Is Female To Male As Nature Is To Culture?," in Michelle Zimbalist Rosaldo and Louise Lamphere (ed.) *Women, Culture and Society*. Stanford: Stanford University Press.
12. Rubin, Gayle. 2006. "Thinking Sex: Notes for a Radical Theory of Politics of Sexuality", in Peter Aggleton and Richard Parker (ed.) *Culture, Society and Sexuality. London:* Routledge.

13. Ryle, Robyn. 2011. *Questioning Gender: A Sociological Exploration*. Thousand Oaks, CA: Pine Forge Press.
14. Tharu, Susie. & Niranjana, Tejaswini., 1994, "Problems for a Contemporary Theory of Gender." *Social Scientist*, vol. 22, no. 3/4.
15. West, Candace., & Fenstermaker, Sarah., (ed.), 2002. *Doing Gender, Doing Difference: Inequality, Power and Institutional Change*, London: Routledge.
16. Wies, Jennifer R., & Haldane, Hillary J., (ed.), 2011, *Anthropology at the Front Lines of Gender-Based Violence*. Vanderbilt University Press.

OR

MDC-02T: Community nutrition and Public health **Credits 03 (Full Marks-50)**

Course contents:

Unit-I: Population, society, community and community health:
Definition and brief study of community, family, village and block. Definition, dimension and determinant of health, positive health, health situation in India. Population, society, community and community health concepts. Nutrition - Introduction. Relationship between health and nutrition. Food as source of nutrients, functions of food, definition of nutrition, nutrients & energy. Adequate, optimum & good nutrition. Malnutrition and under nutrition, over nutrition. Human nutrition- principle, interrelationship between nutrition, health & diseases. Visible symptoms of good health. Nutrition - fitness, athletics & sports.National nutritional policy - Aim, objectives, guidelines and thrust areas. PDS - Public distribution system.Meaning, nature and importance of nutrition education to the community, Training of workers in nutrition education programme.

Unit-II: Food and Diet:
Balanced diet. Diet Survey – Principles. Composition and nutritional value of common Indian food stuff - rice, wheat, pulses, egg, meat, fish and milk. Dietary fibres - role of fibers in human nutrition. Calorie requirement. Vitamins and minerals. Malnutrition and under nutrition.

Principles of formulation of balanced diets for growing child, adult man and woman, pregnant and lactating woman. Diet management of obese, diabetic, hypertensive person and athlete. Basic idea on PCM, marasmus, kwashiorkor and their prevention. Iron and iodine deficiency. Recommended dietary allowances, malnutrition and chronic energy, LBW, PEM, xerophthalmia, micronutrient disorders. Physiology of starvation and obesity. Food toxicity. Effect of processing on nutritive values of foods.

Unit-III: Epidemiology:
Epidemiology: Principle of Epidemiology and Epidemiological methods: Terms used in describing disease transmission and control. Morbidity and mortality indicators. Measurements of epidemiological indicators, Epidemiology study designs. Concepts. Public health and public health issues: Basic ideas. Etiology, epidemiology and prevention of malaria, dengue, filaria, hepatitis, AIDS, nutritional anemia, atherosclerotic disorders. Causes and management of thalassemia, gout, obesity, endemic goiter, dental carries.

Unit-IV: Nutrition intervention Programmes:

Objectives, operation of feeding programmes. ICDS, MDM, TINP, NNMS, IRDP, DWACRA. National organizations and their role in nutrition programmes - ICMR, NIN, NNMB, ICAR, CFTRI, NIPCCD. International organizations - FAO, WHO, UNICEF, UNESCO, World Bank.

Unit-IV: Experiments approach:

1. Survey on the status of dietary intake in the surrounding area through visits, etc.
2. Diet survey report of a family (as per ICMR specification). Each student has to submit a report on his/her own family. [Report should be as per ICMR specification. Report should be hand written].
3. A report (hand-written) on the basis of field survey from one of the followings:
   (a) Physiological parameters of human (at least three parameters).
   (b) Anthropometric measurements on human (at least three parameters).
4. Epidemiological data collection, epidemiologic methods and field survey for any outbreak or incidence of diseases. Observational (descriptive and analytical) and experimental studies.
5. Epidemiological approach and measurements - vital statistics (rates, ratios and proportions), measurements of health indicators.

Suggested Readings:

1. Essential Food and Nutrition. by M. Swaminathan.The Bangalore Printing &Publishing Co. Ltd.
2. Text Book of Preventive and Social Medicine, M.C. Gupta and B. K. Mahajan, Jaypee Brothers
3. Fundamentals of Biostatistics by V. B. Rastogi, Ane Books
4. Park's Text Book of Preventive and Social Medicine by K. Park, Banarsidas Bhanot Publishers.
5. Introduction to Clinical Nutrition by V. Sardesai, CRCPress.
6. Food Microbiology by W.C Frazierand D.C. Westhoff. Tata McGraw Hill Publisher.
7. Basics of Epidemiology - Concepts made simple by Dr. Anil Mishra, Notion Press; 1st edition
8. Epidemiological Studies: A Practical Guide: Alan J. Silman, Gary J. Macfarlane, Tatiana Macfarlane. 3rd Edition. Oxford Academic Publication, Oxford University Press.
9. Modern Epidemiology by Timothy L. Lash, Wolters India Pvt ltd.
10. Epidemiology Concepts and Methods, by Oleckno W. A.CBS Publishers & Distributors
11. Basic Epidemiology by R Beaglehole, Aitbs Publishers

OR

MDC-02T: Physical and Cultural Geography of Bengal **Credits 03 (Full Marks-50)**

Course contents:

1. Geographic location, Physiographic Divisions, Rivers, soils, climate and Natural hazards
2. Natural vegetation, wildlife, and Ecotourism
3. Demography, migration, Scheduled tribes.
4. Agriculture and fishing, Mining, Industrial development, Major cities,
5. Heritage and cultural diversity, and tourist places

Suggested Readings:

1. Dhara, M.K., Basu, S.K., Bandyopadhyay, R.K., Roy, B., Pal, A.K. (Eds.) 1999. Geology and Mineral Resources ofthe States of India, Part-1: West Bengal. Geological Survey of India Miscellaneous Publication.
2. Ghurey, G.S. 1963. The Scheduled Tribes of India, 1980 reprint, Transaction Books.
3. Johnson, B.L.C. (Ed) 2001. Geographical Dictionary of India, Vision Books.
4. Khullar, D.R. 2011. India: A Comprehensive Geography, Kalyani Publishers
5. Mandal, H., Mukherjee, S., Datta, A. 2002. India: An Illustrated Atlas of Tribal World, Anthropological Survey ofIndia.
6. Pathak, C.R. 2003. Spatial Structure and Processes of Development in India, Regional Science Association Kolkata.
7. Rudra, K 2018.Rivers of the Ganga-Brahmaputra-Meghna Delta: A Fluvial Account of Bengal, Springer Nature
8. Bose S.C 1968. Geography of West Bengal, National Book Trust, India, New Delhi,
9. Sharma, T.C. 2012.Economic Geography of India, Rawat Publications.
10. Singh, R.L. 1971. India: A Regional Geography, National Geographical Society of India.
11. Spate, O.H.K., Learmonth, A.T.A. 1967. India and Pakistan: A General and Regional Geography, Methuen.

OR

MDC-02T: Natural Resource Management **Credits 03 (Full Marks-50)**

Course contents:

Unit-I: Natural resources: Definition and types. Sustainable utilization approach of Natural Resources (economic, ecological and socio- cultural)

Unit-II: Land: Utilization (agricultural, pastoral, horticultural, silvicultural); Soil degradation and management.

Unit-III: Water: Fresh water (rivers, lakes, groundwater, aquifers, watershed); Marine; Estuarine; Wetlands; Threats and management strategies.

Unit -IV: Forests: Definition, Cover and its significance (with special reference to India); Major and minor Forest products; Depletion; Management.

Unit- V: Energy: Renewable and non-renewable sources of energy

Unit- VI: Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management.

Unit- VII: National and international efforts in resource management and conservation

Suggested Readings:

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

OR

MDC-02T: Digital Technologies **Credits 03 (Full Marks-50)**

Course contents:

Unit-I: Introduction and Evolution of Digital systems, Role and significance of Digital Technology, Information & communication technology & tools, Computer system & it's working, Software and its types, Operating Systems: types and functions.
Communication systems: Principles, model & transmission media, Computer networks, Internet: concept and applications, WWW, Web Browsers, search engines, Messaging, e-mail, social networking.

Unit- II: Computer Based Information system: significance and types, e-Commerce & digital marketing: basic concepts, benefits & challenges.
Digital India & e-Governance: Initiatives, Infrastructure, Services and Empowerment.
Digital financial tools: Unified Payment Interface, Aadhaar enabled payment System, USSD, Credit/Debit Cards, e-Wallets, Internet banking, NEFT/RTGS and IMPS, Online Bill Payments and PoS, Cyber Security: Threats, Significance, Challenges, Precautions, safety Measures & Tools,

Unit- III: Emerging Technologies & their applications: Overview of Cloud Computing, Big Data, Internet of things, Virtual reality, Block chain, robotics, Artificial intelligence, 3D Printing, Future of digital technologies.

Suggested Readings:

1. Fundamentals of Computers by E Nalagurusamy, ata mcgraw Hill.
2. Data Commination and Networking by Behrouz A. Forouzan, Mcgraw Hill Educaition.
3. Emerging Technologies in Computing: Theory, Practice, and Advances, by P.Kumar, A omar, and R.Sharmila, 1st Edition, 2021.
4. Essentials of cloud computingby K. Chandrasekharan, CrC press, 2014.
5. Blockchanin: Blueprint for a new economy by M. Swan, O'Reilly Media, 2015
6. Introduction to Computers by Peter Norton, Tata McGraw Hill.

OR

MDC-02T: Financial Literacy and Household Decision-Making Credits 03 (Full Marks-50)

Course Contents:

Unit I: Introductory concepts: Concept of Income, Expenditure, Saving and Investment; Concept of financial planning and use of a financial diary; Household budgets; Household decision making: Purchase decisions – small and large, Investing, Retirement planning and Borrowing; Simple and compound interest; Interest and inflation; Consumer credit – The fallacy of 'zero interest loan'. **(7 lectures)**

Unit II: Financial knowledge and awareness: Bank deposits: savings account, current account, recurring deposits and fixed deposit; Small saving investment schemes; Corporate Fixed deposits; PF and PPF; NPS and other Pension products, Corporate financial instruments like equity share, debentures, etc.; Bond; Mutual fund; Tax-free bonds; RBI Floating rate bond; Gold bond; Digital wallets: benefits, types, features and uses; QR code. **(9 lectures)**

Unit III: Bank and financial inclusion: Concept of KYC; BSBDA and Jan Dhan account; Pradhan Mantri Jeevan Jyoti Bima Yojana and Pradhan Mantri Suraksha Bima Yojana; Financial inclusion and financial inclusion index; Mudra scheme; E-banking: NEFT and RTGS; Precautions in e-payments; Risks associated with digital payments; Role of RBI as the regulator. (**8 lectures)**

Unit IV: Insurance: Concept of insurance and risk avoidance; Basic terms in insurance – premium, sum assured, agent, commission, claim; Types of insurance: Life insurance, Accidental insurance, Fire insurance, Health insurance, Crop insurance, etc.: Personal health policies and Public health policies; Role of TPA; Insurance companies in India; IRDA. **(8 lectures)**

Unit V: Investment in stock market: Investment and Speculation; A brief discussion on return and risk; Trading in shares; Dematerialization and Demat account; SEBI- Role and functions. **(6 lectures)**

Unit VI: Rights and awareness of Consumers and Investors: The principle of "Buyer be aware" – its exceptions; Consumer disputes: Role of Consumer Affairs Department; Consumer Protection Act and Consumer Courts; Investor right; Investor awareness and activism; Investor association; Investor grievances and redressal mechanism; Ombudsman. **(7 lectures)**

Suggested readings

1. The Basics of Finance: Financial Tools for Non-Financial Managers: Bryan E Milling, iUniverse
2. Smart Guide to Managing Personal Finance: Alfred Glossbrenner and Emily Glossbrenner, John Wiley
3. Total Money Makeover: Dave Ramsey, Thomas Nelson
4. Stock exchanges, Investments and Derivatives: P. Rajib and V. Raghunathan, TMH
5. Investing in India - A Value Investor's Guide: Rahul Saraogi, Wiley

6. Financial Inclusion in India: Policies & Programmes: N. Mani, New Century
7. Financial Education Series: Reserve Bank of India
8. Introduction to Financial Planning: Indian Institute of Banking & Finance, Taxmann
9. Risk Analysis, Insurance and Retirement Planning: Indian Institute of Banking & Finance, Taxmann
10. Financial Planning & Wealth Management: Concepts and Practice: Joydeep Sen, Shroff Publishers
11. Consumer Protection Act: R.K. Bangia, Allahabad Law Agency
12. Consumer Rights and Awareness: M. Nazer, Discovery Publishing
13. Financial Education Material: SEBI (e-content)
14. OECD/INFE Toolkit For Measuring Financial Literacy and Financial Inclusion: OECD (e-content)

Value Added Course (VAC)

Value Added Course (VAC)- 01

VAC-01: ENVS- Environmental Studies **Credits 04 (Full Marks-100)**

Course contents:

Unit-I: Introduction to environmental studies (2 lectures)

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

Unit-II: Ecosystems (6 lectures)

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem; b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit-III: Natural Resources: Renewable and Non-renewable Resources (8 lectures)

- Land resources and land use change; Land degradation, soil erosion and desertification;
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Joint forest management.
- Water: Use and over--exploitation of surface and ground water, floods, droughts, conflicts over water (international & interstate).
- Energy resources: Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit-IV: Biodiversity and Conservation (8 lectures)

- Levels of biological diversity: genetic, species and ecosystem diversity; Bio-geographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega---biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity: Habitat loss, poaching of wildlife, man--wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit-V: Environmental Pollution (8 lectures)

- Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies.
- Noise pollution.

Unit-VI: Environmental Policies & Practices **(7 lectures)**

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.
- Environmental policy and gender issues

Unit-VII: Human Communities and the Environment **(6 lectures)**

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.
- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g. CNG vehicles in Delhi)

Unit-VIII: Field work **(Equal to 5 lectures)**

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site--Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems--pond, river, Delhi Ridge, etc.
- Disaster management.
- Coastal ecosystem

Suggested Readings:

i. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
ii. Gadgil, M., & Guha, R. 1993. *This Fissured Land:An Ecological History of India*. Univ. of California Press.
iii. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
iv. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
v. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
vi. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36--37.
vii. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp. 29---64). Zed Books.
viii. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
ix. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
x. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
xi. Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co.Pvt. Ltd.
xii. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley& Sons.

xiii. Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
xiv. Sengupta, R. 2003. Ecology and economics: An approach to sustainable development.OUP.
xv. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and
xvi. Conservation. S. Chand Publishing, New Delhi.
xvii. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
xviii. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent. Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.
xix. Wilson, E. O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
xx. World Commission on Environment and Development. 1987. Our Common Future. Oxford University Press.

Value Added Course (VAC) - 02

VAC-02: Human Rights **Credits 04 (Full Marks-50)**

Course contents:

Unit -1: Human Rights: Society and Development-Human Rights in the World

Unit- 2: Human Rights in India: Civil and Political Rights - Human Rights Commissions

Unit -3: Violation of Rights: Violation of Human Rights and Remedies -Violation of Economic, Social and Cultural Rights

Unit - 4: Rights of the Juveniles& Elderly People

a) Rights of the Juveniles and Child Labour and Old People,
b) Protection of Rights to Health,
c) Human Rights and the Civil Society

Suggested Readings

1. Agarwal, H.O., Implementation of Human Rights Covenants with Special Reference to India (Allahabad: Kitab Mahal, 1983).
2. Alam, Aftab, ed., Human Rights in India: Issues and Challenges (New Delhi: Raj Publications, 1999).
3. Amnesty International, Human Rights in India (New Delhi: Sage Publications, 1994).
4. Bajwa, G.S. and D.K. Bajwa, Human Rights in India: Implementation and Violations (New Delhi: D.K. Publishers, 1996).
5. Basu, D.D., Human Rights in Constitutional Law (New Delhi: Prentice Hall, 1994).
6. Baxi, Upendra, Inhuman Wrongs and Human Rights (Delhi: HarAnand Publications, 1994).
7. Begum, S.M., ed., Human Rights in India: Issues and Perspectives (New Delhi: APH Publishing Co., 2000).
8. Bhagwati, P.N., Legal Aid as Human Rights (Dharwad: JagrutBharut, 1985).
9. Bhargava, G.S. and R.M.Pal, ed., Human Rights of Dalits: Societal Violation (New Delhi: Gyan Publishing House, 2000).

OR

VAC-02: Yoga and Wellness **Credits 04 (Full Marks-50)**

Course contents:

Unit -I: Introduction of Yoga

1.1 Meaning, Definition, Aim, Objectives and Importance of Yoga
1.2 History and Development of Yoga
1.3 Astanga Yoga, Hatha Yoga, Observation of International Yoga Day
1.4 Suryanamaskar, Pranayamas and Meditations.

Unit -II: Health and Health Problems in India

2.1 Health: Meaning, Definition, Dimensions and Factors.
2.2 Health Education: Meaning, Definition, Aim, Objectives and Principles. Personal Hygiene: Care of Eyes, Ear, Nose, Skin, Mouth, Teeth and Feet.
2.3 Aim, Objectives and Functions of Health Agencies: World Health Organization (WHO), United Nations Educational Scientific & Cultural Organization (UNESCO), United Nations International Children's Emergency Fund (UNICEF). Integrated Child Development Services (ICDS), Ministry of Health and Family Welfare (MHFW).
2.4 Life Style Diseases (Hypokinetic): obesity and Diabetes. Life Style Diseases (Hyperkinetic): Hypertension and Psychological Disorder-Stress.

Unit -III: Wellness and Wellness Programme

3.1 Wellness - Concept, Definition, Components, Significance with reference to Positive Lifestyle.
3.2 Concepts of Quality of Life and Body Image.
3.3 Factors affecting Wellness.
3.4 Wellness Programme in Reference to Physical Activities & Yoga

Suggested Readings

1. Corbin, C. B. G. J. Welk. W. R Corbin, K. A. Welk (2006) Concepts of Physical Fitness: for Wellness. McGraw Hill, New York, USA.
2. Kamlesh, M. L. & Singh, M. K. (2006) Physical Education (Naveen Publications).
3. Kansal, D.K. (2008) Textbook of Applied Measurement, Evaluation & Sports Selection. Sports & Spiritual Science Publications, New Delhi.
4. Uppal, A.K. (2004), Fitness and Health 5th ed. (U.K., Human Kinetics).
5. Sharma Jai Prakash And Sehgal Madhu(2006). Yog-Shiksha. Friends Publication. Delhi.
6. Mukerji, A.P. (2010). The Doctorine and Practice of Yoga, General Books, LLC, New Delhi.
7. Sarin N (2003). Yoga Dawara Rogoon Ka Upchhar. Khel Sahitya Kendra.
8. Text Book Hath Yoga Pradipika.
9. Text Book Patanjali Yoga Sutra.
10. Kayal, R. Yoga Sikha. Clasique Books. Kolkata.
11. Sahu, D. A Critical review on Modern Trend of Yogic Asana. Clasique Books. Kolkata.

OR

VAC-02: Disaster Management **Credits 04 (Full Marks-50)**

Course contents:

Unit -1: Introduction to Disaster: Disaster:

- Concepts and definitions (Disaster, Hazards, Vulnerability, Resilience, Risks).
- Factors & significance, causes, nature, types and magnitude of disasters.
- Parameters of Disaster Risks. Levels of disasters as per national guideline.
- Difference between accidents and Disasters.
- Simple and Complex disasters,
- Brief explanation of some frequently occurring natural disasters in India.

Unit -2: Impacts of disasters:

Impacts of disasters (including social, economic, political, environmental, health, psychosocial, etc.).
Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change.
Hazards, Response time, frequencies, forewarning, exposure time of different hazards.
Common approaches to study natural and manmade hazards; vulnerability and disasters.

Unit -3: Disaster Management:

Aims of disaster management. Principles and component of disaster management. Dimension of natural and anthropogenic disaster.

Unit- 4: Consequences of disaster:

Causes and consequences of hazards-physical, economic, cultural. Repercussion of disasters and hazards, Economic damage. Loss of human and animal life. Destruction of Ecosystem.

Unit -5: Global perspectives:

• Natural disaster - Study of environmental impacts induced by human activity. Causes, impact, consequences, trends understanding of: Earthquake, volcanisms, cyclones, tsunami, floods, draughts and famines, landslides and avalanches, heat and cold waves.

• Man-made disasters: Biological disasters, chemical disasters, nuclear disasters, building fire, cold fire, forest fire, oil fire, air pollution, water pollution, deforestations, industrial pollution, road accidents, rail accidents, air accidents, sea accidents, oil slicks and spills, out- break of disease and epidemic, building collapse, rural and urban fire, war and conflicts, over exploitation of natural resources.

Suggested Readings

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)
2. Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth Heineman.
3. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
4. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.
5. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.

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VIDYASAGAR UNIVERSITY

Curriculum for 3 -Year B Sc (HONOURS)
in
Botany

Under Choice Based Credit System (CBCS)
w.e.f 2017-2018

VIDYASAGAR UNIVERSITY

B Sc (Honours) in Botany

[Choice Based Credit System]

Year	Semester	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
							CA	ESE	TOTAL
	Semester-I								
1	I	Core-1		CT1: Algae and Microbiology	6	4-0-0	15	60	75
				CP1: Algae and Microbiology-**Lab**		0-0-4			
		Core-2		CT2: Biomolecule and Cell Biology	6	4-0-0	15	60	75
				CP2: Biomolecule and Cell Biology-**Lab**		0-0-4			
		GE-1		TBD	6	4/5	15	60	75
				TBD		2/1			
		AECC-1		English/MIL	2	1-1-0	10	40	50
	Semester –I: total				**20**				**275**
	Semester-II								
	II	Core-3		CT3: Mycology and Phytopathology	6	4-0-0	15	60	75
				CP3: Mycology and Phytopathology -**Lab**		0-0-4			
		Core-4		CT4: Archegoniate	6	4-0-0	15	60	75
				CP4: Archegoniate-**Lab**		0-0-4			
		GE-2		TBD	6	4/5	15	60	75
				TBD		2/1			
		AECC-2		ENVS	4		20	80	100
	Semester-II : total				**22**				**325**

Year	Semester	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
							CA	ESE	TOTAL
2	**Semester-III**								
	III	Core-5		CT5: Morphology and Anatomy	6	4-0-0	15	60	75
				CP5: Morphology and Anatomy - **Lab**		0-0-4			
		Core-6		CT6: Economic Botany	6	4-0-0	15	60	75
				CP6: Economic Botany-**Lab**		0-0-4			
		Core-7		CT7: Genetics	6	4-0-0	15	60	75
				CP7: Genetics -**Lab**		0-0-4			
		GE-3		TBD	6	4/5	15	60	75
						2/1			
		SEC-1		TBD	2		10	40	50
		Semester – III : total			**26**				**350**
	Semester-IV								
	IV	Core-8		CT8: Molecular Biology	6	4-0-0	15	60	75
				CP8: Molecular Biology -**Lab**		0-0-4			
		Core-9		CT9: Plant Ecology and Phytogeography	6	4-0-0	15	60	75
				CP9: Plant Ecology and Phytogeography **-Lab**		0-0-4			
		Core-10		CT10: Plant Systematics	6	4-0-0	15	60	75
				CP10: Plant Systematics-**Lab**		0-0-4			
		GE-4		TBD	6	4/5	15	60	75
						2/1			
		SEC-2		TBD	2		10	40	50
		Semester – IV : total			**26**				**350**

Year	Semester	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
							CA	ESE	TOTAL
3	V	**Semester-V**							
		Core-11		CT11: Reproductive Biology Angiosperms	6	4-0-0	15	60	75
				CP11: Reproductive Biology Angiosperms -**Lab**		0-0-4			
		Core-12		CT12: Plant Physiology	6	4-0-0	15	60	75
				CP12: Plant Physiology -**Lab**		0-0-4			
		DSE-1		TBD	6	4-0-0	15	60	75
						0-0-4			
		DSE-2		TBD	6	4-0-0	15	60	75
						0-0-4			
		Semester –V : total			**24**				**300**
		Semester-VI							
	VI	Core-13		CT13: Plant Metabolism	6	4-0-0	15	60	75
				CP13: Plant Metabolism -**Lab**		0-0-4			
		Core-14		CT14: Plant Biotechnology	6	4-0-0	15	60	75
				CP14: Plant Biotechnology-**Lab**		0-0-4			
		DSE-3		TBD	6	4-0-0	15	60	75
						0-0-4			
		DSE-4		TBD	6	4-0-0	15	60	75
						0-0-4			
		Semester – VI : total			**24**				**300**
Total in all semester:					**142**				**1900**

CC = Core Course , **AECC** = Ability Enhancement Compulsory Course , **GE** = Generic Elective , **SEC** = Skill Enhancement Course , **DSE** = Discipline Specific Elective , **CA**= Continuous Assessment , **ESE**= End Semester Examination , **TBD**=To be decided , **CT** = Core Theory, **CP**=Core Practical , **L** = Lecture, **T** = Tutorial ,**P** = Practical , **MI**L = Modern Indian Language , **ENV**S = Environmental Studies ,

List of Core Course (CC)

CC-1: Phycology and Microbiology
CC-2: Bio-molecules and Cell Biology
CC-3: Mycology and Phytopathology
CC-4: Archegoniate
CC-5: Anatomy of Angiosperms
CC-6: Economic Botany
CC-7: Genetics
CC-8: Molecular Biology
CC-9: Plant Ecology and Phytogeography
CC-10: Plant Systematics
CC-11: Reproductive Biology of Angiosperms
CC-12: Plant Physiology
CC-13: Plant Metabolism
CC-14: Plant Biotechnology

Discipline Specific Electives (DSE)

DSE-1: Natural Resource Management
Or
DSE-1: Biostatistics
DSE-2: Plant Breeding
Or
DSE-2: Stress Biology
DSE-3: Industrial and Environmental Microbiology
Or
DSE-3: Bioinformatics
DSE-4: Analytical Techniques in Plant Sciences
Or
DSE- 4: Research Methodology

Skill Enhancement Course (SEC)

SEC-1: Biofertilizers
Or
SEC- 1: Floriculture

SEC-2: Medicinal Botany
Or
SEC-2: Mushroom Culture Technology

Generic Electives (GE)

GE-1: Biodiversity (Microbes, Algae, Fungi and Archegoniate)
GE-2 : Plant Ecology and Taxonomy
GE-3: Economic Botany and Plant Biotechnology
GE-4: Plant Anatomy and Embryology
Or
GE-4: Plant Physiology and Metabolism

Core Courses(CC)

CC-1: Phycology and Microbiology **Credits 06**

C1T: Phycology and Microbiology **Credits 04**

Course Contents:

Unit 1: Introduction to microbial world
Microbial nutrition, growth and metabolism. Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

Unit 2: Viruses
Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV).

Unit 3: Bacteria
Discovery, general characteristics; Types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).

Unit 4: Algae
General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; methods of reproduction; Classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups) and Van – den Hoek et.al(1982); Significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar). Role of algae in the environment, agriculture, biotechnology and industry.

Unit 5: Cyanophyta and Xanthophyta
Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of *Nostoc* and *Vaucheria.*

Unit 6: Chlorophyta and Charophyta
General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Chlamydomonas, Volvox, Oedogonium, Coleochaete, Chara.*
Evolutionary significance of *Prochloron.*

Unit 7: Phaeophyta and Rhodophyta
Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Ectocarpus, Fucus* and *Polysiphonia.*

C1P: Phycology and Microbiology (Practical) **Credits 02**

(Practical)

Microbiology

1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.
3. Gram staining.
4. Endospore staining with malachite green using the (endospores taken from soil bacteria).
5. Study of bacteria from root nodules/Curd sample.

Phycology

Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron micrographs), Volvox, *Oedogonium,Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia, Procholoron* through electron micrographs, temporary preparations and permanent slides.

Suggested Readings:

- Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
- Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw
- Hill International.
- Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
- 4.Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International,New Delhi.
- Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson
- R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
- Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

CC-2 : Bio-molecules and Cell Biology **Credits 06**

C2T : Bio-molecules and Cell Biology **Credits 04**

Course Contents:

Unit-1: Biomolecules

Types and significance of chemical bonds; Structure and properties of water; pH and buffers.

Carbohydrates: Nomenclature and classification; Monosaccharides ; Disaccharides; Oligosaccharides and polysaccharides.

Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacyl glycerols structure, functions and properties; Phosphoglycerides.
Proteins: Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quarternary; Protein denaturation and biological roles of proteins.

Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Unit- 2: Bioenergenetics
Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.

Unit- 3: Enzymes
Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theroy), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.

Unit-4: The cell
Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin ofeukaryotic cell (Endosymbiotic theory).

Unit- 5: Cell wall and plasma membrane
Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

Unit- 6: Cell organelles
Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. **Cytoskeleton:** Role and structure of microtubules, microfilaments and intermediary filament. **Chloroplast, mitochondria and peroxisomes:** Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast. **Endomembrane system:** Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosomes

Unit -7: Cell division
Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases.

C2P : Bio-molecules and Cell Biology **Credits 02**

(Practical)

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.

2. Study of plant cell structure with the help of epidermal peel mount of Onion/*Rhoeo/Crinum*.
3. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.
4. Measurement of cell size by the technique of micrometry.
5. Counting the cells per unit volume with the help of haemocytometer. (Yeast / pollen grains).
6. Study of cell and its organelles with the help of electron micrographs.
7. Cytochemical staining of : DNA- Feulgen Acto carmin and Aceto Orcrin stain and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.
8. Study the phenomenon of plasmolysis and deplasmolysis.
9. Study the effect of organic solvent and temperature on membrane permeability.
10. Study different stages of mitosis and meiosis.

Suggested Readings:

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

CC-3 : Mycology and Phytopathology **Credits 06**

C3 T : Mycology and Phytopathology **Credits 04**

Course Contents:

Unit- 1: Introduction to true fungi

General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.

Unit- 2: Chytridiomycota and Zygomycota

Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to *Synchytrium, Rhizopus* .

Unit-3: Ascomycota

General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; Life cycle and classification with reference to *Saccharomyces, Aspergillus, Penicillium, Alternaria, Neurospora* and *Peziza.*

Unit- 4: Basidiomycota
General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat *Puccinia* (Physiological Specialization), loose and covered smut (symptoms only), *Agaricus*; Bioluminescence, Fairy Rings and Mushroom Cultivation with special reference to Oyster Mashroom..

Unit- 5: Allied Fungi
General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.

Unit- 6: Oomycota
General characteristics; Ecology; Life cycle and classification with reference to *Phytophthora, Albugo.*

Unit -7: Symbiotic associations
Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance.

Unit- 8: Applied Mycology
Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.

Unit- 9: Phytopathology
Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine.
Bacterial diseases – Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers.

C3P: Mycology and Phytopathology **Credits 02**

Practical
1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).
2. *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides.
3. *Aspergillus* and *Penicillium*: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.
4. *Peziza*: Ascobulus sectioning through ascocarp.
5. *Alternaria:* Specimens/photographs and temporary mounts.

6. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
7. *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*, fairy rings and bioluminescent mushrooms to be shown.
8. Study of phaneroplasmodium from actual specimens and /or photograph. Study of *Stemonitis* sporangia.
9. *Albugo:* Study of symptoms of plants infected with *Albugo*; asexual phase study through section/ temporary mounts and sexual structures through permanent slides.
10. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs)
11. Phytopathology : Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.

Suggested Readings:

- Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.
- Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
- Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
- Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
- Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

CC-4: Archegoniate **Credits 06**

C4T: Archegoniate **Credits 04**

Course Contents:

Unit 1: Introduction

Unifying features of archegoniates; Transition to land habit; Alternation of generations.

Unit 2: Bryophytes

General characteristics; Adaptations to land habit; Classification; Range of thallus organization.

Unit 3: Type Studies- Bryophytes

Classification (up to family), morphology, anatomy and reproduction of *Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum and Funaria*; Pogonatum,Reproduction and evolutionary trends in *Riccia, Marchantia, Plagichasma Anthoceros* and *Funaria* (developmental stages not included). Ecological and economic importance of bryophytes with special reference to *Sphagnum*.

Unit 4: Pteridophytes

General characteristics; Classification; Early land plants (*Cooksonia* and *Rhynia*).

Unit 5: Type Studies- Pteridophytes
Classification (up to family), morphology, anatomy and reproduction of *Psilotum*, *Selaginella*, *Equisetum* and *Pteris* (Developmental details not to be included).Apogamy, and apospory, heterospory andseed habit, telome theory, stelar evolution; Ecological and economic importance.

Unit 6: Gymnosperms
General characteristics, classification (up to family), morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum* (Developmental details not to be included); Ecological and economic importance.

C4P : Archegoniate **Credits 02**

Practical

1. ***Riccia*** – Morphology of thallus.

2. ***Marchantia***- Morphology of thallus, whole mount of rhizoids & Scales, vertical sectionof thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).

3. ***Anthoceros***- Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).

4. ***Pellia, Porella***- Permanent slides.

5. ***Sphagnum***- Morphology of plant, whole mounts of leaf (permanent slide only).

6. ***Funaria***- Pogonatum/ Polytrichum 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.

7. ***Psilotum***- Study of specimen, transverse section of synangium (permanent slide).

8. ***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).

9. ***Equisetum***- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).

10. ***Pteris***- Morphology, transverse section of rachis, vertical section of sporophyll, wholemount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).

11. ***Cycas***- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide).

12. ***Pinus***- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle, 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).

13. ***Gnetum***- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)

14. **Botanical excursion.**

Suggested Readings:

- Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
- Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
- Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
- Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
- Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.

CC-5: Anatomy of Angiosperms **Credits 06**

C5T: Anatomy of Angiosperms **Credits 04**

Course Contents:

Unit 1: Introduction and scope of Plant Anatomy: Applications in systematics, forensics and pharmacognosy**.**

Unit 2: Structure and Development of Plant Body

Internal organization of plant body: The three tissue systems, types of cells and tissues. Development of plant body: polarity, cytodifferentiation and organogenesis during embryogenic development, Root-stem transition, Nodal anatomy – Basic concept.

Unit 2: Tissues

Classification of tissues; Simple and complex tissues (no phylogeny); cytodifferentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers.

Unit 3: Apical meristems

Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation); Types of vascular bundles; Structure of dicot and monocot stem. Origin, development, arrangement and diversity in size and shape of leaves; Structure of dicot and monocot leaf, Kranz anatomy. Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermises and origin of lateral root.

Unit 4: Vascular Cambium and Wood

Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Anomalous secondary growth in Bignonia, Boerhaavia , *Aristolochia* and Dracaena. Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels.

Unit 5: Adaptive and Protective Systems

Epidermal tissue system, cuticle, epicuticular waxes, trichomes(uni-and multicellular, glandular and nonglandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes. Mechanical tissue – distribution and significance.

C5P: Anatomy of Angiosperms **Credits 02**

Practical

1. Study of anatomical details through permanent slides/temporary stain mounts/ macerations/museum specimens with the help of suitable examples.
2. Apical meristem of root, shoot and vascular cambium.
3. Distribution and types of parenchyma, collenchyma and sclerenchyma.
4. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres.
5. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
6. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
7. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
8. Root: monocot, dicot, secondary growth.
9. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
10. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
11. Adaptive Anatomy: xerophytes, hydrophytes.
12. Secretory tissues: cavities, lithocysts and laticifers.

Suggested Readings:

- Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
- Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
- Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
- Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

CC-6: Economic Botany **Credits 06**

C6T: Economic Botany **Credits 04**

Course Contents:

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: Cereals
Wheat and Rice (origin, morphology, cultivation, management processing & uses); Brief account of millets.

Unit 3: Legumes
Origin, morphology cultivation, management and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and ecosystem.

Unit 4: Sources of sugars and starches

Morphology cultivation, management and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.

Unit 5: Spices
Listing of important spices, their family and part used. Economic importance with special reference to fennel, saffron, clove and black pepper

Unit 6: Beverages
Tea, Coffee (morphology, processing & uses)

Unit 7: Sources of oils and fats
General description, classification, extraction, their uses and health implications groundnut, coconut, linseed, soybean, mustard and coconut (Botanical name, family & uses). Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.

Unit 8: Natural Rubber
Para-rubber: tapping, processing and uses.

Unit 9: Drug-yielding plants
Therapeutic and habit-forming drugs with special reference to C*inchona, Digitalis, Papaver* and *Cannabis*; Tobacco (Morphology, processing, uses and health hazards).

Unit 10: Timber plants
General account with special reference to teak and pine.

Unit 11: Fibers

Classification based on the origin of fibers; Cotton, Coir and Jute (morphology, extraction and uses).

C6P: Economic Botany **Credits 02**

Practical

1. **Cereals**: Wheat (habit sketch, L. S/T.S. grain, starch grains, micro-chemical tests) Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
2. **Legumes**: Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
3. **Sources of sugars and starches**: Sugarcane (habit sketch; cane juice- micro-chemical tests), Potato (habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, w.m. starch grains, micro-chemical tests).
4. **Spices:** Black pepper, Fennel and Clove (habit and sections).
5. **Beverages**: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
6. **Sources of oils and fats**: Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds.
7. **Essential oil-yielding plants**: Habit sketch of *Rosa*, *Vetiveria*, *Santalum* and *Eucalyptus* (specimens/photographs).
8. **Rubber**: specimen, photograph/model of tapping, samples of rubber products.
9. **Drug-yielding plants**: Specimens of *Digitalis*, *Papaver* and *Cannabis.*
10. **Tobacco**: specimen and products of Tobacco.
11. **Woods:** *Tectona*, *Pinus*: Specimen, Section of young stem.
12. **Fiber-yielding plants**: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).

Suggested Readings:

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

CC-7: Genetics **Credits 06**

C7T: Genetics **Credits 04**

Course Contents:

Unit 1: Mendelian genetics and its extension

Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance and Expressivity, Numericals; Polygenic inheritance.

Unit 2: Extra-chromosomal Inheritance

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 3: 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; Sex Linkage.

Unit 4: Variation in chromosome number and structure
Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy

Unit 5: Gene mutations
Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method. Role of Transposons in mutation.DNA repair mechanisms.

Unit 6: Fine structure of gene
Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rII Locus.

Unit 6. Population and Evolutionary Genetics
Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.

C7P: Genetics **Credits 02**

Practical

1. Demonstration on pretreatment, fixation, staining and squash and smear preparation.
2. Study of Mitosis from Onion / Garlic / Lentil root.
3. Study of Meiosis with pollen mother cell (PMC) of Onion / Solanum / Datura by smear preparation.
4. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square.
5. Chromosome mapping using point test cross data.
6. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
7. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
8. Blood Typing: groups & Rh factor.
9. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.
10. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
11. Study of human genetic traits: Sickle cell anemia, Xeroderma Pigmentosum, Albinism, red-green Colour blindness, Widow's peak, Rolling of tongue, Hitchhiker's thumb and Attached ear lobe.

Suggested Readings:

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.
- Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India.5th edition.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A. 9th edition.
- 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.

CC-8: Molecular Biology **Credits 06**

C8T: Molecular Biology **Credits 04**

Course Contents:

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.

Unit -2. The Structures of DNA and RNA / Genetic Material
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-Prokaryotes, Viruses, Eukaryotes.RNA Structure-Organelle DNA -- mitochondria and chloroplast DNA.The Nucleosome-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, replication of linear ds-DNA, replication of the 5'end of linear chromosome; Enzymes involved in DNA replication.

Unit- 3: Central dogma and genetic code
Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features**)**

Unit 4: Transcription
Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation;
Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in *E.coli.* 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, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing 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; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.

C8P: Molecular Biology **Credits 02**

Practical

1. Preparation of LB medium and raising *E.Coli.*
2. Isolation of genomic DNA from *E.Coli.*
3. DNA isolation from cauliflower head.
4. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
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.
7. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al,Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)
8. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.

Suggested Readings

- 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.
- Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc.,U.S.A. 5th edition.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
- Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
- 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.

CC-9: Plant Ecology and Phytogeography **Credits 06**

C9T: Plant Ecology and Phytogeography **Credits 04**

Course Contents:

Unit 1: Introduction
Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, homeostasis.

Unit 2: Soil
Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development.

Unit 3: Water
Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table.

Unit 4: Light, temperature, wind and fire
Variations; adaptations of plants to their variation.

Unit 5: Ecosystems
Structure; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids.

Unit 6: Population ecology
Characteristics and Dynamics .Ecological Speciation

Unit 7: Plant communities
Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.

Unit 8: Biotic interactions
Trophic organization, basic source of energy, autotrophy, heterotrophy; symbiosis, commensalism, parasitism; food chains and webs; ecological pyramids; biomass, standing crop.

Unit 9: Functional aspects of ecosystem
Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.

Unit 10: 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.

C9P: Plant Ecology and Phytogeography **Credits 02**

Practical

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. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from
4. two soil samples by rapid field tests.
5. Determination of organic matter of different soil samples by Walkley & Black rapid titration
6. method.

7. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
8. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
9. (a). Study of morphological adaptations of hydrophytes and xerophytes (four each).
   (b). Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobanche*) Epiphytes, Predation (Insectivorous plants).
10. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
11. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
12. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.
13. Field visit to familiarise students with ecology of different sites.

Suggested Readings:

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

CC-10: Plant Systematics **Credits 06**

C10T: Plant Systematics **Credits 04**

Course Contents:

Unit 1: Significance of Plant systematics

Introduction to systematics; Plant identification, Classification, Nomenclature. Evidences from palynology, cytology, phytochemistry and molecular data. Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys:Single access and Multi-access.

Unit 2: Taxonomic hierarchy

Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).

Unit 3: Botanical nomenclature

Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.

Unit 4: Systems of classification
Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (upto series); Brief reference of Angiosperm Phylogeny Group (APG III) classification.

Unit 5: Biometrics, numerical taxonomy and cladistics
Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).

Unit 6: Phylogeny of Angiosperms
Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of angiosperms; Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).

C10P: Plant Systematics **Credits 02**

Practical
1. 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):
   1. Ranunculaceae - *Ranunculus, Delphinium.*
   2. Brassicaceae - *Brassica, Alyssum / Iberis.*
   3. Malvaceae – *Sida Sp. Urena lobota.*
   4. Myrtaceae - *Eucalyptus, Callistemon*
   5. Umbelliferae - *Coriandrum /Anethum / Foeniculum.*
   6. Asteraceae - *Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax.*
   7. Solanaceae - *Solanum nigrum/Withania, Nicotina, Plumbaginefolia.*
   8. Lamiaceae - *Salvia/Ocimum.*
   9. Euphorbiaceae - *Euphorbia hirta/E.milii, Jatropha.*
   10. Fasaceae – *Tephrosia Sp.,Crotalaria Sp.,*
   11. Caesalpineaeceae – *Cassia* Sp.,
   12. Asclepiadaeceae- *Pesgularia Gygnema,*
   13. Apocynaceae – *Hollorhen, Catharanthus.*
   14. Rubiaceae – *Oldenladeae, Spermoeoceae,*
   15. Liliaceae - *Asphodelus/Lilium/Allium.*
   16. Poaceae - *Triticum/Hordeum/Avena.*

2. Field visit (local) – Subject to grant of funds from the university.

3. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Suggested Readings:

- Singh, (2012). *Plant Systematics:* Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

- Jeffrey, C. (1982). An Introduction to *Plant Taxonomy.* Cambridge University Press, Cambridge.
- Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A
- Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
- Maheshwari, J.K. (1963). *Flora* of Delhi. CSIR, New Delhi.
- Radford, A.E. (1986). Fundamentals of *Plant Systematics*. Harper and Row, New York.

CC-11: Reproductive Biology of Angiosperms **Credits 06**

C11T: Reproductive Biology of Angiosperms **Credits 04**

Course Contents:

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 *Polygonum* type); Organization and ultrastructure of mature embryo sac.

Unit 4: Pollination and fertilization
Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization.

Unit 5: 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 *in vitro* pollination; Modification of stigma surface, parasexual hybridization; Cybrids, *in vitro* fertilization.

Unit 6: 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 *Paeonia*. Seed structure, importance and dispersal mechanisms

Units 7: Polyembryony and apomixis
Introduction; Classification; Causes and applications.

C11P: Reproductive Biology of Angiosperms **Credits 02**

Practical

1. Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bicelled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.

2. Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, 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:

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

CC-12: Plant Physiology **Credits 06**

C12T: Plant Physiology **Credits 04**

Course Contents:

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
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.

Unit 3: Nutrient Uptake
Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.

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: Plant growth regulators
Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid.

Unit 6: Physiology of flowering
Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.

Unit 7: Phytochrome , crytochromes and phototropins
Discovery, chemical nature, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.

C12P: Plant Physiology **Credits 02**

Practical

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of water potential of given tissue (potato tuber) by weight method.
3. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf.
4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.
5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces).
6. To study the phenomenon of seed germination (effect of light).
7. To study the effect of different concentrations of IAA on *Avena* coleoptile elongation (IAA Bioassay).

8. To study the induction of amylase activity in germinating barley grains.

Demonstration experiments

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

Suggested Readings:

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

CC-13: Plant Metabolism **Credits 06**

C13T: Plant Metabolism **Credits 04**

Course Contents:

Unit 1: Concept of metabolism

Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric ,covalent modulation and Isozymes).

Unit 2: 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, CO2 reduction, photorespiration, C4 pathways; Crassulacean acid metabolism; Factors affecting CO2 reduction.

Unit 3: Carbohydrate metabolism

Synthesis and catabolism of sucrose and starch.

Unit 4: 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 5: 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 6: Lipid metabolism

Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation.

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: Mechanisms of signal transduction
Receptor-ligand interactions; Second messenger concept, Calcium calmodulin, MAP kinase cascade.

C13P: Plant Metabolism **Credits 02**

Practical

1. Chemical separation of photosynthetic pigments.
2. Experimental demonstration of Hill's reaction.
3. To study the effect of light intensity on the rate of photosynthesis.
4. Effect of carbon dioxide on the rate of photosynthesis.
5. To compare the rate of respiration in different parts of a plant.
6. To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources.
7. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids
1. during germination.
8. Demonstration of fluorescence by isolated chlorophyll pigments.
9. Demonstration of absorption spectrum of photosynthetic pigments.

Suggested Readings

- Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
- Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
- Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.

CC-14: Plant Biotechnology **Credits 06**

C14T: Plant Biotechnology **Credits 04**

Course Contents:

Unit -1: Plant Tissue Culture
Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation).

Unit- 2: Recombinant DNA technology

Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction

Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC).

Unit- 3:Gene Cloning

Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCRmediated gene cloning; Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; PCR

Unit- 4: Methods of gene transfer

Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).

Unit - 5: 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); Gentically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.

C14P: Plant Biotechnology **Credits 02**

Practical

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 Readings:

- Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
- Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

- Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
- Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
- Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

Discipline Specific Electives (DSE)

DSE-1: Natural Resource Management **Credits 06**

DSE1T: Natural Resource Management **Credits 04**

Course Contents:

Unit- 1: Natural resources : Definition and types.

Unit- 2: Sustainable utilization : Concept, approaches (economic, ecological and socio-cultural).

Unit- 3: Land : Utilization (agricultural, pastoral, horticultural, silvicultural); Soil degradation and management.

Unit- 4: Water
Fresh water (rivers, lakes, groundwater, aquifers, watershed); Marine; Estuarine; Wetlands; Threats and management strategies.

Unit- 5: Biological Resources
Biodiversity-definition and types; Significance; Threats; Management strategies; Bio-prospecting; IPR; CBD; National Biodiversity Action Plan).

Unit - 6: Forests
Definition, Cover and its significance (with special reference to India); Major and minor Forest products; Depletion; Management.

Unit- 7: Energy : Renewable and non-renewable sources of energy

Unit- 8: Contemporary practices in resource management
EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management.

Unit- 9: National and international efforts in resource management and conservation

DSE-1P: Natural Resource Management **Credits 02**

Practical

1. Estimation of solid waste generated by a domestic system (biodegradable and nonbiodegradable) and its impact on land degradation.
2. Collection of data on forest cover of specific area.

3. Measurement of dominance of woody species by DBH (diameter at breast height) method.
4. Calculation and analysis of ecological footprint.
5. Ecological modeling.

Suggested Readings:

- Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
- Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
- Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

Or

DSE-1: Biostatistics **Credits 06**

DSE1T: Biostatistics **Credits 04**

Course Contents:

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.

DSE1P: Biostatistics **Credits 02**

Practical

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.

Suggested Readings

- Biostatistic, Danniel, W.W., 1987.New York, John Wiley Sons.

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

DSE-2: Plant Breeding **Credits 06**

DSE2T: Plant Breeding **Credits 04**

Course Contents:

Unit -1: Plant Breeding

Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.

Unit -2: Methods of Crop improvement

Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.

Unit -3: Quantitative inheritance

Concept, mechanism, examples of inheritance of Kernel colour in wheat, Skin colour in human beings. Monogenic vs polygenic Inheritance.

Unit - 4: Inbreeding depression and heterosis

History, genetic basis of inbreeding depression and heterosis : Applications.

Unit - 5: Crop improvement and breeding

Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.

DSE2P: Plant Breeding (Practical) **Credits 02**

Practical

1. Identification of offspring's having parental genotypes and recombinant genotypes, based on combination of morphological attributes in a dihybrid cross.

2. Processes of emaculation –

a) By applying higher temperature,
b) By amputing anthers.

3. Determination of genetic inheritance of characters in monohybrid and dihybrid crosses by Chi-square test (including Mendelian ratios and the ratios of gene interactions e.g. Dominant Epistasis, Supplementary gene action, Polymeric Gene action, Complementary Gene action, Inhibitory Gene action and Duplicating Gene action.

4. Identification of fertile and sterile pollens with carmine stain and TTC test.

Suggested Readings:

1. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
2. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford-IBH. 2nd edition.
3. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

Or

DSE-2: Stress Biology **Credits 06**

DSE2T: Stress Biology **Credits 04**

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.

DSE2P: Stress Biology **Credits 02**

Practical

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:

- Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
- Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.

DSE-3: Industrial and Environmental Microbiology **Credits 06**

DSE-3T: Industrial and Environmental Microbiology **Credits 04**

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.

A visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations.

Unit 3: Microbial production of industrial products

Microorganisms involved, media, fermentation conditions, downstream processing and uses; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, 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.

DSE-3P: Industrial and Environmental Microbiology Credits 02

Practical

1. Principles and functioning of instruments in microbiology laboratory
2. Hands on sterilization techniques and preparation of culture media.

Suggested Readings:

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

OR

DSE-3: Bioinformatics Credits 06

DSE3T: Bioinformatics Credits 04

Course Contents:

Unit 1. Introduction to Bioinformatics
Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics.

Unit 2. Databases in Bioinformatics
Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System.

Unit 3. Biological Sequence Databases
National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database. EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools. DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ. Protein

Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR. Swiss-Prot: Introduction and Salient Features.

Unit 4. Sequence Alignments
Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

Unit 5. Molecular Phylogeny

Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

Unit 6. Applications of Bioinformatics
Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement

DSE3P: Bioinformatics **Credits 02**

Practical
1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.
3. Sequence alignment.
4. Sequence homology and Gene annotation.
5. Construction of phylogenetic tree.

Suggested Readings:

- Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
- Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
- Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

DSE-4: Analytical Techniques in Plant Sciences **Credits 06**

DSE4T: Analytical Techniques in Plant Sciences **Credits 04**

Course Contents:

Unit- 1: Imaging and related techniques
Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit- 2: Cell fractionation

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Unit- 3: Radioisotopes
Use in biological research, auto-radiography, pulse chase experiment.

Unit- 4: Spectrophotometry
Principle and its application in biological research.

Unit- 5: Chromatography
Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Unit- 6: Characterization of proteins and nucleic acids
Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

Unit- 7: Biostatistics
Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

DSE4P: Analytical Techniques in Plant Sciences **Credits 02**

Practical

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separation DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining).

Suggested Readings:

- Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.
- Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
- Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.

- Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

OR

DSE-4: Research Methodology **Credits 06**

DSE4T: Research Methodology **Credits 04**

Course Contents:

Unit 1: Basic concepts of research

Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs emperical).Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

Unit 2: General laboratory practices

Common calculations in botany laboratories. Understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases.Preparation of solutions. Dilutions. Percentage solutions. Molar, molal and normal solutions.Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling.

Unit 3: Data collection and documentation of observations

Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of Tissue specimens and application of scale bars. The art of field photography.

Unit 4: Overview of Biological Problems

History; Key biology research areas, Model organisms in biology (A Brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics Transcriptional regulatory network.

Unit 5: **Methods to study plant cell/tissue structure**

Whole mounts, peel mounts, squash preparations, clearing, maceration and sectioning; Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, non-coagulant fixatives; tissue dehydration using graded solvent series; Paraffin and plastic infiltration; Preparation of thin and ultrathin sections.

Unit 6: Plant microtechniques

Staining procedures, classification and chemistry of stains. Staining equipment. Reactive dyes and fluorochromes (including genetically engineered protein labeling with GFP and other tags). Cytogenetic techniques with squashed plant materials.

Unit 7: The art of scientific writing and its presentation

Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Powerpoint presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

DSE4P: Research Methodology **Credits 02**

Practical

1. Experiments based on chemical calculations.
2. Plant microtechnique experiments.
3. The art of imaging of samples through microphotography and field photography.
4. Poster presentation on defined topics.
5. Technical writing on topics assigned.

Suggested Readings:

- Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
- Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
- Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

Skill Enhancement Course (SEC)

SEC-1: Biofertilizers **Credits 02**

SEC1T: Biofertilizers **Credits 02**

Course Contents:

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:

- Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
- Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
- John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay _Publication, New Delhi.

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

OR

SEC- 1: Floriculture **Credits 02**

SEC1T: Floriculture

Course Contents:

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:

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

SEC-2: Medicinal Botany **Credits 02**

SEC-2T: Medicinal Botany

Course Contents:

Unit 1:
History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope - **Ayurveda**: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, **Siddha:** Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. **Unani**: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations.

Unit 2:
Conservation of endangered and endemic medicinal plants. Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.

Unit 3:
Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. Folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

Suggested Readings:

- Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
- Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.

Or

SEC-2: Mushroom Culture Technology **Credits 02**

SEC-2T: Mushroom Culture Technology

Course Contents:

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, pickels, papads), drying, storage in saltsolutions. 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:

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

Generic Elective (GE)
[Interdisciplinary for other department]

GE-1: Biodiversity (Microbes, Algae, Fungi and Archegoniate) Credits 06

GE1T: Biodiversity (Microbes, Algae, Fungi and Archegoniate) Credits 04

Course Contents:

Unit 1: Microbes
Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

Unit 2: Algae
General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas*, *Oedogonium*, *Vaucheria*, *Fucus*, *Polysiphonia*. Economic importance of algae.

Unit 3: Fungi
Introduction- General characteristics, ecology and significance, range of thallus organization,cell wall composition, nutrition, reproduction and classification; True Fungi-General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium*,*Alternaria* (Ascomycota), *Puccinia, Agaricus* (Basidiomycota); Symbiotic

Associations-Lichens:General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.

Unit 4: Introduction to Archegoniate
Unifying features of archegoniates, Transition to land habit, Alternation of generations.

Unit 5: Bryophytes
General characteristics, adaptations to land habit, Classification, Range of thallus organization.Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*.(Developmental details not to be included).Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

Unit 6: Pteridophytes
General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella, Equisetum* and *Pteris*.(Developmental details not to be included).Heterospory and seed habit, stellar evolution. Ecological and economical importance of Pteridophytes.

Unit 4: Gymnosperms
General characteristics; Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus* (Developmental details not to be included). Ecological and economical importance.

GE1P: Biodiversity (Microbes, Algae, Fungi and Archegoniate) (Practical) Credits 02

Practical:

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.

1. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.

2. Gram staining.

3. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron micrographs), *Oedogonium, Vaucheria, Fucus* and Polysiphonia* through temporary preparations and permanent slides. (* *Fucus* - Specimen and permanent slides).

4. *Rhizopus and Penicillium*: Asexual stage from temporary mounts and sexual Structures through permanent slides.

5. *Alternaria:* Specimens/photographs and tease mounts.

6. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberryleaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.

7. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
8. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)

9. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)

10. *Marchantia*- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemmacup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).

11. *Funaria*- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
12. *Selaginella*- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m.microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
14. *Equisetum*- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore,w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).
13. Pteris- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
14. *Cycas*- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet,v.s. micro sporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).

15. *Pinus*- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m.dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. &r.l.s. stem (permanent slide).

Suggested Readings:

- Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
- Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
- Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
- Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
- Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
- Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
- Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
- Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

GE-2: Plant Ecology and Taxonomy **Credits 06**

GE2T: Plant Ecology and Taxonomy **Credits 04**

Course Contents:

Unit- 1: Introduction

Unit- 2: Ecological factors

Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes

Unit -3: Plant communities

Characters; Ecotone and edge effect; Succession; Processes and types

Unit- 4: Ecosystem

Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Bio-geochemical cycling; Cycling of carbon, nitrogen and Phosphorous

Unit- 5: Phytogeography

Principle of Biogeographical zone; Endemism.

Unit- 6: Introduction to plant taxonomy

Identification, Classification, Nomenclature.

Unit- 7 : Identification

Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access

Unit 8 : Taxonomic evidences from palynology, cytology, phytochemistry and molecular data.

Unit 9 : Taxonomic hierarchy
Ranks, categories and taxonomic groups

Unit 10: Botanical nomenclature
Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

Unit 11: Classification

Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).

Unit 12: Biometrics, numerical taxonomy and cladistics
Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

GE2P: Practical **Credit 02**

Practical:

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, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b) Study of biotic interactions of the following: Stem parasite (*Cuscuta),* Root parasite (*Orobanche*), Epiphytes, Predation (Insectivorous plants).
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
7. 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):Brassicaceae - *Brassica,Alyssum / Iberis;* Asteraceae -*Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax;* Solanaceae -*Solanum nigrum, Withania;* Lamiaceae -*Salvia, Ocimum*; Liliaceae - *Asphodelus / Lilium / Allium.*
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Suggested Readings:

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition

GE-3: Economic Botany and Plant Biotechnology **Credits 06**

GE3T: Economic Botany and Plant Biotechnology **Credits 04**

Course Contents:

Unit 1: Origin of Cultivated Plants
Concept of centres of origin, their importance with reference to Vavilov's work.

Unit 2: Cereals

Wheat - Origin, morphology, uses

Unit 3: Legumes

General account with special reference to Gram and soybean

U nit 4: Spices

General account with special reference to clove and black pepper (Botanical name, family, part used morphology and uses)

U nit 5: Beverages

Tea (morphology, processing, uses)

Unit 6: Oils and Fats

General description with special reference to groundnut

Unit 7: Fibre Yielding Plants

General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

Unit 8: Introduction to biotechnology

Unit 9: Plant tissue culture

Micropropagation ; haploid production through androgenesis and gynogenesis; brief account of embryo and endosperm culture with their applications

Unit 10: Recombinant DNA Techniques

Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immuno detection. Molecular diagnosis of human disease, Human gene Therapy.

GE3P: Economic Botany and Plant Biotechnology **Credits 04**

Practical:

1. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and micro chemical tests

2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

Suggested Readings:

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

GE-4: Plant Anatomy and Embryology **Credits 06**

GE4T: Plant Anatomy and Embryology **Credits 04**

Course Contents:

Unit 1: Meristematic and permanent tissues
Root and shoot apical meristems; Simple and complex tissues

U nit 2: Organs
Structure of dicot and monocot root stem and leaf.

Unit 3: Secondary Growth
Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood)

Unit 4: Adaptive and protective systems
Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit 5: Structural organization of flower
Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

Unit 6: Pollination and fertilization
Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

Unit 7: Embryo and endosperm
Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship

Unit 8: Apomixis and polyembryony
Definition, types and Practical applications

GE4P: Plant Anatomy and Embryology **Credits 02**

Practical:

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays;* Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

Suggested Readings:

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

OR

GE-4: Plant Physiology and Metabolism **Credits 06**

GE4T: Plant Physiology and Metabolism **Credits 04**

Course Contents:

Unit 1: Plant-water relations
Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

U nit 2: Mineral nutrition
Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

Unit 3: Translocation in phloem.

C omposition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading

Unit 4: Photosynthesis
Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.

U nit 5: Respiration
Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

U nit 6: Enzymes
Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

U nit 7: Nitrogen metabolism
Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit 8: Plant growth regulators
Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

Unit 9: Plant response to light and temperature
Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

GE4P: Plant Physiology and Metabolism **Credits 02**

Practical

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

Suggested Readings

- Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
- Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
- Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

VIDYASAGAR UNIVERSITY

Curriculum for 3-Year BSc (General)
in

Botany

Under Choice Based Credit System (CBCS)
[w.e.f 2018-2019]

VIDYASAGAR UNIVERSITY

B Sc (General) in Botany

[Choice Based Credit System]

Year	Semester	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
1	I	**SEMESTER-I**					**CA**	**ESE**	**TOTAL**
		Core-1 (DSC-1A)		Biodiversity (Microbes, Algae, Fungi and Archegoniate) - **Practical**	6	4-0-4	15	60	75
		Core-2 (DSC-2A)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		Core-3 (DSC-3A)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		AECC-1 (Elective)		English/MIL	2	1-1-0	10	40	50
		Semester - I : Total			**20**				**275**
		SEMESTER-II							
	II	Core-4 (DSC-1B)		Plant Ecology and Taxonomy - **Practical**	6	4-0-4	15	60	75
		Core-5 (DSC-2B)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		Core-6 (DSC-3B)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		AECC-2 (Elective)		Environmental Studies	4		20	80	100
		Semester - 2 : Total			**22**				**325**

Year	Semester	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
2	**III**	**SEMESTER-III**					**CA**	**ESE**	**TOTAL**
		Core-7 (DSC-1C)		Plant Anatomy and Embryology - **Practical**	6	4-0-4	15	60	75
		Core-8 (DSC-2C)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		Core-9 (DSC-3C)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		SEC-1		SEC-1: Biofertilizers Or Nursery and Gardening	2	1-1-0	10	40	50
		Semester - 3 : Total			**20**				**275**
		SEMESTER-IV							
	IV	Core-10 (DSC-1D)		Plant Physiology and Metabolism - **Practical**	6	4-0-4	15	60	75
		Core-11 (DSC-2D)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		Core-12 (DSC-3D)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		SEC-2		SEC-2: Herbal Technology Or Mushroom Culture Technology	2	1-1-0	10	40	50
		Semester - 4 : Total			**20**				**275**

Year	Semester	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
3	V	SEMESTER-V					CA	ESE	TOTAL
		DSE-1A		Discipline-1(Botany)	6	4-0-4/ 5-1-0	15	60	75
		DSE-2A		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		DSE-3A		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		SEC-3		SEC-3: Floriculture Or Ethnobotany	2	1-1-0	10	40	50
				Semester - 5 : Total	**20**				**275**
		SEMESTER-VI							
	VI	DSE-1B		Discipline-1(Botany)	6	4-0-4/ 5-1-0	15	60	75
		DSE-2B		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		DSE-3B		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		SEC-4		SEC-4: Medicinal Botany Or Plant Diversity and Human Welfare Or Intellectual Property Rights	2	1-1-0	10	40	50
				Semester - 6 : Total	**20**				**275**
		Total in all semester:			**122**				**1700**

CC = Core Course , **AECC** = Ability Enhancement Compulsory Course , **GE** = Generic Elective , **SEC** = Skill Enhancement Course , **DSE** = Discipline Specific Elective , **CA**= Continuous Assessment , **ESE**= End Semester Examination , **TBD**=To be decided , **CT** = Core Theory, **CP**=Core Practical , **L** = Lecture, **T** = Tutorial ,**P** = Practical , **MI**L = Modern Indian Language , **ENV**S = Environmental Studies ,

List of Core Courses and Electives

Core Course (CC)

DSC-1A: Biodiversity (Microbes, Algae, Fungi and Archegoniate)
DSC-1B: Plant Ecology and Taxonomy
DSC-1C: Plant Anatomy and Embryology
DSC-1D: Plant Physiology and Metabolism

Discipline Specific Electives (DSE)

DSE-1: Cell and Molecular Biology
Or
DSE-1: Economic Botany and Biotechnology
Or
DSE-1: Bioinformatics

DSE-2: Genetics and Plant Breeding
Or
DSE-2: Analytical Techniques in Plant Sciences
Or
DSE-2: Research Methodology

Skill Enhancement Course (SEC)

SEC-1: Bio-fertilizers
Or
SEC-1: Nursery and Gardening

SEC-2: Herbal Technology
Or
SEC-2: Mushroom Culture Technology

SEC-3: Floriculture
Or
SEC-3: Ethnobotany

SEC-4: Medicinal Botany
Or
SEC-4: Plant Diversity and Human Welfare
Or
SEC-4: Intellectual Property Rights

Core Course (CC)

DSC-1A(CC-1) : Biodiversity (Microbes, Algae, Fungi and Archegoniate)

Credits 06

DSC1AT(C1T) : Biodiversity (Microbes, Algae, Fungi and Archegoniate)

Credits 04

Unit 1: Microbes

Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

Unit 2: Algae

General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas, Oedogonium, Vaucheria*, *Fucus*, *Polysiphonia*. Economic importance of algae

Unit 3: Fungi

Introduction - General characteristics, ecology and significance, range of thallus organization, cell wall composition , nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium, Alternaria* (Ascomycota), *Puccinia, Agaricus* (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

Unit 4: Introduction to Archegoniate

Unifying features of archegoniates, Transition to land habit, Alternation of generations.

U nit 5: Bryophytes

General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

Unit 6: Pteridophytes

General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.

U nit 4: Gymnosperms

General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

DSC1P(C1P) : Biodiversity (Microbes, Algae, Fungi and Archegoniate(Practical))

List of Practical **Credits : 02**

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.Gram staining
3. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron micrographs), *Oedogonium, Vaucheria, Fucus* and Polysiphonia* through temporary preparations and permanent slides. (* *Fucus* - Specimen and permanent slides)
4. *Rhizopus and Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.
5. *Alternaria:* Specimens/photographs and tease mounts.
6. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
7. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
8. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
9. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
10. *Marchantia*- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
11. *Funaria*- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
12. *Selaginella* - morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
13. *Equisetum* - morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).
14. *Pteris* - morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
15. *Cycas* - morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
16. *Pinus* - morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, , l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

Suggested Readings:

- Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
- Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
- Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.

- Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
- Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
- Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
- Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
- Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

DSC-1B(CC-2): Plant Ecology and Taxonomy **Credits 06**

DSC1B(C2T): Plant Ecology and Taxonomy **Credits 04**

Unit 1: Introduction

Unit 2: Ecological factors
Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

U nit 3: Plant communities
Characters; Ecotone and edge effect; Succession; Processes and types.

Unit 4: Ecosystem
Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous

Unit 5: Phytogeography
Principle biogeographical zones; Endemism

U nit 6 Introduction to plant taxonomy
Identification, Classification, Nomenclature.

Unit 7: Identification
Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access

Unit 8:Taxonomic evidences from palynology, cytology, phytochemistry and molecular data.

Unit 9: Taxonomic hierarchy
Ranks, categories and taxonomic groups

Unit 10: Botanical nomenclature
Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

U nit 11: Classification

Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).

Unit 12: Biometrics, numerical taxonomy and cladistics

Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

DSC1BP(C2P): Plant Ecology and Taxonomy(Practical) Credits 02

Practical:

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, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
    a. Study of morphological adaptations of hydrophytes and xerophytes (four each).
    b. Study of biotic interactions of the following: Stem parasite (*Cuscuta),* Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants)
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. 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):Brassicaceae - *Brassica, Alyssum / Iberis;* Asteraceae -*Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax;* Solanaceae -*Solanum nigrum, Withania;* Lamiaceae -*Salvia, Ocimum*; Liliaceae - *Asphodelus / Lilium / Allium.*
7. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Suggested Readings:

- Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
- Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
- Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A.
- Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

DSC-1C(CC-3) : Plant Anatomy and Embryology Credits 06

DSC 1CT(C3T) : Plant Anatomy and Embryology Credits 04

Unit 1: Meristematic and permanent tissues

Root and shoot apical meristems; Simple and complex tissues.

U nit 2: Organs
Structure of dicot and monocot root stem and leaf.

Unit 3: Secondary Growth
Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).

U nit 4: Adaptive and protective systems
Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit 5: Structural organization of flower
Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

Unit 6: Pollination and fertilization
Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

Unit 7: Embryo and endosperm
Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship.

Unit 8: Apomixis and polyembryony
Definition, types and practical applications.

DSC1CP(C3P) : Plant Anatomy and Embryology(Practical) Credits 02

Practical

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays;* Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.

13. Calculation of percentage of germinated pollen in a given medium.

Suggested Readings:

- Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
- Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

DSC-1D(CC-4): Plant Physiology and Metabolism **Credits 06**

DSC1DT(C4T): Plant Physiology and Metabolism **Credits 04**

Unit 1: Plant-water relations

Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

U nit 2: Mineral nutrition

Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

Unit 3: Translocation in phloem

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

Unit 4: Photosynthesis

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.

Unit 5: Respiration

Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

Unit 6: Enzymes

Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

Unit 7: Nitrogen metabolism

Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit 8: Plant growth regulators

Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

Unit 9: Plant response to light and temperature

Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

DSC1DP(C4P): Plant Physiology and Metabolism (Practical) **Credits 02**

Practical

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

Suggested Readings:

- Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5thEdition.
- Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
- Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

Discipline Specific Electives (DSE)

DSE-1: Cell and Molecular Biology **Credits 06**

DSE1T: Cell and Molecular Biology **Credits 04**

Unit 1: Techniques in Biology

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy;
Electron microscopy (EM) - Scanning EM and Scanning Transmission EM (STEM); Sample preparation for electron microscopy; X-ray diffraction analysis.

Unit 2: Cell as a unit of Life

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components.

Unit 3: Cell Organelles

Mitochondria : Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA. Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplast

DNA. ER, Golgi body & Lysosomes : Structures and roles. Peroxisomes and Glyoxisomes :Structures, composition, functions in animals and plants and biogenesis. Nucleus :Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

Unit 4: 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.

Unit 5: Cell Cycle

Overview of Cell cycle, Mitosis and Meiosis; Molecular controls.

Unit 6: Genetic material

DNA : Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material.

DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi–conservative, semi discontinuous RNA priming, Ø (theta) mode of replication, replication of linear, ds-DNA, replicating the 5′end of linear chromosome including replication enzymes.

Unit 7: Transcription (Prokaryotes and Eukaryotes)

Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase - various types; Translation (Prokaryotes and eukaryotes), genetic code.

Unit 8: Regulation of gene expression

Prokaryotes:Lac operon and Tryptophan operon ; and in Eukaryotes.

DSE1P: Cell and Molecular Biology (Practical) Credits 02

Practical

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. To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.
5. Preparation of temporary mounts of striated muscle fiber
6. To prepare temporary stained preparation of mitochondria from striated muscle cells /cheek epithelial cells using vital stain Janus green.
7. Study of mitosis and meiosis (temporary mounts and permanent slides).
8. Study the effect of temperature, organic solvent on semi permeable membrane.
9. Demonstration of dialysis of starch and simple sugar.
10. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
11. Measure the cell size (either length or breadth/diameter) by micrometry.
12. Study the structure of nuclear pore complex by photograph (from Gerald Karp)

13. Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
14. Study DNA packaging by micrographs.
15. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

Suggested Readings :

- Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
- 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.

Or

DSE-1 : Economic Botany and Biotechnology **Credits 06**

DSE1T : Economic Botany and Biotechnology **Credits 04**

Unit 1: Origin of Cultivated Plants
Concept of centres of origin, their importance with reference to Vavilov's work

Unit 2: Cereals
Wheat -Origin, morphology, uses

U nit 3: Legumes
General account with special reference to Gram and soybean

U nit 4: Spices
General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)

U nit 5: Beverages
Tea (morphology, processing, uses)

U nit 6: Oils and Fats
General description with special reference to groundnut

Unit 7: Fibre Yielding Plants
General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

Unit 8: Introduction to biotechnology

U nit 9: Plant tissue culture
Micropropagation ; haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications

Unit 10: Recombinant DNA Techniques

Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy.

DSE1P : Economic Botany and Biotechnology(Practical) Credits 02

Practical

1. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

Suggested Readings

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

Or

DSE-1: Bioinformatics Credits 06

DSE1T: Bioinformatics Credits 04

Unit 1: Introduction to Bioinformatics

Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics.

Unit 2: Databases in Bioinformatics

Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System.

Unit 3 : Biological Sequence Databases

National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database.

EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools. DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at

DDBJ. Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR. Swiss-Prot: Introduction and Salient Features.

Unit 4: Sequence Alignments

Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

Unit 5: Molecular Phylogeny
Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

Unit 6: Applications of Bioinformatics
Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement.

DSE1P: Bioinformatics (Practical) Credits 02

Practical

1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.
3. Sequence alignment.
4. Sequence homology and Gene annotation.
5. Construction of phylogenetic tree.

Suggested Readings:

- Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
- Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
- Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. _II Edition. Benjamin Cummings.

DSE-2: Genetics and Plant Breeding Credits 06

DSE2T: Genetics and Plant Breeding Credits 04

Unit 1: Heredity

1. Brief life history of Mendel
2. Terminologies
3. Laws of Inheritance
4. Modified Mandelian Ratios: 2:1- lethal Genes; 1:2:1- Co - dominance, incomplete dominance;- 9:7; 9:4:3; 13:3; 12:3:1.
5. Chi Square
6. Pedigree Analysis
7. Cytoplasmic Inheritance: Shell Coiling in Snail, Kappa particles in Paramecium, leaf variegation in Mirabilis jalapa, Male sterility.
8. Multiple allelism
9. Pleiotropism
10. Chromosome theory of Inheritance.

Unit 2: Sex-determination and Sex-linked Inheritance

Unit 3: **Linkage and Crossing over**
Linkage: concept & history, complete & incomplete linkage, bridges experiment, coupling & repulsion, recombination frequency, linkage maps based on two and three factor crosses. Crossing over: concept and significance, cytological proof of crossing over.

Unit 4: Mutations and Chromosomal Aberrations
Types of mutations, effects of physical & chemical mutagens. Numerical chromosomal changes: Euploidy, Polyploidy and Aneuploidy ; Structural chromosomal changes: Deletions, Duplications, Inversions & Translocations.

Unit 5: Plant Breeding
Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.

Unit 6: Methods of crop improvement
Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.

Unit 7: Quantitative inheritance
Concept, mechanism, examples. Monogenic vs polygenic Inheritance.

Unit 8: Inbreeding depression and heterosis
History, genetic basis of inbreeding depression and heterosis; Applications.

Unit 9: Crop improvement and breeding
Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.

DSE2P: Genetics and Plant Breeding(Practical) Credits 02

Practical

1. Mendel's laws through seed ratios. Laboratory exercises in probability and chisquare.
2. Chromosome mapping using point test cross data.
3. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
4. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
5. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes through photographs.
6. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
7. Hybridization techniques - Emasculation, Bagging (For demonstration only).
8. Induction of polyploidy conditions in plants (For demonstration only).

Suggested Readings:

- Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley- India.

- Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
- Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
- 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.
- Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
- Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
- Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.
- Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

Or

DSE-2: Analytical Techniques in Plant Sciences **Credits 06**

DSE2T: Analytical Techniques in Plant Sciences **Credits 04**

Unit 1: Imaging and related techniques
Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit 2: Cell fractionation
Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2 gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Unit 3: Radioisotopes
Use in biological research, auto-radiography, pulse chase experiment.

Unit 4: Spectrophotometry
Principle and its application in biological research.

Unit 5: Chromatography
Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ionexchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Unit 6: Characterization of proteins and nucleic acids
Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

Unit 7: Biostatistics

Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

DSE2P: Analytical Techniques in Plant Sciences **Credits 02**

Practical

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining).

Suggested Readings:

- Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.
- Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
- Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
- Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

Or

DSE-2: Research Methodology **Credits 06**

DSE2T: Research Methodology **Credits 04**

Unit 1: Basic concepts of research

Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs emperical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

Unit 2: General laboratory practices

Common calculations in botany laboratories. Understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases. Preparation of solutions. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique

of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling.

Unit 3: Data collection and documentation of observations
Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissue specimens and application of scale bars. The art of field photography.

Unit 4: Overview of Biological Problems
History; Key biology research areas, Model organisms in biology (A Brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics-Transcriptional regulatory network.

Unit 5: **Methods to study plant cell/tissue structure**
Whole mounts, peel mounts, squash preparations, clearing, maceration and sectioning; Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, noncoagulant fixatives; tissue dehydration using graded solvent series; Paraffin and plastic infiltration; Preparation of thin and ultrathin sections.

Unit 6: Plant microtechniques
Staining procedures, classification and chemistry of stains. Staining equipment. Reactive dyes and fluorochromes (including genetically engineered protein labeling with GFP and other tags). Cytogenetic techniques with squashed plant materials.

Unit 7: The art of scientific writing and its presentation
Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Powerpoint presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

DSE2P: Research Methodology **Credits 02**

Practical

1. Experiments based on chemical calculations.
2. Plant microtechnique experiments.
3. The art of imaging of samples through microphotography and field photography.
4. Poster presentation on defined topics.
5. Technical writing on topics assigned.

Suggested Readings:

1. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice
3. Development Association, Hong Kong.
4. Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

Skill Enhancement Course(SEC)

SEC-1: Bio-fertilizers **Credits 02**

SEC1T: Bio-fertilizers

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:

- Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
- Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
- John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay _Publication, New Delhi.
- Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
- Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New _Delhi.
- Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic _Farming Akta Prakashan, Nadiad

Or

SEC-1: Nursery and Gardening **Credits 02**

SEC1T: Nursery and Gardening

Unit-1: Nursery: definition, objectives and scope and building up of infrastructure fornursery, planning and seasonal activities - Planting - direct seeding and transplants.

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.

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.

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.

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.

Suggested Readings:

- Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH PublishingCo., New Delhi.
- Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
- Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
- Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co.,New Delhi.
- Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture andCooperation, National _Seed Corporation Ltd., NewDelhi.
- Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., SanFrancisco, USA.

SEC-2: Herbal Technology **Credits 02**

SEC2T: Herbal Technology

Unit-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.

Unit-2: Pharmacognosy - systematic position m edicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.

Unit-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).

Unit-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)

Unit-5: Medicinal plant banks micro propagation of important species (*Withania somnifera*, neem and tulsi- Herbal foods-future of pharmacognosy)

Suggested Readings:

- Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
- The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book _Distributors.
- Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
- Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH _publishing Co.
- Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
- Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
- Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.

Or

SEC-2: Mushroom Culture Technology **Credits 02**

SEC2T: Mushroom Culture Technology

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, pickels, papads), drying, storage in saltsolutions. 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:

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

SEC-3: Floriculture **Credits 02**

SEC3T Floriculture

Unit-1: Introduction: History of gardening; Importance and scope of floriculture andl andscape 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:

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

Or

SEC-3: Ethnobotany **Credits 02**

SEC3T: Ethnobotany
Unit-1: Ethnobotany
Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

Unit-2: Methodology of Ethnobotanical studies
a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

Unit-3: Role of ethnobotany in modern Medicine

Medico-ethnobotanical sources in India;Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiractha indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*. Role of ethnobotany in modern medicine with special example *Rauvolfia sepentina, Trichopus zeylanicus, Artemisia,Withania*.
Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

Unit-4: Ethnobotany and legal aspects
Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

Suggested Readings:

- S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
- S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981
- S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
- S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.
- Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
- Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah._8) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996_9)

SEC-4: Medicinal Botany **Credits 02**

SEC4T: Medicinal Botany

Unit-1: History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridoshaconcepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations.

Unit-2: Conservation of endangered and endemic medicinal plants. Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.
Unit- 3: Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of

India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

Suggested Readings

- Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
- Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.

Or

SEC-4: Plant Diversity and Human Welfare **Credits 02**

SEC4T: Plant Diversity and Human Welfare

Unit-1: Plant diversity and its scope - Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agro biodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.

Unit-2: Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agro-biodiversity, Projected scenario for biodiversity loss,

Management of Plant Biodiversity: Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.

Unit-3: Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.

Unit-4: Role of plants in relation to Human Welfare a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.

Suggested Readings:

- Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity – Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi

Or

SEC-4: Intellectual Property Rights **Credits 02**

SEC4T: Intellectual Property Rights

Unit-1: Introduction to Intellectual Property Right (IPR)
Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples.IPR and WTO (TRIPS, WIPO).

Unit-2 : Patents
Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement.

Unit-3: Copyrights
Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement.

Unit-4: Trademarks
Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name.

Unit-5: Geographical Indications
Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position.

Unit-6: Protection of Traditional Knowledge
Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Prospecting and Bio-Piracy, Alternative ways, Protectability, needfor a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library.

Unit-7: Industrial Designs
Objectives, Rights, Assignments, Infringements, Defences of Design Infringement

Unit-8: Protection of Plant Varieties
Plant Varieties Protection-Objectives, Justification, International Position, Plant varieties protection in India. Rights of farmers, Breeders and Researchers.National gene bank, Benefit sharing.Protection of Plant Varieties and Farmers' Rights Act, 2001.

Unit-9:Information Technology Related Intellectual Property Rights
Computer Software and Intellectual Property, Database and Data Protection, Protection of Semi-conductor chips, Domain Name Protection

Unit-10: Biotechnology and Intellectual Property Rights.
Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting Biotechnological inventions.

Suggested Readings:

- N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).
- Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).
- P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, TataMcGraw-Hill (2001).
- Arthur Raphael Miller, Micheal H.Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
- Jayashree Watal, Intellectual property rights in the WTO and developing countries, Oxford University Press, Oxford.