



DEPARTMENT OF BOTANY
SYLLABUS FOR M.Sc BOTANY
UNDER CHOICE BASED CREDIT SYSTEM (CBCS)
FOR CANDIDATES ADMITTED IN THE ACADEMIC YEAR
2020 -2021



Bishop Heber College (Autonomous)
(Nationally Reaccredited at the A Grade by NAAC with CGPA 3.58/4)
(Recognized by UGC as “College of Excellence”)
(Affiliated to Bharathidasan University, Tiruchirappalli)
Tiruchirappalli- 620 017.

M. Sc BOTANY PROGRAMME STRUCTURE-2020-21

Sem.	Course	Course Code	Course Title	Hours / week	Credits	Marks		
						CIA	ESA	Total
I	Core I	P18BY101	Plant Diversity	6	5	25	75	100
	Core II	P18BY102	Plant Anatomy, Embryology and Morphogenesis	6	5	25	75	100
	Core III	P18BY103	Ecology and Phytogeography	6	5	25	75	100
	Core Prac. I	P18BY1P1	Plant Diversity	3	3	40	60	100
	Core Prac. II	P18BY1P2	Anatomy, Embryology, Morphogenesis and Ecology	3	3	40	60	100
	Elective I	P18BY1:1	Farm Sciences	6	4	25	75	100
II	Core IV	P18BY204	Plant Systematics/ Angiosperm Taxonomy	5	5	25	75	100
	Core V	P18BY205	Genetics and Plant Breeding	5	5	25	75	100
	Core VI	P18BY206	Cell and Molecular Biology	6	5	25	75	100
	Core Prac. III	P18BY2P3	Plant Systematics, Genetics, Plant breeding, Cell and Molecular Biology	3	3	40	60	100
	Elective II	P19BY2:1	Bioinformatics and Nanotechnology	5	4	25	75	100
	Elective III	P19BY2:P	Green wealth	4	4	40	60	100
III	VLO	P17VL2:1/ P17VL2:2	RI/ MI	2	2	25	75	100
	Core VII	P18BY307	Plant Physiology	6	5	25	75	100
	Core VIII	P18BY308	Biophysics, Biochemistry, and Pharmacognosy	6	5	25	75	100
	Core IX	P19BY309	Microbiology and Plant Pathology	6	4	25	75	100
	Core X	P19BY310	Plant Biotechnology	6	4	25	75	100
	Core Prac. IV	P20BY3P4	Plant Physiology, Microbiology and Plant Pathology	3	3	40	60	100
IV	Core Prac. V	P20BY3P5	Biochemistry, Pharmacognosy and Plant Biotechnology	3	3	40	60	100
	Elective III	P20BY4:4	Research Methodology	6	4	25	75	100
	Elective IV	P20BY4:5	Forestry and Conservational Biology	6	4	25	75	100
IV	Core Project	P18BY4PJ	Project	18	5	--	--	100
	TOTAL					90		

CORE PAPER I – PLANT DIVERSITY

**(ALGAE, FUNGI, LICHEN, BRYOPHYTES, PTERIDOPHYTES AND
GYMNOSPERMS)**

**Semester: I
Credits : 5**

**Course Code : P18BY101
Hours/Week : 6**

SYLLABUS

Unit 1: Algae

(18 Hours)

- 1.0 Algae - General characteristics of major classes of Algae.
- 1.1 Fritsch's Classification
- 1.2 Thallus variations

- 1.3 Reproduction, Life cycle patterns and Phylogenetic trends
- 1.4 Distribution and economic importance of major groups of Algae.
- 1.5 *In vitro* algal culture.

Unit 2: Fungi and Lichen

(18 Hours)

2.0 Fungi - General characteristics of major classes of Fungi.

- 2.1 Ainsworth's classification,
- 2.2 Ecology and distribution
- 2.3 Types of Reproduction
 - 2.3.1 Spore dispersal mechanisms.
- 2.4 Lichen - General account of Lichen
- 2.5 Classification
- 2.6 Structure and Reproduction
- 2.7 Economic Importance.

Unit 3: Bryophytes

(18 Hours)

3.0 Bryophytes

- 3.1 General characteristics of Major classes
- 3.2 Classification -Rothmalar
- 3.3 Ecology and Distribution
- 3.4 Methods of Reproduction
- 3.5 General account on origin and evolution of sporophytes
- 3.6 Economic importance.

Unit 4: Pteridophytes

(18 Hours)

4.0 Pteridophytes - General Characteristics

- 4.1 Classification (Sporne, 1975).
- 4.2 Distribution and Life Cycle pattern of major classes
- 4.3 Evolutionary trend in structures and organization
- 4.4 Heterospory and seed habit
- 4.5 Telome theory
- 4.6 Comparative study of Fossil forms –(a) Rhynia, (b) Lepidodendron, (c) Lyginopteris, (d) Calamites (e) Medullosa
- 4.7 Fern Culture and Economic importance.

Unit 5: Gymnosperms

(18 Hours)

- 5.0 Gymnosperms - General account of major classes
- 5.1 Characteristics and distribution
- 5.2 Classification – Sporne
- 5.3 Reproduction and life cycle - Evolutionary trend and phylogenetic relationship
- 5.5 Economic importance.

TEXT BOOKS:

1. Vashishta, B.R., Singha, A. K. and Singh, V.P. 2005. *Botany for degree students Algae*. S.

Chand and company Pvt. Ltd., New Delhi.

2. Vashishta, B.R., Singha, A. K. and Singh, V.P. 2005. *Botany for degree students Fungi*. S. Chand and company Pvt. Ltd. New Delhi.
3. Vashishta, B.R., Singha, A. K. and Singh, V.P. 2005. *Botany for degree students Bryophytes*. S. Chand and company Pvt. Ltd. New Delhi.
4. Vashishta, B.R. and Sinha, A. K. 2007. *Botany for Degree students, Pteridophytes*. Ravindra printers Pvt. Ltd., New Delhi.
5. Vashishta, B.R and Sinha, A. K. 2007. *Botany for Degree students, Gymnosperm*. S. Chand and company Pvt. Ltd., New Delhi.
6. Fritch, F.E., 1976. *Structure and Reproduction of Algae*. Volume I and II. BI Publishers, New Delhi.

REFERENCE BOOKS:

1. Fritch, F.E. 1976. *Structure and Reproduction of Algae*. Volume I and II. BI Publishers, New Delhi.
 2. Watson, E.V. 1964. *The structure and life of Bryophytes*. Hutchinson and Co. London
 3. Sporne, K.R, 1975. *The Morphology of Pteridophytes*. Hutchinson and Co., London
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CORE PAPER- II
PLANT ANATOMY, EMBRYOLOGY AND MORPHOGENESIS

Semester : I
Credits : 5

Course Code: P18BY102
Hours/Week : 6

SYLLABUS

Unit 1: DEVELOPMENTAL PLANT ANATOMY (18 Hours)

- 1.1. Shoot apex
- 1.2. The apical cell meristem –Definition, structure, types and theories
- 1.3. Primordium initiation

- 1.4. Transition to Flowering
- 1.5. Growth and formation of organs
- 1.6. Organization of root apical meristem (RAM)
 - 1.6.1. Cell fate and lineages
 - 1.6.2. Vascular tissue differentiation
 - 1.6.3. Lateral roots
 - 1.6.4. Root hairs
 - 1.6.5. Theories of root meristem

Unit 2: WOOD DEVELOPMENT

(15 Hours)

- 2.1. Secondary tissue differentiation
- 2.2. Role of cambium
 - 2.2.1. Secondary xylem
 - 2.2.2. secondary phloem
- 2.3. Wood
 - 2.3.1. Structure
 - 2.3.2. Types – Sapwood, Heartwood
 - 2.3.3. Functions
- 2.4. Wood development in relation to environmental factors

Unit 3: EMBRYOLOGY – DEVELOPMENT OF MALE AND FEMALE GAMETES

(15 Hours)

- 3.1. Microsporangium - Anther wall, sporogenous tissue
- 3.2. Microsporogenesis – Meiosis, Microspore tetrad
- 3.3. Male gametophyte
 - 3.3.1. Morphology- Pollen wall features, preparation of pollen grains
 - 3.3.2. Development – Formation of vegetative and generative cells, Inheritance of cytoplasmic traits, Pollen wall, Abnormal features
- 3.4. Female gametophyte
 - 3.4.1. Ovule development, megasporogenesis, organization of the embryo sac, structure of the embryo sac.
- 3.5. Pollination- Definition, Floral characteristics, pollination mechanisms and vectors, breeding systems, commercial considerations.
- 3.6. Sexual incompatibility – Pollen stigma interactions, sporophytic and gametophytic self-incompatibility (cytological, biochemical and molecular aspects)

Unit 4: EMBRYOLOGY – FERTILIZATION AND POST FERTILIZATION CHANGES –

(15 Hours)

- 4.0. Pollen germination, pollen tube growth and guidance, pollen allergy, pollen embryos
- 4.1. Double fertilization- Definition, importance and uniqueness of angiosperms
- 4.2. Endosperm development - Early maturation and desiccation stages
- 4.3. Embryogenesis – Definition, ultrastructure, cell lineages during late embryo development
- 4.4. Storage proteins of endosperm and embryo, polyembryony and apomixes.
- 4.5. Dynamics of fruit growth, biochemistry
- 4.6. Molecular biology of fruit maturation

Unit 5: MORPHOGENESIS

(15 Hours)

- 5.1. Morphogenesis – Definition, scope and importance
- 5.2. Correlation, polarity, symmetry, differentiation, regeneration
- 5.3. Morphogenetic factors - Physical, mechanical, chemical and genetic factors
- 5.4. Molecular basis of morphogenesis in *Arabidopsis*.
- 5.5. Seed germination
- 5.6. Seedling growth

TEXT BOOKS:

1. Pandey, B. P. 2011. *Plant Anatomy*. S. Chand and company Pvt. Ltd. New Delhi.
2. Bhojwani, S.S. and Bhatnagar, S.P. 2011. *Embryology of Angiosperms (5th Edt.)*. Vi Publication House Pvt. Ltd. New Delhi.
3. Pandey, S.N. and Chadha, A. 1997. *Plant Anatomy and Embryology*. Sangam Books Ltd. New Delhi.
4. Mauseth, J.D. 1988. *Plant Anatomy*. The Benjamin/Cummings Publisher, USA
5. Esau, K. 1985. *Anatomy of seed plants*. John Willey
6. Cutter, E.G. 1989. *Plant Anatomy –Part I-Addison –Wesley Publishing Co*
7. Maheswari, P. 1991. *An Introduction to Embryology of Angiosperms*. Tata McGraw Publishing Co. Ltd. India
8. Erdtman, G. 1954. *An introduction to pollen analysis*. Chronica Botanica, Waltham, Mass. USA.

REFERENCES BOOKS:

- 1 Atwell, B.J. Kriedcrmann, P.E. and Jumbull, 1999. C.G.N. *Plants in Action: Adaption in Nature Performance*, in Cultivation, MacMillan Education. Sydney, Australia.
- 2 Bewley. J.D. and Black, M. 1994. *Seeds: Physiology of Development and Germination*, Plenum Press. New York.
- 3 Burgess, J. 1985. *An Introduction to Plant Cell Development* Cambridge University Press, Cambridge.
- 4 Leins, P., Tucker, S.C. and Endress, P.K. 1988. *Aspects of Floral Development* J. Cramer, Germany.
- 5 Lyndon, R.F. 1990. *Plant Development. The Cellular Basis*. Unwin Hyman, London
- 6 Murphy, T.M. and Thompson, W.E. 1988. *Molecular Plant Development*. Prentice Hall, New Jersey.

CORE PAPER III: ECOLOGY AND PHYTOGEOGRAPHY

Semester: I

Credits: 5

Course Code : P18BY103

Hours/Week : 6

SYLLABUS:

Unit 1: Geology, Pedology, Topography and Biogeochemical Cycles (18 Hours)

- 1.2 Origin of solar system
- 1.3 Age of earth
- 1.3.1 Earth – structure and degradation
- 1.3.2 Land distribution, use pattern
- 1.3.3 Rock formation and Types of Rocks
 - (a) Igneous Rocks (b) Sedimentary Rocks (c) Metamorphic Rocks
- 1.4 Soil – Definition, Origin (Pedogenesis: Definition), Concept, Composition and Types
- 1.5 Classification of soils: Urvara [fertile] and Usara [sterile]
- 1.6 Soil profile- Organic matter, Surface soil, Parent rock, Bedrock.
- 1.7 Edaphic factors – moisture, reaction, temperature, nutrients and organisms.
- 1.8 Types of soil erosion: Normal and Accelerated soil erosion
- 1.9 Soil Degradation and Reclamation
- 1.10 Topographic factors: Definition, height, direction and Steepness of the slope
- 1.11 Biogeochemical cycles: Gaseous cycles and Sedimentary cycles

Unit 2: Climatology and Hydrology- (18 Hours)

- 2.1 Structure and composition of Atmosphere
- 2.2 Climatology: Definition and Climate changes
 - 2.2.1 Weather forecast
 - 2.2.2 Types of precipitation
 - 2.2.2 Climatological factors regulating plants
- 2.3 Hydrological cycle
 - 2.3.1 Distribution of water on earth
 - 2.3.2 Lentic and lotic system
 - 2.3.3 Water resource and quality abuses
 - 2.3.4 Wetland management
- 2.4 Oceanography and marine resources management.

Unit 3: Ecological approaches and biotic interaction (18 Hours)

- 3.1 Species and its characteristics
 - 3.1.1 Speciation
- 3.2 Population Ecology
 - 3.2.1 Population structure and Interaction
 - 3.2.2 Ecads (Ecophenes) and Ecotypes
- 3.3 Community Ecology
 - 3.3.1 Composition, Dynamics, classification and physiognomy
 - 3.3.2 Plant communities

- 3.4 Plant Succession
 - 3.4.1 Causes and Kinds of succession
 - 3.4.2 Climax concept and Secondary succession
- 3.5 Plant Adaptations
 - 3.5.1 Types and Factors influencing the plants
- 3.6 Ecosystem
 - 3.6.1 Definition, structures, component and functions.
 - 3.6.2 Biosphere and its interaction with abiotic factors.

Unit 4: Phytogeography

(18Hours)

- 4.1 Phytogeography
 - 4.1.1 Definition, Importance, Types and Principles.
 - 4.1.2 Environment and Plant responses
- 4.2 Migration, Ecesis and Colonization
- 4.3 Distribution of flora
 - 4.3.1 Wides and endemics
 - 4.3.2 Factors affecting Distribution of species
- 4.4 Vegetation of World, India and Tamil Nadu (Altitudinal and Longitudinal variations).
- 4.5 Phytogeographic regions of India

Unit 5: Applied Ecology

(18 Hours)

- 5.1 Applied Ecology - overview
- 5.2 Carbon foot print and Carbon sequestration
- 5.3 Temperature regulation and Control of global warming
- 5.4 Phytoremediation
- 5.5 Erosion control and Disaster management
- 5.6 Advanced ecological studies in the developing and developed nations

TEXT BOOKS:

1. Sharma, P.D. 2015. *Ecology and Environment* (12th Edt.). Rastogi Publications, Meerut, Uttar Pradesh.
2. Pandey, P. B. 2007. *Botany for Degree students*. S. Chand and Company Pvt. Ltd., New Delhi.
3. Schulze, E.D., Beck, E. and Muller-Hohenstein, K. 2005. *Plant Ecology*. Springer, Heidelberg, New York.
4. Sharma, P. D.2019. *Plant Ecology and Phytogeography* (1st Edt.). Rastogi Publications, Meerut, Uttar Pradesh.

REFERENCE BOOKS:

1. Geiger, R., Aron, R. H. and Tod hunter, P. 2003. *The Climate near the Ground*, 6th Edn. Rowman and Littlefield Publishers, Lanham, MD, USA.
2. Good, R. 1977. *The Geography of the flowering plants* (2nd Edn.), Longmans and Green & Co., Inc., London and Allied Science publishers, New Delhi.

3. Krishnan, M. S. 1982. *Geology of India and Burma*. 6th edition, (Delhi: CBS Publishers and Distributors), PP 536.
4. Mishra, R. 1991. *Planning for environmentally Sustainable Development*. Keynote Lecturer-Symposium of School of Environmental science, J.N.U. New Delhi.
5. Mukarjee, P. K. 1996. *A Textbook of Geology*. World Press, Calcutta, pp 528.
6. Odum, E.P. 1983. *Basic Ecology*, CBS College Publishing, New York.

CORE PRACTICAL I - PLANT DIVERSITY

Semester : I

Course code : P18BY1P1

Credits : 3

Hours/Week : 3

SYLLABUS:

Unit- 1: Algae

(6 Hours)

Thallus and reproductive structure of the following, *Caulerpa*, *Nostoc*, *Oscillatoria*, *Chlamydomonas*, *Volvox*, *Oedogonium*

Unit-2: Fungi

(6 Hours)

Mycelium and reproductive structure of the following, *Plasmodiophora*, *Saprolegnia*, *Pilobolus*, *Claviceps*, *Xylaria*, *Aspergillus*, *Penicillium*, *Alternaria*, *Fusarium*.

Unit- 3: Lichen

(3 Hours)

Usnea – Thallus and fruit body.

Unit- 4: Bryophytes

(6 Hours)

Study of morphological, anatomical and reproductive structures of the following *Marchantia*, *Anthoceros* and *Polytrichum*.

Unit- 5: Pteridophytes

(9 Hours)

Comparative anatomy and sporangial organization in *Lycopodium*, *Seleginella*, *Equisetum*, *Adiantum* and *Marsilea*.

Unit- 6: Fossils

(6 Hours)

Study of the anatomical features of the following fossils specimens *Rhynia*, *Lepidodendron*, *Lyginopteris*, *Calamites* and *Medullosa*.

Unit- 7: Gymnosperms

(9 Hours)

Comparative study of the wood and cone structures by *Cycas*, *Cupressus*, *Araucaria* and *Gnetum*. Field Trip to a place of botanical interest to study the habit and habitat of the genera mentioned in the syllabus.

TEXT BOOKS:

1. Vashishta, B.R., Singha, A.K. and Singh, V.P. 2005. *Botany for degree students Algae*. S. Chand and company Pvt. Ltd., New Delhi.
2. Vashishta, B.R., Singha, A.K. and Singh, V.P. 2005. *Botany for degree students Fungi*. S. Chand and company Pvt. Ltd. New Delhi.
3. Vashishta, B.R., Singha, A.K. and Singh, V.P. 2005. *Botany for degree students Bryophytes*. S. Chand and company Pvt. Ltd. New Delhi.
4. Vashishta, B.R. and Sinha, A.K. 2007. *Botany for Degree students Pteridophytes*. Rajendra Ravindra printers Pvt. Ltd., New Delhi.
5. Vashishta, B.R and Sinha, A. K. 2007. *Botany for Degree students Gymnosperm*. S. Chand and company Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. Pandey, B.P. 2015. *College Botany Volume II*. S. Chand and company Pvt. Ltd., New Delhi.
2. Pandey, B.P. 1993. *The Text of Botany Fungi*. S. Chand and company Pvt. Ltd., New Delhi.
3. Bhatnagar, S.P and Alok Moitra. 2003. *Gymnosperms*. K.K Gupta for New International Pvt. Ltd, New Delhi.
4. Fritch, F.E., 1976. *Structure and Reproduction of Algae*. Volume I and II. BI Publishers, New Delhi.

CORE PRACTICAL – II**ANATOMY, EMBRYOLOGY, MORPHOGENESIS AND ECOLOGY****Semester: I****Credits : 3****Course code: P18BY1P2****Hours/Week : 3****SYLLABUS:****Unit- 1: Anatomy****(15 Hours)**

1. Study of cambia - non storied and storied.
2. Study the anomalous primary and secondary features in, *Amaranthus*, *Boerhaavia*, *Mirabilis*, *Nyctanthes*, *Piper* and *Strychnos*.
3. Study of stomata, trichomes, and laticifers. Determination of stomatal index.
4. Study the anatomical peculiarities of C4 and CAM plants (Leaf/Stem).
5. Study of nodal patterns.
6. Prepare a histo-taxonomic key.
7. Study the pericarp anatomy of a legume, follicle and berry.
8. Identification of wood - soft wood and hard wood.

Unit-2: Embryology and Morphogenesis

(15 Hours)

1. Study of microsporogenesis and gametogenesis in sections of anthers.
2. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa*, *Crotolaria*, *Tradescantia*, *Brassica*, *Petunia*, *Solanum melongena*, etc.)
3. Tests for pollen viability using stains and *in vitro* germination. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
4. Estimating percentage and average pollen tube length *in vitro*.
5. Pollen storage, pollen-pistil interaction, self-incompatibility, *in vitro* pollination.
6. Study of ovules in cleared preparations, study of monosporic, bisporic and tetrasporic types of embryo sac development through examination of permanent, stained serial sections.
7. Field study of several types of flower with different pollination mechanisms (Wind pollination, thrips pollination, bee/butterfly pollination, bird pollination).
8. Emasculation, bagging and hand pollination to study pollen germination, seed and fruit development using self-compatible and obligate outcrossing systems
9. Study of cleistogamous flowers and their adaptations.
10. Study of nuclear and cellular endosperm through dissections and staining.
11. Isolation of zygotic globular, heart-shaped, torpedo stage and mature embryos from suitable seeds and polyembryony in Citrus, Jamun (*Syzygium cumini*) etc. by dissections.
12. Study of seed dormancy and methods to break dormancy.

Unit- 3: Ecology

(15 Hours)

1. Study of atmosphere – Temperature, Humidity, wind velocity, light intensity.
2. Study of geographical position, altitude, latitude, longitude.
3. Study of water - Temp. pH, EC, DO and Salinity.
4. Study of soil – pH, EC, Porosity, Retentivity, Minerals (spot test) nature of soil, profile.
5. Study of individual species – Plant dimensions - length, wt. R/s ratio, leaf area, chl. Phenology, dissemination and regeneration.
6. Study of plant community – Quadrat, Transect, point methods and determination of Den, Fr, Ab, IVA and Phytograph.
7. Study of an ecosystem – Abiotic and biotic components
8. Morphometry of water bodies lentic / lotic – Productivity.

TEXT BOOKS:

1. Shivanna, K.R. and Rangaswamy, N.S. 1992. *Pollen Biology: A Laboratory Manual*. Springer-Verlag, Berlin.
2. Soetaert, Karline, Herman and Peter, M. J.2009. *A Practical Guide to Ecological Modelling*. Springer.

REFERENCES BOOKS:

1. Ambasht, R.S. 1974. *Text Book of Plant Ecology* (3rd Edition) Students & Friends Co., Varanasi.

2. Odum, E.P. 1975. *Ecology*, Holt, Rinert & Winston.
3. Kochhar, P.L. 1975. *Plant Ecology* (9th Edition) S.Nagi & Co, Jullandhar.
4. Shukla, R.S. and Chandel. P.S. *Plant Ecology & Soil Science*. S. Chand & Co., New Delhi.

Elective I - FARM SCIENCES

Semester : I
Credits : 4

Course Code : P18BY1:1
Hours/Week : 6

SYLLABUS:

Unit 1: Agriculture and Farm practices (18 Hours)

- 1.1 Farm practices
 - 1.1.1 Traditional, Modern with special reference to India.
 - 1.1.2 Threat to Agriculture.
 - 1.1.3 Labour problems and mechanization.
 - 1.1.4 Land use (Urbanization), Agro economic concepts and policies.
- 1.2 Agricultural information forecasting systems
- 1.3 Green card systems and subsidies.

Unit 2: Organic farming (18 Hours)

- 2.1 Concept and Scope of organic farming
- 2.2 Compost
 - 2.2.1 Decomposition manure
 - 2.2.2 Vermicompost, Scope and importance, Types and uses
 - 2.2.3 Vermi castings
 - 2.2.4 Potentials and constraints for vermiculture in India.

Unit 3: Application and Mass cultivation (18 Hours)

- 3.1.1 Chemical fertilizer, Definition, Scope and importance
- 3.1.2 Types: N,P,K
- 3.1.3 Biofertilizers, Definitions, Scope and uses
- 3.2 Mass production
 - 3.2.1 Blue green algae
 - 3.2.2 *Azospirillum* and *Azolla*
- 3.3 Bio pesticides and Neem products
- 3.4 Leguminous plants in green manuring.

Unit 4: Horticulture and its management (18 Hours)

- 4.1 Horticulture: Definitions, Objective, Scope and its role
- 4.2 Classification and Management
 - 4.2.1 Floriculture
 - 4.2.2 Olericulture
 - 4.2.3 Arboriculture
 - 4.2.4 Pomiculture

Unit 5: Integrated Farming System (18 Hours)

- 5.1 Integrated Farming System: Definitions and Scopes
- 5.2 Types of integrated farming and cultural methods

5.3 Practices in Agriculture water management

5.3.1 Drip irrigation

5.3.2 Fertigation

TEXT BOOKS:

1. Bugdol, M. and Jedynak, P. 2015. *Integrated Management Systems*. Springer International Publishing, Switzerland.
2. Gupta, P.K. 2010. *Vermicomposting for sustainable Agriculture*. Agrobios, Jodhpur, India.
3. Kumar, N. 2010. *Introduction to Horticulture*. Oxford and BH Publishing Co. Pvt. Ltd., India.
4. Lee, T.H., Shiba, S. and Wood, R. C. 1999. *Integrated Management Systems: A Practical Approach to Transforming Organizations*. John Wiley & Sons, Inc., India.
5. Maheshwari, D.K. 2014. *Composting for Sustainable Agriculture*. Springer International Publishing, Switzerland.

REFERENCES BOOKS:

1. Narasaiah, M. 2006. *Agriculture and Water Management*. Discovery Publishing House, New Delhi.
2. Palaniappan, S.P. and Annadurai, K. 2012. *Organic Farming – Theory and Practice*. Scientific Publishers, India.

CORE PAPER IV - PLANT SYSTEMATICS / ANGIOSPERM TAXONOMY

Semester: II

Credit: 5

Course Code : P18BY204

Hours/Week : 5

SYLLABUS:

Unit 1: Introduction, Classification systems and Techniques (15 Hours)

- 1.0 Introduction – Scope and objectives.
- 1.1 History of classification
- 1.2 A detailed study of classification –(a) Sexual system - Carolus Linnaeus (b) Natural System -Bentham and Hooker(c) Modern System - Engler and Prantl, Hutchinson, Takhtajan, APG system.
- 1.3 Taxonomic key
- 1.4 Specimen preparation and herbarium management.
- 1.5 Modern trends in Taxonomy – chemotaxonomy and numerical taxonomy/ Phenetics
- 1.6 Digital taxonomy – need, application and data base structure.

1.7 OTU, weighting and cluster analysis

Unit-2: Botanical Nomenclature and Taxonomic Principles (15 Hours)

- 2.0 International Code of Botanical Nomenclature - Salient features– Principles, Rules, Recommendations, Provisions and Appendices.
- 2.1 Typification, Principles of priority and their limitations.
- 2.3 Effective and valid publications - Author citation, retention, choice and rejection of names.
- 2.4 Familiarity with botanical literature - Monographs, periodicals and floras.
- 2.5 A brief account of B.S.I. and its role in taxonomic studies.

Unit 3: Characters as taxonomic evidence (15 Hours)

- 3.0 Concept of characters and following characters as taxonomic evidence in solving taxonomic problems. (a) Morphology, (b) comparative plant anatomy (c) karyology (d) embryology, (e) palynology, (f) paleobotany, (g) ecology and Plant genome as source of taxonomic evidence
- 3.1 Taxonomic hierarchy - categories and ranks.
- 3.2 Relevance of taxonomy to conservation.

Unit 4: Understanding Angiosperm families (15 Hours)

- 4.1 Detailed study of the following families covering diagnostic features, distribution and description: (a) Menispermaceae, (b) Nymphaeaceae, (c) Capparaceae, (d) Caryophyllaceae, (e) Meliaceae, (f) Aizoaceae, (g) Rubiaceae, (h) Asteraceae, (i) Convolvulaceae, (j) Solanaceae,
- 4.2 Economic importance of the above mentioned families.

Unit 5: Understanding Angiosperm families (Contd.,) (15 Hours)

- 5.1 Detailed study of the following families covering diagnostic features, distribution and description: (a) Scrophulariaceae, (b) Acanthaceae, (c) Verbenaceae (d) Lamiaceae, (e) Loranthaceae, (f) Euphorbiaceae, (g) Hydrocharitaceae, (h) Commelinaceae, (i) Araceae (j) Cyperaceae.
- 5.2 Economic importance of the above mentioned families.

TEXT BOOKS:

- 1. Burkill, I.H. 1965. *Chapters of the history of Botany in India*, Government of India Press, The Manager of Publications, Nasik.
- 2. Young, D.A. and Seiyler, D.S. 1981. *Phytochemical and Angiosperm Phylogeny*. Prager Publications. New York.
- 3. Davis, P.H. and Heywood, V.H. 1967. *Principles of Angiosperm Taxonomy*. Oliver and Boyd, London.
- 4. Heywood, V.H. 1967. *Plant Taxonomy*. English Language Book Society, London.

5. Jeffrey, C. 1982. *Introduction of Plant Taxonomy*, Cambridge University Press, Cambridge.
6. Gamble, J.S. 1933. *Flora of the Presidency of Madras*. Botanical Survey of India, Calcutta.
7. Tiagi, Y.D. and Kshetrapal, S. 1988. *An Introduction to the Taxonomy of Angiosperms*. Ramesh Book Depot, Jaipur, India.
8. Takhtajan, A.L. 1997. *Diversity and Classification of Flowering Plants*. Columbia, University Press, New York.
9. Nordenstam, B., ElGazaly, G. and Kassas, M. 2000. *Plant systematics for 21st Century*. Portland Press Ltd. London.
10. Singh, G. 2005. *Plant Systematics: Theory and Practices* (2nd Ed.). Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.
11. Naik, V.N. 2006. *Taxonomy of Angiosperms*. Tata McGraw Hill Education, Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. Sambamurty, A.V.S.S. 2005. *Taxonomy of Angiosperms*. I.K. International Pvt. Ltd., New Delhi, 2005

CORE PAPER V-GENETICS AND PLANT BREEDING

Semester : II

Course Code : P18BY205

Credits : 5

Hours/Week : 5

SYLLABUS:

Unit 1: Genetics

(15 Hours)

1.1 Genetics – Definition and Historical perspectives

1.1.1 Phenomenon of Inheritance –

i) Vapour and Fluid theories ii) Preformation theories iii) Particulate theories

1.2 Mendelian Principles

i) Phenomenon of Dominance – Law of segregation and Law of Independent Assortment ii) Mono hybrid Cross, Dihybrid Cross, Back cross and Test cross

iii) Variation in Dominance- (a) Incomplete dominance (b) Co-dominance

1.3. Gene Interaction

- 1.3.1 Gene Interaction – Definition
- 1.3.2 Kinds of Gene Interaction -
 - (a) Non-allelic /Non- Epistatic Inter allelic genetic Interaction – Ex: Combs in Fowl (b) Epistasis and Epistatic Interaction – Definition and types
 - i) Dominant and Recessive Epistasis ii) Duplicate genes with cumulative effect
 - iii) Duplicate Recessive and Dominant Genes (iv) Dominant and Recessive Interactions
- 1.3.3 Lethal Genes – Definition
- 1.4. Multiple alleles**
- 1.4.1 Multiple alleles – Definition and Characteristics
- 1.4.2 Examples – i) Coat colour of Rabbits ii) ABO Blood group in Human beings
- 1.4.3 Rh factor
- 1.5. Mechanisms of Sex Determination**
- 1.5.1 Sex Determination – Definition, Common Mechanisms – A) Genetically Controlled Sex determining mechanisms B) Metabolically Controlled C) Hormonally Controlled D) Environmentally Controlled
- 1.5.2 Genetically Controlled Mechanisms – A) Heterogametes B) Genic Balance Mechanism C) Male Haploidy D) Single Gene Effects
- 1.6 Intergenic and Intragenic Complementation and Recombination**
- 1.6.1 Complementation and Recombination – Definition and Types
- 1.6.2 Intergenic (Ex: Apricot eye colour in *Drosophila*) and Intragenic Complementation (Ex: Lozenge Locus in *Drosophila*)
- 1.6.3 Intergenic and Intragenic Recombination
- 1.7 Extranuclear Inheritance**
- 1.7.1 Extranuclear Inheritance – Definition and Characteristics
- 1.7.2 Examples – A) Maternal Inheritance – Ex: Shell coiling in *Limnaea* B) Cellular Organelles – Ex: Chloroplast Inheritance in *Mirabilis jalapa* and mitochondrial Inheritance – Male Sterility in Maize C) Endosymbionts – Ex: Kappa Particles in *Paramecium aurelia*
- 1.8. Polygenic inheritance**
- 1.8.1 Definition, Characteristics
- 1.8.2 Examples -(a) Kernal Colour in Wheat (b) Skin colour in Man

Unit 2: Genetic Material

(15 Hours)

- 2.1 Nucleic acids**
- 2.1.1 Structure of DNA – Watson and Crick Model and Types – B-DNA, A-DNA and Z-DNA
- 2.1.2 Structure of RNA
- 2.2 Fine Structure of Gene**
- 2.2.1 Gene – Definition and types – i) Hypomorphs ii) Amorphs iii) Hypermorphs iv) Hypermorphs v) Neomorphs
- 2.3 Modern Concept of Gene – Cistron, Recon and Muton**
- 2.4 Gene Amplification**
- 2.4.1 Gene Amplification – Definition and Characteristics
- 2.4.2 Example – Transposable Element- Discovery, Characteristics, Mode of Discovery – McClintock Experiment in Maize
- 2.4.3 Types – i) Insertion Sequence ii) Complex Transposons with examples
- 2.5 Polymerases**
- 2.5.1 DNA Polymerases – Role and types –
 - i) Prokaryotic DNA Polymerases – DNA Polymerase I, II and III

- ii) Eukaryotic DNA Polymerases – a) Alpha b) Beta c) Gamma d) Delta e) Epsilon
- iii) DNA Ligase

2.6 Replication of RNA genomes

- 2.6.1 RNA Replication – Ex: In Viruses
- 2.6.2 Role of Replicase and Reverse Transcriptase

2.7 Microbial Genetics

- 2.7.1 Gene Transfer – Definition and types
- 2.7.2 Transformation – Griffith's Experiment
- 2.7.3 Transduction – Lederberg and Zinder Experiment
- 2.7.4 Conjugation – Bacterial conjugation in *E. coli*
- 2.7.5 Sexduction

Unit 3: Genetic Mapping and Human Genetics

(15 Hours)

3.1 Gene Mapping Methods

- 3.1.1 Linkage – Definition, Kinds – i) Complete Linkage ii) Incomplete Linkage
- 3.1.2 Linkage Map construction -
 - i) Determination of Linkage Groups
 - ii) Determination of Map Distance- Two point Test Cross, Three Point Test Cross
 - iii) Determination of Gene Order
 - iv) Combining Map Segments

3.2 Tetrad Analysis

- 3.2.1 Tetrad Analysis – *Neurospora* Analysis
- 3.2.2 First division segregation and Second Division Segregation

3.3 Mapping with Molecular Markers

- 3.3.1 Molecular Marker – Definition, Characteristics
- 3.3.2 Example – i) RFLP – Procedure, Advantages ii) RAPD – Procedure, Advantages

3.4 Mapping by using Somatic Cell Hybrids

- 3.4.1 Somatic Cell Hybrids – Definition, Characteristics
- 3.4.2 Procedure – Mapping of Somatic Cell Hybrids

3.5 Development of Mapping Population in Plants

3.6 Mapping genes by Interrupted mating

3.7 Human Genetics

- 3.7.1 Pedigree Analysis
- 3.7.2 Lod Score for Linkage Testing
- 3.7.3 Karyotypes – definition, Procedure
- 3.7.4 Genetic Disorders
- 3.7.5 Eugenics – Definition and types – i) Positive Eugenics ii) Negative Eugenics

Unit 4: Plant Breeding

(15 Hours)

4.1 Introduction to Plant breeding

- (a) History (b) Objective and (c) Importance

4.2. Plant Domestication- i) Concepts of Domestication ii) Center of Origin of Species- N. Vavilov

4.3. Principles of selection and its methods - i) Mass Selection, ii) Pure line Selection and iii) Clonal selection

4.4. Hybridization

- i) Objectives and ii) Hybridization procedure- (a) Choice of parents, (b) Emasculation, (c) Bagging and Labelling and (d) Harvesting and Raising F1 generation
- 4.5. Effect of Heterosis
 - (a) Genetic causes - i) Dominance theory and ii) Over dominance, (b) Physiological causes of heterosis
- 4.6. Heterosis- Definition**

Unit 5: Polyploidy and Mutation Breeding

(15 hours)

5.1. Polyploidy Breeding

- 5.1.1. Types of chromosome number- i) Heteroploidy and ii) Euploidy.
- 5.1.2. Origin, Production, Application and Limitation of Autopolyploidy and Allopolyploidy

5.2. Mutation breeding

- 5.2.1. Types of Mutation- Spontaneous and induced mutations
- 5.2.2. Types of Mutagen – (a) Physical and chemical mutagens, (b) Dose and treatment (c) Factors affecting the mutation (d) Methods of mutation breeding – i) Oligogenic and ii) Polygenic
- 5.2.3. Limitations and achievements of mutation breeding.
- 5.3. Distant Hybridization
 - 5.3.1. Types of Crosses- i) Intra and Inter varietal crosses ii) Inter- specific and Intergeneric crosses
 - 5.3.2. Techniques, Procedure, Application and limitation
- 5.4. Biotechnology in Breeding - (a) Anther culture (b) Pollen culture (c) Somatic hybridization
- 5.5. Commercial release of Varieties- (a) Evaluation (b) Identification and (e) Release and Notification.

TEXT BOOKS:

Genetics:

1. Elrod Susan, L. 2010. *Genetics* (4th Ed.). Tata McGraw Hill, New Delhi, India.
2. Gupta, P.K.1988. *Cytology and Genetics – A Text Book for University students.* (5th Ed.) , Rastogi Publishers, Meerut, Uttar Pradesh India.
3. Meyyan, R.P. 1999. *Genetics and Evolution.* Saras Publication, Nagarcovil, Tamil Nadu, India.
4. Sinnot, E.W., Dunn, L.C. and Dobshansky, T. 1958. *Principles of Genetics* (5th Ed.). McGraw Hill Publishing Co., New Delhi, India.

Plant Breeding:

1. Chaudhary, R.C. 1991. *Introduction to Plant Breeding.* Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi India.
2. Ghahal, G.S. and Gosal, S.S. 2002. *Principles and Procedures of Plant Breeding.* Narosa Publishing House, India .
3. Singh, B.D. 2006. *Plant Breeding: Principles and Methods,* Kalyani Publishers, India.

REFERENCE BOOKS:

Genetics

1. Dyansagar, V.R.1990. *Cytology and Genetics*. Tata McGraw Hill Publishing Co. Pvt. Ltd., New Delhi, India.
2. Miglani, G.S. 2002. *Advanced Genetics*. Narosa Publishing House, India.
3. Sinha, U. and Sinha, S. 1976. *Cytogenetics, Plant Breeding and Evolution*. Vikas Publishing House, New Delhi India.

Plant Breeding:

1. Acquaah, G. 2007. *Principles of Plant Genetics and Breeding*. Blackwell Publishing, USA.
2. Agarwal, R.I. 1998. *Fundamentals of Plant Breeding and Hybrid Seed Production*. Oxford and IBH Publications, New Delhi, India.
3. Allard, R.W. 1999. *Principles of Plant breeding*. John Wiley Publications, New York.
4. Baudai, M. M.1974. *Practical Plant Breeding*. Oxford and IBH Publication, Pvt. Ltd., New Delhi, India.
5. Chopra, V.I. 1998. *Plant breeding – Theory and Practice* (2nd Ed.). Oxford and IBH Publishing, Pvt. Ltd., New Delhi, India.

CORE PAPER - VI CELL AND MOLECULAR BIOLOGY

Semester: II

Credits: 5

Course Code: P18BY206

Hours/Week :6

SYLLABUS:

Unit 1 : Introduction to cell biology

(18 Hours)

- 1.1 Cell Biology – (a) Definition, (b) History,(c) Theory
- 1.2 Cell – Prokaryotic and Eukaryotic
- 1.3 Plasma membrane – (a) Chemical composition, (b) Structure (Fluid mosaic model of membrane) (c) Functions
- 1.4 Cell wall – (a) Chemical compositions (b) Structure (Primary, Secondary, Tertiary), Functions, Growth
- 1.5 Cytoskeleton (a) Microtubules and microfilaments, (b) Motor and flagella movements.
- 1.6 Chloroplast and mitochondria: Structure and function.
- 1.7 Plant vacuole - Structure and function.

1.8 Other Cellular organelles: Structure and functions of (a) Micro-bodies (b) Golgi apparatus (c) Ribosomes (d) Lysosomes(e) Endoplasmic Reticulum.

Unit 2 : Karyology and karyotype (18 Hours)

- 2.1 Nucleus (a) Structure (b) Nuclear pores (c) Nucleosome organization(d) nucleolous,
- 2.2 Chromatin organization (a) Chromosome structure and packaging of DNA, (b) Molecular organization of centromere and telomere(c) Euchromatin and Heterochromatin.
- 2.3 Karyotype (a) Karyotype analysis(b) Banding patterns(c) karyotype evolution.
- 2.4 Specialized types of chromosomes (a) polytene (b) lampbrush and sex chromosomes (c) molecular basis of chromosome pairing.
- 2.5 Cell cycle (a) Mitosis and Meiosis - cytokinesis and cell plate formation.

Unit 3 -Molecular Biology (18 Hours)

- 3.1 Nucleic Acids – (a) DNA (b) RNA
- 3.2 Deoxyribonucleic acid: (a) Chemical compositions (b) Molecular structure
 - 3.2.1 Watson and crick’s double helical model– Biological Significance
 - 3.2.2 Different forms of DNA – A, B, C, D and Z
 - 3.2.3 Denaturation – Renaturation
- 3.3 DNA Replication:
 - 3.3.1 Molecular Mechanism of Prokaryotic and Eukaryotic
 - 3.3.2 Enzymology of DNA Replication – (a) DNA polymerase enzymes (b) Polynucleotide ligase (c) Exonuclease
- 3.4 Ribonucleic Acid: The genetic, Non - genetic and other types of RNAs
 - 3.4.1 Genetic RNA
 - 3.4.2 Non genetic RNA – mRNA, rRNA, tRNA
 - 3.4.3 Other types of RNAs – snRNAs, hnRNAs
- 3.5 Genetic code: (a) Triplet code (b) Nature and characteristic features

Unit-4- Protein synthesis (18 Hours)

- 4.1 Central dogma and central dogma reverse.
 - 4.1.1 Raw material for protein synthesis
 - 4.1.2 Mechanism of Protein synthesis - Transcription (a) Mechanism of RNA Transcription in Prokaryotes (b) Molecular Mechanism of Transcription in Eukaryotic cells (c) Post Transcriptional modification of RNA(d) Mechanism of RNA splicing
 - 4.1.3 Mechanism of Protein synthesis – Translation (a) Translation in prokaryotes (b) Translation in Eukaryotes(c) Post translational processing of proteins

Unit 5 Cell signalling (18 Hours)

- 5.1 Hormones and their receptors,
- 5.2 Cell surface receptors,
- 5.3 Signal transduction pathways.
- 5.4 Mechanism and cellular response to environmental and Hormonal signaling,
- 5.5 Senescence and Abscission.
- 5.6 Programmed cell death in plants.

TEXT BOOKS:

1. Veer Bala Rastogi, 2008. *Fundamental of Molecular Biology*, Ane Books, India.
2. Benjamin, L.2014. *Genes IX*, New York: Oxford University.
3. Bruce Alberts. 2008. *Essentials of Cell Biology*. New York: Garland Science, 2008.

4. David P. Clark. 2005. *Molecular Biology*. Elsevier, New York.
De Robertis, E. D. P, and De Robertis. E.M.F. 2007. *Cell and Molecular Biology*, (6th ed.) W.B. Saunders College, Philadelphia.
5. Freifelder, D. *Molecular Biology*. (2ndEd.). Boston: Jones and Barlett, 1987.
6. Karp, G. 2007. *Cell and Molecular Biology*. John Wiley, New York
7. Morris, M.D.2016. *Molecular Biotechnology*, CBS New Delhi, India.

REFERENCE BOOKS:

1. Polard. F.D., Earnshaw, W.C. and Schwartz, J. L, 2008.. *Cell Biology*. Philadelphia: Saunders.
2. Wolfe, S.L. 1999. *Molecular and Cellular Biology*. USA: Wadsworth.

CORE PRACTICAL- III

**PLANT SYSTEMATICS, GENETICS, CELL AND MOLECULAR BIOLOGY AND
PLANT BREEDING**

Semester : II

Course Code : P18BY2P3

Credits : 3

Hours/Week : 3

SYLLABUS:

Unit 1: Plant Systematics (15 Hours)

1. Identification and their description of a specimen from representative, locally available families.
2. Location of key characters and use of keys at family level
3. Description of various species of a genus, location of key characters and preparation of keys at generic level.
4. Training in using floras and herbarium for identification of specimens described in class.
5. Field trips/Excursion, compilation of field notes and preparation of herbarium specimens of wild plants.

Unit 2: Genetics (12 Hours)

1. Genetics problems – Interaction of factors, sex linked inheritance.
2. Linkage mapping
3. Chromosome mapping

Unit 3: Molecular Biology (9 Hours)

1. Elution of enzymes
2. Isolation of DNA
3. Isolation of RNA

4. Isolation of plasmid from bacterium, Restriction, digestion, ligation and PCR amplification.

Unit 4: Plant Breeding

(9 Hours)

1. Emasculation
2. Mass Selection
3. Pure Line Selection
4. Back Cross Selection
5. Mutagens
6. Centres and origin for cultivated plants.

TEXT BOOKS:

1. Veer Bala Rastogi, 2008. *Fundamental of Molecular Biology*, Ane Books, India.
2. Benjamin, L.2014. *Genes IX*, New York: Oxford University, 2014.
3. Chaudhary, R.C. 1991. *Introduction to Plant Breeding*. Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi India

REFERENCE BOOKS:

Plant systematics

1. Gamble, J.S. 1933. *Flora of the Presidency of Madras*. Botanical Survey of India, Calcutta, India.
2. Matthew, K. M. 1999. *The Flora of Palni Hills, The Rapinat Herbarium, Tiruchirappalli, Tamil Nadu*

Genetics

1. Gelbarty, W.M. 1996. *An introduction of Genetic Analysis*. 7th Ed. W.H. Freeman. NewYork.
2. Sinha, U. and Sinha, S. 1976. *Cytogenetics, Plant Breeding and Evolution*, Vikas Publishing House, New Delhi.

Molecular Biology

1. Henry, R.J. 1997. *Practical Applications of Plant Molecular Biology*. Chapman and Hall, London, UK.
2. Rashid. A. 2009. *Molecular physiology and biotechnology of flowering plants*, Narosa Publishing House, New Delhi , India.

Plant Breeding

1. Acquaah, G. 2007. *Principles of Plant Genetics and Breeding*. Blackwell Publishing, USA.
2. Agarwal, R.I. 1998. *Fundamentals of Plant Breeding and Hybrid Seed Production*. Oxford and IBH Publications, New Delhi, India.

3. Singh, B.D. 2006. *Plant Breeding: Principles and Methods*. Kalyani Publishers, India.

ELECTIVE PAPER: II - BIOINFORMATICS AND NANOTECHNOLOGY

Semester : II
Credits : 4

Course Code : P19BY2:1
Hours/Week : 5

Unit 1: COMPUTER APPLICATION IN BIOLOGY (15 Hours)

- 1:1 Bioinformatics – definition and its applications
- 1:2 Biological database- definition, types- Primary, secondary and specialized databases-Molecular biology databases, bibliographic databases, taxonomical databases, sequences cluster databases, Genomic databases, protein sequences databases, protein families and domain databases and integrated databases.
- 1:3 Biological database management system- organizing data- Flat files and spread sheets, Hierarchical files, Relational files, object oriented files and importance of biological databases.
- 1:4 Information networks – Internet, World wide web and internet explorer.
- 1:5 Text based searching- SRS, entrez and DBGET
- 1:6 Search concepts- Boolean search, broadening the search, Narrowing the search, proximity search and wild cards.
- 1:7 Search engine – definition and Google, Bing, Baidu, Yahoo.
- 1:8 Bioinformatics tools: Introduction and uses- a. BLAST, b. FASTA, c. Multiple sequence alignment- CLUSTAL-W, d. MEDLINE & PubMed, e. Retrieving and installing a programme (Tree Tool)
- 1:9 Science Citation Index

Unit 2: DATABASES AND SEQUENCES ALIGNMENT (15 Hours)

- 2:1 Uses of nucleic acids
- 2:2 Protein data banks and databases- NCBI, EMBL, DDBJ, SWISSPORT
- 2:3 Sequence alignments – definition and types
- 2:4 Sequence Alignment and alignment programs- Dot matrix, PAM matrices and Blosum matrices
- 2:5 Pair wise sequence alignment – definition and methods Global and Local alignment, Dot-matrix and Dynamic programming methods
- 2:6 Multiple sequence alignment- Global alignment and Sequence block
- 2:7 Computer drug designing.

Unit 3: DNA AND PROTEIN SEQUENCE ANALYSIS (15 Hours)

- 3:1 Phylogenetic analysis- definition, steps and importance of molecular phylogenetic
- 3:2 Phylogenetic methods- Phylogenetics vs Taxonomy, Cladistic vs phenetic, Clusterin and Parsimony vs Maximum likelihood methods.
- 3:3 Methods for determining evolutionary trees- Maximum parsimony, distance and maximum likelihood methods- Fitch and Margoliash method and Neighbor joining algorithm.

- 3:4 DNA sequence analysis
- 3:5 Protein structure visualization, comparison- Intermolecular, intra molecular and combine methods
- 3:6 Classification- SCOP and CATH
- 3:7 Protein secondary structure prediction methods- Abinitio based, homology based and prediction with multiple methods.
- 3:8 Protein tertiary structure prediction methods- Homology modeling, threading, abinitio prediction.

Unit 4 NANO-BIOTECHNOLOGY

(15 Hours)

- 4:1 Nanotechnology – definition, scope and importance
- 4:2 Nano particle Synthesis processes- Approach – Bottom up and Topdown approach and Methods- Physical, chemical and biological and application,
- 4:3 Nanoparticle synthesis- bacteria, fungi, Actinomycetes and plants
- 4:4 Natural synthesis of magnetic nanoparticles- Magnetotactic bacteria, Magnetosomes and their applications

Unit 5 : Application of Nanobiology

(15 Hours)

- 5:1 Nanomaterial- in medicine, in food, in Environment, for water purification, in energy and in computer
- 5:2 Special applications- Nanosensors and Nanoprobes
- 5:3 Current status of nanobiotechnology
- 5:4 Future perspectives of Nanobiotechnology.

TEXT BOOKS:

1. Teresa, K., Attwood and David J. Parry –Smith. 2003. *Cell and Molecular Biology in action series: Introduction to Bioinformatics*. Pearson education (Singapore) Pvt. Ltd., Indian branch, Patparganj, New Delhi.
2. Gladys Helan Hebsyba, S. and Hemalatha, C. R. 2009. *Basic Bioinformatics*. MJ Publisher, Tamil Nadu.
3. Vittal R. Srinivas, 2009. *Bioinformatics a modern approach*. Asoke K. Ghosh, PHI learning Private Limited, New Delhi.
4. Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2008. *4th Edition Bioinformatics methods and applications*. PHI learning Private Limited, New Delhi, India.

REFERENCE BOOK:

Jin Xiong. 2006. *Essential of Bioinformatics*. Published by Cambridge University press, Daryaganj, New Delhi

ELECTIVE: III- GREEN WEALTH

Semester : II

Course Code : P19BY2:P

Credits : 4

Hours/Week : 4

SYLLABUS:

Unit 1 : Plants and Nutrition

(8 Hours)

- 1.0. Plants and their Nutrition
- 1.1. Basic taxonomic knowledge, cultivation practices and Nutritional values – Cereals and millets, Pulses, Nuts
- 1.2. Field visit to crop land and report.
- 1.3. Preparation of diet chart - (a) Normal children (b) Adult (c) Senior people (d) Pregnant woman (e) Lactating mother (f) Diabetic and diuretic people.
- 1.4. Preparation of Indian Traditional food
- 1.4.1. Recipes along with nutritional values (Cereals/millets to be used either singly or in combination)

Unit 2 : Plants and Medicine

(8 Hours)

- 2.0. Plants and their medicinal values
- 2.1. A brief knowledge of five plants used in first aid
- 2.2. Plants used to treat hypertension
- 2.3. Plants used to treat obesity
- 2.4. Plants used to treat blood sugar
- 2.5. Plants used to treat antifertility
- 2.6. Method of herbal preparations and administration
- 2.7. Maintenance of medicinal plants lively- Medicinal garden.

Unit 3 : Plants and Aesthetics

(12)Hours

- 3.0 Plants and Aesthetics values
- 3.1. Vegetable carving
- 3.2. Bouquet
- 3.3. Jungle jewels
- 3.3.1. Ear drops
- 3.3.2. Studs
- 3.3.3. Bangles
- 3.3.4. Necklace
- 3.4. Cosmetics
- 3.4.1. Face packs
- 3.4.2. Skin cares
- 3.5. Jute
- 3.6. Coir items

Unit 4 : Plants and Environment

(8 Hours)

- 4.0. Plants and Environment
- 4.1. Plant indicators
- 4.2. Plants as wind breakers 4
- .3. Green house plants
- 4.4. Plants in disaster management
- 4.5. Plants as radiation, gas and noise absorbents
- 4.6. Plants as dust filters
- 4.7. Temperature mitigants.

Unit 5 : Plants and Entrepreneurship

(12 Hours)

- 5.0. Plants and Entrepreneurship
- 5.1. Learning skills -(a) Topiary (b) Bonsai (c) Formation of lawns (d) Kitchen garden (e) Herbal (medicinal) gardens (f) Hanging garden (g) Rock garden
- 5.2 Visit to botanical garden and report

TEXT BOOKS:

1. Ambast, S. P. 1986. *The Useful Plants of India*. Publications and Information Directorate, CSIR, New Delhi.
2. Pandey, B.P.1999. *Economic Botany*. S. Chand and company Pvt. Ltd., New Delhi.
3. Prajapati, N.D., Purohit, S.S. and Sharma, A.K. 2011. *A Handbook of Medicinal Plants*. Motilal Banarsidass Publishers Pvt. Ltd., New Delhi.
4. Sambamurty, A.V.S.S. and Subrahmanyam, N.S. 1989. *A Text Book of Economic Botany*. New Delhi.
5. Swaminathan, M. 1992. *Human Nutrition and Diet*. Bappco, Bangalore.
6. Verma, V. 2009. *Textbook of Economic Botany*. Ane Books, India.

REFERENCE BOOKS:

Bose. T.K, Singh. L.J, Sadhu. M.K, Maitu. L.K. 2000. *Ornamental Plants and Garden designing*. Encyclopedia Vol. 1 & 2, Kolkatta.

CORE PAPER VII- PLANT PHYSIOLOGY

Semester : III

Credits : 5

SYLLABUS:

Course Code : P18BY307

Hours/Week : 6

Unit 1 : PHYSIOLOGY OF GROWTH AND MOVEMENTS

(18 Hours)

1.1 Viability - Definition

1.1.1 Factors affecting viability of seed

(a) Time (b) Temperature and Moisture (c) Nature (d) Storage Conditions (e) Pollination

1.1.2 Seed Viability Test – Tetrazolium Test

1.2 Dormancy- Definition

1.2.1 Factors responsible for dormancy - (a) Hard seed coat (b) Immature Embryo (c) Period after ripening (d) Germination Inhibitors

1.2.2 Mechanism and Factors regulating dormancy

1.2.3 Hormonal Control of Dormancy in seeds

1.2.4 Dormancy controlled by Temperature and restricted oxygen uptake.

1.2.5 Methods of breaking Dormancy – (a) Scarification (b) Mechanical (c) Low Temperature (d) Alternating Temperature (e) Light (f) Pressure.

1.3 Vernalization

1.3.1 Definition, Vernalization and Flowering, Vernalization and Gibberellins

1.3.2 Mechanism of Vernalization– (a) Phasic Development Theory (b) Hormonal

Theories 1.3.3 Devernalization, Practical utility.

1.4 Germination

1.4.1 Structure of Dicot Seed, Physiological Changes

1.4.2 Conditions essential for germination – Water, Oxygen, Temperature and Light.

1.5 Flowering Physiology

1.5.1 Synthesis of Flowering Hormone

1.5.2 Gibberellins and flowering response

1.5.3 Photoperiodism and the C/N ratio

1.6 Photobiology

1.6.1 Phytochrome – Photochemical and Biochemical properties, Pr and Pfr forms, Characteristics of Phytochrome induced responses, Structure and function of Phytochrome proteins.

1.6.2 Cryptochromes – Regulation in Plant Development, Photo receptor interaction in the inhibition of stem elongation.

1.6.3 Critical Day length and Photoperiodic Induction – Definition – Photoperiodism, Classification based on photoperiodic responses- (a) SDPs (b) LDPs (c) LSDPs (d) SLDPs (e) DNPs, Photoperiodic induction- Clock Hypothesis.

1.7 Phytohormone

1.7.1 Biosynthesis and Physiological role of the following Phytohormones

a) Auxin b) Gibberellins c) Cytokinins d) ABA e) Ethylene

1.8 Fruiting Physiology

1.8.1 Fruit Initiation – Resource for fruit growth & Synthesis of starch

1.8.2 Fruit Maturation – Sugar storage & Starch storage

1.8.3 Fruit Ripening – Changes (a) Carbohydrate Composition (b) colour (c) Flesh Softening & textural change (d) Aroma Volatiles (e) Accumulation of organic acids

1.9 Physiology of Senescence and Abscission

1.9.1 Senescence – Definition, Types- (a) Organ (b) Whole Plant (c) Shoot (d) Sequential (e) Synchronous

1.9.2 Mechanism – (a) Theory of Hormonal induction of senescence (b) Hormonal root Pruning theory (c) Senescence due to hormones

- 1.9.3 Programmed cell death
- 1.9.4 **Abscission-** Definition, Mechanism – Auxin gradient Hypothesis
- 1.10 Movement in Plants**
- 1.10.1 Classification of Plant Movements – a) Movement of Locomotion b) Movement of Curvature
- 1.10.2 Biological Clock – Evidences
- 1.10.3 Circadian Rhythms – a) Diurnal Variations (b) Seasonal Variations

Unit 2 : WATER PHYSIOLOGY

(18 Hours)

2.1 Nature of Protoplasm

- 2.1.1 Properties of Protoplasm, Polyphasic Colloidal System

2.2 Permeability

- 2.2.1 Theories of Cell Permeability – a) Fluid Mosaic Theory b) Colloidal Theory c) Sieve or Ultrafiltration Theory

2.3 Properties of Water, Water relations

- 2.3.1 Elixir of Life, Physico-chemical Properties
- 2.3.2 Diffusion, Osmosis, Imbibition, DPD, Turgor Pressure, Wall Pressure, Suction Pressure and Water Potential.

2.4 Absorption of Water

- 2.4.1 Soil Water, Movement of water into the root cells
- 2.4.2 Mechanism – a) Active – i) Osmotic Theory ii) Non-Osmotic Theory b) Passive

2.5 Ascent of Sap

- 2.5.1 Definition, Mechanism – i) Vital Theories ii) Root Pressure Theory iii) Physical Theory

2.6 Transpiration

- 2.6.1 Definition and types- Cuticular, Stomatal and Lenticular.
- 2.6.2 Mechanism of Stomatal opening and closing- Theories – i) Photosynthetic Production in the guard cells ii) The starch-sugar hypothesis iii) Glycolate theory iv) Active K^+ Transport Mechanism
- 2.6.3 Factors regulating Transpiration and its significance
- 2.6.4 Guttation

Unit 3 : CARBON METABOLISM & INTEGRATION OF METABOLIC CYCLES

(18 Hours)

3.1 Photosynthesis

- 3.1.1 Definition, Significance and Photosynthetic apparatus – i) Photosynthetic Pigments - Chl a,b,c,d and e ii) Light Harvesting Complexes – Reaction Centres- PSI, PSII.
- 3.1.2 The role of light – Radiant energy
- 3.1.3 Photophysiological reaction – i) Cyclic Photophosphorylation ii) Non-cyclic Photophosphorylation.

3.2 Carbon Fixation

- 3.2.1 Pathways and Carbon Productivity of the following Cycles- C3, C4, CAM, HMP and C2 cycle.

3.3 Translocation of Solutes

- 3.3.1 Path of translocation- i) Downward ii) Upward
- 3.3.2 Mechanism of Phloem conduction – Theories i) Diffusion Hypothesis ii) Activated Diffusion iii) Electro-osmotic Theory iv) Interfacial flow Hypothesis v) Munch Mass Flow Hypothesis
- 3.4 Respiration**
- 3.4.1 Definition, Types- i) Aerobic ii) Anerobic Respiration
- 3.4.2 Mechanism of Aerobic Respiration –Glycolysis, Kreb’s Cycle, Oxidative Phosphorylation
- 3.4.3 Energy Transfer – ATP Synthesis
- 3.4.4 Pasteur’s Effect, Bioluminescence – Definition, Significance, Role of Luciferase
- 3.4.5 Integration of Metabolic Pathways through Kreb cycle, Distribution of Metabolites
- 3.4.6 Factors regulating Respiration

Unit 4 : MINERAL NUTRITION AND NITROGEN METABOLISM (18 Hours)

4.1 Mineral Nutrition

- 4.1.1 Physiological role and deficiency symptoms of essential elements in Plants – a) Macro Nutrients- C,H,O₂, N,S, P, Cl, K, Mg, Silicon. b) Micronutrients (I, Mn, Bo, Cu, Zn, Mo, Na)
- 4.1.2 Sand Culture, Hydroponics – definition, Nutrient Film Technique, Significance
- 4.1.3 Chemical Fertilizers – N, P, K. Manures, Foliar application of nutrients
- 4.1.4 Mineral Absorption – availability of nutrients in soil and air
- 4.1.5 Mechanism of mineral absorption – i) Passive – Mass flow, diffusion, Ion Exchange Donnan Equilibrium ii) Active - The Carrier concept, Lundegardh’s cytochrome Pump Theory, Bennet-Clark’s Protein-Lecithin Theory
- 4.1.6 Source and sink relations – Phloem Loading and Unloading
- 4.1.7 Heterotrophic Plants – i) Parasites ii) Saprobies iii) Symbionts

4.2 Nitrogen Metabolism

- 4.2.1 Sources of Nitrogen
- 4.2.2 Nitrogen Fixation
 - i) Physical – Photochemical reactions, Lightning ii) Biological – a) Non-symbiotic b) Symbiotic Nitrogen Fixation – *Rhizobium*, Process of Nitrogen Fixation
- 4.2.3 Nitrogen Cycle – Nitrogen fixation, Ammonification and Denitrification
- 4.2.4 Synthesis of Amino Acids – Reductive Amination, Transamination, Conversion of Ammonium into Amino Acids, Types of Amino Acids, Breakdown of Amino Acids, Nucleic Acids-DNA, mRNA, tRNA and rRNA.

Unit 5 : APPLIED PHYSIOLOGY (18 Hours)

5.1 Stress Physiology

- 5.1.1 Physiological changes during the following stresses – i) Temperature ii) Pathogens iii) Water iv) Salt v) Pesticide and Xenobiotics vi) Heavy Metal vi) Radiation vii) Noise
- 5.1.2 Mechanism of stress tolerance and resistance

5.2 Agricultural Physiology

- 5.2.1 Water regulation and Anti transpiration

5.2.2 Seed Technology – Seed Storage, Physical Methods, Cold Storage, Seed Viability and dormancy regulation

5.3 Applied Photosynthesis

5.3.1 Hydrogen Products for Combustion

5.3.2 NanoPhotocells

TEXT BOOKS:

1. Verma, V. 2016. *Plant Physiology* (II Ed). Athena Academic. London.
2. William, G. Hopkins. 1995. *Introduction to Plant Physiology* (II Ed). John Wiley and Sons Inc., New York.
3. Noggle, G.R. and Fritz G.J. 1992. *Introductory Plant Physiology*. Prentice Hall of India Pvt. Ltd. New Delhi India.
4. Lincoln Taiz and Eduardo Zeiger. 2010. *Plant Physiology* (5th Edition). Sunderland, Massachusetts. USA.
5. Salisbury, C.B and Ross C.W. 1986. *Plant Physiology*. CBS Publication and Distributions. New Delhi, India.
6. Devlin, R.M. and Witham F.H. 1986. *Plant Physiology*. CBS Publication and Distributions. New Delhi, India.

REFERENCE BOOKS

1. Lincoln Taiz and Eduardo Zeiger. 2010. *Plant Physiology 5th Edition*. Sunderland, Massachusetts, USA,
- 2., Beever, L. 1976. *Nitrogen metabolism in Plants*. William and Sons Ltd., London.
3. Bray, C. M. 1983. *Nitrogen metabolism in Plants*. Longman.
4. Epstein, E. 1976. *Mineral nutrition in Plants. Principles and Perspectives*. Wil
5. Levitt. 1972. *Responses of plant to Environmental Stress*. Academic Press, New York.

CORE PAPER -VIII - BIOCHEMISTRY, BIOPHYSICS AND PHARMACOGNOSY

Semester : III

Course Code : P18BY308

Credits : 5

Hours/Week : 6

SYLLABUS:

Unit 1: BIOPHYSICS

(18 Hours)

- 1:1 Atom- Definition and Structure of atom,
- 1:2 Schrodinger's theory – Principle and application
- 1:3 Quantum numbers- definition and types
- 1:4 Pauli's exclusion principle,

- 1:5 Hund's rule.
- 1:6 Bonds – definition and types -Ionic, covalent, Hydrogen, Electrostatic, Disulphide and peptide bonds,
- 1:7 Vander waals forces- Principle and procedure
- 1:8 Isomerism- definition and types- Structural isomerism, geometrical isomerism, optical isomerism and optical activity.
- 1:9 Bioenergetics – definition, Radiant energy and light absorption,
- 1:10 Energy and Heat transfer with in plants and environment and plants,
- 1:11 Laws of thermodynamic- Concept of free energy, Energy rich compounds, Entropy, free energy and enthalpy
- 1:12 Redox potential
- 1:13 Oxidation – Reduction reaction.

Unit 2: BIOMOLECULES

(18 Hours)

- 2:1 Biopolymers- definition, type and application
- 2:2 Carbohydrates-definition, Classification - Monosaccharides, Oligosaccharides, polysaccharides and glycosides, Chemistry of monosaccharide- Isomerism and Ring structure and its significance, Biosynthesis and metabolism –Gluconeogenesis.
- 2:3 Amino acids- definition and Classification – Aliphatic, aromatic and heterocyclic and its significance
- 2:4 Protein- definition and classification – Simple, Conjugate and Derived protein, Structure-Primary, Secondary, Tertiary and Quaternary and its significance and Ramachandran's curve.
- 2:5 Lipids- Definition and classification- Simple- Saturated, Unsaturated, branched chain and Cyclic fatty acids, Compound and Derived –Steroids:- Stigmasterol, Ecdysone, Lophenol and Cycloaudenol and its significance, Biosynthesis and metabolism --oxidation.
- 2:6 Enzymes: Definition- Nature, Properties, Classification, Isoenzymes, Michaelis Constant, Model for explaining enzyme action- Lock and key model and Induced fit model, Enzyme action- Exergonic, Reversible and Endergonic reaction, Enzyme , Enzyme Inhibition-Competitive, Non competitive, Uncompetitive and Allosteric inhibition and factors affecting enzyme activity.
- 2:7 Secondary metabolites – definition and type, chemical and role- Alkaloids, Steroids, Terpenes, Phenols, and Glycosides.
- 2:8 Vitamins – Definition and types, Fat soluble- Vitamin A, D, E and K water soluble vitamins- B, C, H O- occurrence, Structure and properties.

Unit 3 : BIOINSTRUMENTATION

(18 Hours)

- 3:1 pH- Meter– Principle, structure and application.
- 3:2 Electrolytes – definition –pH - Glass, Calomel and combination, Ion Selective and oxygen electrode
- 3:3 Acid and base- Definition, differences and Acid and base reactions-
- 3:5 Buffers- definition, characteristics, and types-Phosphate and Tris buffer.
- 3:6 Chromatography: definition and types- Adsorption and Partition chromatography

- 3:7 Principle, structure and applications- PC, TLC CC, GC, HPLC, GC-MS, LC-MS, Colorimetry, Spectrophotometry- UV-Vis, Electrophoresis, Ultracentrifugation.

Unit 4: PHARMACOGNOSY

(18 Hours)

- 4:1 Traditional and alternative systems of medicine- Ayurveda, siddha, Unani, Naturopathy and Yoga.
- 4:2 Classification of crude drugs- Aliphatic, Taxonomical, Morphological, Pharmacological, chemical and chemotaxonomical classification.
- 4:3 Scheme for pharmacognostic studies of a crude drug- Official title, synonyms, biological origin, geographical source, Cultivation, collection and protection of plant, preparation of crude drugs for market, macroscopic and microscopic characters, chemical constituents, chemical test, therapeutic and pharmacological uses, Commercial varieties, substitutes and adulterants and storage.
- 4:4 Collection, processing and preparation of crude drugs.

Unit 5 : DRUG THERAPHY

(18 Hours)

- 5:1 Analytical pharmacognosy –Definition
- 5:2 Drug adulteration, methods of drug evaluation – Replacement by exhausted drugs, substitution with superficially similar but inferior drugs, substitution of artificially manufactured substitutes, presence of organic matter obtained from the same plant and chemical constituent of the drugs.
- 5:3 Drug Evaluation – Confirmation of drug identity, determination of quality and purity, Organic, Microscopic, Physical, Chemical and biological evaluation, Biological testing of herbal drugs- Toxic, Symptomatic and tissue method- Hepatoprotective, Hypoglycaemic and antifertility activities
- 5:4 Phytochemical investigations
- 5:5 Phytopharmoaceuticals – Retrospects and prospect
- 5:6 Ayurvedic Pharmacy- Definition, Rasa, guna, virya, vipaka and Prabhava
- 5:7 AYUSH- Definition and their programme and Quality standard for drug

TEXT BOOKS:

1. Rastogi, S.C. 2008. *Biochemistry*. Tata McGraw Hill publishing Company Limited, New Delhi.
2. Jain. J. L., Sunjay Jain and Nitin Jain, 2012. *Fundamental of Biochemistry*. S. Chand and Company Pvt. Ltd., New Delhi.
3. Sathyanarayana, U. and Chakrapani, U.2009. *Biochemistry* (3rd Edt.). Arunabha Sen Books and Allied Pvt.Ltd. Kolkata, India.
4. Veerakumari, L. 2006. *Bioinstrumentation*. MJP Publisher, Chennai. Tamil Nadu.

5. Gurumani, N. 2014. *Research Methodology for biological sciences*. MJP Publisher, Chennai. Tamil Nadu.
6. Verma, S.K. and Mohit Verma, A. 2016. *Text book of Plant physiology, Biochemistry and Biotechnology*. S.Chand and Company Pvt. Ltd., New Delhi, India
7. Harborne, J.B. 1998. *Phytochemical methods a guide to modern techniques for plant analysis* (3rdEdt.). Chapman and Hill, London,.
8. Shah, C.S. and Quadry, J. S. 2008. *A Text book of Pharmacognosy* (13th Edt.). B.S. Shah Prakashan, Ahmedbad, India.
9. Michael Heinrich, Joanne Barnes, Simmon Gibbons and Elizabeth Williamson. 2012. *Fundamental of Pharmacognosy and Phytothraphy* (2nd edition). Elsevier

Reference Books:

1. Bob B. Buchanan, Wilhelm Gruissem and Russel, L. Jones. 2007. *Biochemistry and Molecular biology of plants*. Krishan Makhijanifo I.K. International Pvt. Ltd, New Delhi.
2. Jeremy M. Berg and John, L., Tymoczko and LubertStryer. 2006. *Biochemistry* (6th Edition). W.H. Freeman company, New York

Core IX - MICROBIOLOGY AND PLANT PATHOLOGY

Semester : III
Credits : 4

Course Code : P19BY309
Hours/Week : 6

Syllabus

Unit 1: Introductory Microbiology (18 Hours)

- 1.0. Fundamental concepts and scope of microbiology
- 1.1. Types of microorganism in nature
- 1.2. Outline classification of Bergey's Manual of 9th Edition.
- 1.3. Study of microbes Bacteria, Viruses, Mycoplasma, Rickets and chlamidiae under these aspects structure, physiology and reproduction.

Unit 2 : Methods of studying bacteria (18 Hours)

- 2.0. Staining techniques – simple, differential, (Gram Staining and acid-fast staining), negative and endospore staining.
- 2.1. Culture and growth of bacteria
- 2.2. Culture of viruses - in embryonated egg and in plants.

Unit 3: Microbes in the environment (18 Hours)

- 3.0. Microbial flora of soil
- 3.1. Factors affecting the microbial community in soil
- 3.2. Microbiology of water and air
- 3.3. Water borne diseases - diphtheria, chicken pox.
- 3.4. Air borne diseases - Swine flu and Nosocomial infections.

Unit 4 - Microbial applications (18 Hours)

- 4.0. Microbes in decomposition and recycling processes- Solid and liquid waste (Domestic)
- 4.1. Biofertilizer – Definition and types
 - 4.1.1. Methods of mass multiplication and applications.
- 4.2. Food preservation – Definition, types – physical, chemical methods and radiation.
- 4.3. Food poisoning - Definition and Types - Food intoxication (Botulism, Staphylococcal food poisoning)
- 4.4. Milk preservation methods – Pasteurization, Sterilization and dehydration

Unit 5: Plant diseases and defence mechanisms (18 Hours)

- 5.0. Causal organism, symptoms, disease cycle and control measures of
 - i) Fungal disease –*Puccinia* ii) Bacterial disease –*Xanthomonas* iii) Viral disease – Cauliflower mosaic. iv) Mycoplasma – Little leaf and Nematode disease – Root rot.
- 5.1. Mode of infection and dissemination.
- 5.2. Molecular basis of infection and disease resistance / defense.
- 5.3. Physiology of parasitism

TEXT BOOKS:

1. Mehrotra R.S., and Askok Agarwall. 2008. *Plant pathology*, Tata McGraw Hill Education Pvt., Ltd., New Delhi, India.
2. Hogg, S. 2010. *Essentials Microbiology*. England: John Wiley. Joanne M Willey. 2011. *Microbiology*. MC Graw- Hill.
3. Kathleen P.Talaro and Berry Chess 2012. *Foundations in Microbiology*. Tata McGraw Hill Education Pvt., Ltd., New Delhi, India.
4. Parry, J. Thelma, P. and Rosa, K. 1984. *Principles of Microbiology*. Hutchinson London
5. Pelczar, J. Michael, (Jr.), D. Reid, Roger, Chan E. C. S. and Kreig. 1993. *Microbiology*. Tata McGraw – Hill, New Delhi, India

6. Panda S.C., 2011. *Principles and Practices of Water Management*. Agrobios.

7. Prescott, L.M., John, P.H. and Klein D.A.2005. *Microbiology*. W.M. Brown, USA.

REFERENCE BOOK:

Prescott, S. C., and Dunn, C. G. 1987. (CBS Publishers and Distributors, Bhola Nath Nagar, Delhi,1987

CORE PAPER X- PLANT BIOTECHNOLOGY

Semester : III

Course Code : P19BY310

Credits : 4

Hours/Week : 6

SYLLABUS:

Unit – 1: Genome organization in Plants (18 Hours)

- 1.1 Nuclear – Nucleus and chromatin organisation
- 1.2 Chloroplast – Chemistry and function
- 1.3 Mitochondrial genome – Structure and functions
- 1.4 Molecular Marker-aided Breeding
(a) RFLP maps (b) linkage analysis (c) RAPD markers (d) STS (e) Microsatellites (f) SCAR (Sequence Characterized Amplified Regions), (g) SSCP (Single Strand Conformational Polymorphism), (h) AFLP, (i) SSR,(j) ISSR, (k) QTL, map based cloning, molecular marker assisted selection.

Unit 2: Plant Tissue Culture (18 Hours)

- 2.2.1 Tissue culture media (composition and preparation)
- 2.2.2 Callus and suspension culture
- 2.2.3 Somaclonal variation
- 2.2.4 Micropropagation
- 2.2.5 Organogenesis
- 2.2.6 Somatic embryogenesis
- 2.2.7 Hardening.
- 2.3 Embryo culture and embryo rescue.
- 2.4 Synthetic seeds.
- 2.5 Protoplast isolation and fusion
- 2.6 Somatic hybridization
- 2.7 Cybrids
- 2.8 Anther, pollen and ovary culture for production of haploid plants.
- 2.9 Cryopreservation
- 2.10 Germplasm conservation.

Unit 3: Plant Genetic Transformation methods (18 Hours)

- 3.1 Features of Ti and Ri plasmids and its use as vectors,
- 3.1.2 Binary vectors

- 3.1.3 Viral vectors
- 3.1.4 35S and other promoters,
- 3.1.5 Use of reporter genes and marker genes,
- 3.2 Gene transfer methods in plants:
 - 3.2.1 Direct and indirect DNA transfer.
 - 3.2.2 Chloroplast transformation and its advantages.
 - 3.2.3 Transgene stability and gene silencing.

Unit 4 : Application of Biotechnology in Plant improvement (18 Hours)

- 4.1 Improvement of photosynthetic efficiency of plants;
- 4.2 Concepts of transgenic plants
- 4.3 Developing disease resistant Varieties- bacterial and fungal
- 4.4 Improvement of quality of seed storage Proteins
- 4.5 Genetic engineering for extended shelf-life of fruits,
- 4.6 Development of stress tolerant plants
- 4.7 Regulation of gene expression under stress condition
- 4.8 Role of monoclonal antibodies in agriculture
- 4.9 Antisense technology.

Unit 5 : Bioprospecting Plants (18 Hours)

- 5.1 Molecular farming- benefits and risks,
- 5.2 Plantibodies
- 5.3 Edible vaccines
- 5.4 Edible interferon's
- 5.5 Production of secondary metabolites.
- 5.6 Procedures involved in commercialization of transgenic crops.
- 5.7 Policy and technological options to deal with India's food surpluses and shortages.
- 5.8 Ethical issues related to G.M. crop.
- 5.9 Biotechnology and intellectual property rights (IPR)
- 5.10 Plant genetic resources GATT & TRIPS
- 5.11 Patent for higher plant genes.

TEXT BOOKS:

1. Dubey, R.C. 2005. *A textbook of Biotechnology*, S. Chand Publishers, New Delhi, India.
2. Ramawat, K.G., and Shaily Goyal 2009. *Comprehensive Biotechnology*. S. Chand Publishers, New Delhi. India.
3. Mantel, Mathews and Mickee. 1985. *An introduction to genetic engineering in plants*. Blackwell Scientific Publishers. London.
4. Grierson, D. and Convey S.V. 1984. *Plant Molecular Biology*. Blackie and Son Limited. New York .
5. Mantell, S.H and Smith, H. 1983. *Plant Biotechnology*. Cambridge University press, UK

6. Chrispeels, M. J. and Sadava, D.F. 2000. *Plants, genes and agriculture*. The American Scientific Publishers, USA.

7. Hammond, J., Mc Garvey, P. and Yusibov, V. 2000. *Plant Biotechnology* Springer, Verlag, UK

REFERENCE BOOKS:

1. J. Hammond, P. Mc Garvey and V. Yusibov 2000. *Plant Biotechnology* Springer Verlag, UK.

2. Kirsi-Marja Oksman - Caldentey and Wolfgang H. Barz. Marcel Dekker, 2002. *Plant Biotechnology and Transgenic Plants*, New York.

CORE PRACTICAL -IV- PLANT PHYSIOLOGY, MICROBIOLOGY AND PLANT PATHOLOGY

Semester : IV

Course Code : P20BY3P4

Credits : 3

Hours/Week : 3

SYLLABUS:

Unit I: Microbiology

(21 Hours)

1. Preparation of Fungal and Bacterial media
2. Micrometry, hemocytometry and Colony counter.
3. Isolation of microorganisms from compost and sewage.
4. Methylene Blue Reductase test
5. Bacterial Staining – Differential
6. TC, FC, FS and MPN techniques.

Unit- II: Physiology

(21 Hours)

7. Determination of water potential (Shardakov's method)
8. Determination of solute potential
9. Hill reaction
10. Absorption spectrum of photosynthetic pigments.
11. Estimation of total acidity in CAM plants.
12. Determination of Respiratory quotient using respirometer
13. *In vivo* assay of NR and NIR
14. Effect of temperature on membrane permeability
15. Effect of pH on membrane permeability
16. Assay of catalase in young and sensed seeds
17. Assay of amylase in germinating seeds
18. Determination growth curve under different conditions.
19. Germination under stress (Salinity, temp. etc.)

Unit- III: Plant Pathology

(3 Hours)

20. Morphological and anatomical study of diseased plants included in theory.

Text Books:

1. Gupta, N.P., Sangha Manju Bala, M.K. and Sunita Gupta. 2016. *Practical in Plant Physiology and Biochemistry*, Scientific Publishers, India.
2. Dubey, R.C and Maheshwari, D. K.2010. *Practical Microbiology*, S. Chand and Company Pvt. Ltd., New Delhi,
3. Huma Naz, Hadi Husain Kahn, Chandan Kumar Singh, Asma Naz, Samiya Maqsood, Brima, F.I. A. and Ayesha. 2015. *Practical Lab Manuel for Microbiology and Plant Pathology*, Akinik Publication, New Delhi.
4. Kathleen P.Talaro and Berry Chess 2012. *Foundations in Microbiology*. Tata McGrew Hill Education Pvt., Ltd., New Delhi, India.
5. Parry, J. Thelma, Pawsey and Rosa, K. 1984. *Principles of Microbiology*. Hutchinson London

CORE PRACTICAL V- BIOCHEMISTRY, PHARMACOGNOSY AND PLANT BIOTECHNOLOGY

Credits : 3
Semester: IV

Course Code: P20BY3P5
Hours/Week: 3

SYLLABUS:**Unit I: Phytochemistry****(15 HOURS)**

1. Qualitative tests for phytochemicals Carbohydrate, protein, Secondary metabolites
2. Quantitative test of total starch, total protein, total amino acid and total lipid
3. Chromatography – TLC, Paper chromatography, sugars, phenols, aminoacids.

Unit II: Pharmacognosy**(15 HOURS)**

4. Histochemical tests – Carbohydrates, Glycosides, Lipids, Volatile oils, resins, tannins, alkaloids etc.
5. Ash value test

6. Solubility test
7. Maceration and study of cells.
8. Epidermal and trichome study
9. Testing adulterants

Unit III: Biotechnology

(15 HOURS)

10. Essentials of plant tissue culture laboratory.
11. Good laboratory practices and safety guidelines.
12. Basic design and layout of plant tissue culture laboratory
13. Preparation of basal tissue culture medium and preparation of stocks
14. Micropropagation, callus induction and regeneration using different explants of plants.
15. Agrobacterium rhizogenes for hairy root culture.
16. Synthetic seed preparation.

TEXT BOOKS:

1. David, L. Noelson and Michael, M. Cox. Lehninger. 2017. *Principles of Biochemistry* (7th ed) . W.H. Freeman company, New York.
2. Bob B. Buchanan, Wilhelm Gruissem and Russel, L. Jones. 2007. *Biochemistry and Molecular biology of plants*. Krishan Makhijanifo I.K. International Pvt. Ltd, New Delhi, India.
3. Jeremy M. Berg, John, L. Tymoczko and Lubert Stryer. 2006. *Biochemistry* (6th Edition). W. H. Freeman company, New York.

REFERENCE BOOK:

- Rastogi, S.C. 2008. *Biochemistry*. Tata McGraw Hill publishing company Limited, New Delhi, India
- 1 Atwell, B.J. Kriedermann, P.E. and Jumbull, 1999. C.G.N. *Plants in Action: Adaption in Nature Performance*, in Cultivation, MacMillan Education. Sydney, Australia.
 - 2 Bewley. J.D. and Black, M. 1994. *Seeds: Physiology of Development and Germination*, Plenum Press. New York.

Elective III - RESEARCH METHODOLOGY

Semester : IV
Credits : 4

Course Code : P20BY4:4
Hours/Week : 6

SYLLABUS:

Unit 1: Research planning and Literature Collection

(18 Hours)

- 1.1. Research
 - (a) Objectives (b) Types- Basic, Applied, Quantitative and Qualitative and Problem oriented (c) Essential steps in Research (d) Significance
- 1.2. Review of Literature
 - (a) Need for review (b) Objectives (c) Sources - Primary, Secondary and Tertiary sources
- 1.3. Internet basics (a) web browsing (b) web sites (Biological website) (c) web pages-links (d) Bibliometrics databases
- 1.4. Monographs and Reprints

Unit 2: Methodology and data collection

(18 Hours)

- 2.1. Sample – (a) Types (b) Sampling Techniques – Survey and Questionnaires.
- 2.2. Hypothesis – (a) Definition (b) Qualities of a good Hypothesis (c) characteristics,
 - 2.2.1. Types Of Hypothesis- (a) Null (b) Alternative (b) Formulating (c) Simple (d) Complex (e) Statistical.
 - 2.2.2. Level of significance.
- 2.3. Principles of experiments – Definition
 - 2.3.1. Types of field Experiments- (a) Provenance (b) Progeny (c) Clonal (d) fertilizer, (e) Agronomic
 - 2.3.2. Components in Experiments- (a) Randomization(b) Replication (c) Local control (d) Size and shape of the plot (e) experimental Errors
- 2.4. Experimental Design - (a) Completely Randomized Design (CRD) (b) Randomized Complete Block Design(RCB).
- 2.5. Collection of Primary Data
 - (a) Observation Method (b) Interview Method (c) Collection of Data through Questionnaires (d) Collection of Data through Schedules (e) Difference between Questionnaires and Schedules (f) Collection of Secondary Data

Unit 3: Computation and presentation of data

(18 Hours)

- 3.1. Definition, Scope and Importance
 - 3.1.1. Data Presentation: tabulation, graphical presentation
- 3.2. Measure of Central values- Mean, Median and Mode
- 3.3. Measure of Dispersion- Absolute and Relative Dispersion
- 3.4. Skewness and kurtosis
- 3.5. Probability- (a) Binomial (b) Poisson (c) normal distributions.
- 3.6. Correlation and regression- Types, Methods and analysis
- 3.7. Student Test – definition and types
- 3.8. Chi-square Test- (a) Introduction (b) Distribution (c) significance
- 3.9. ANOVA- (a) definition (b) test of ANOVA - one and two way ANOVA

Unit 4: Structure of thesis and Laboratory safety

(18 Hours)

- 4.1. Report
 - 4.1.1. Thesis chapterization- (a) Title (b) Abstract (c)Introduction (d) Materials and methods (e)results (f) discussion (g) conclusion (h) Bibliography.

- 4.2. Tables – (a) Need and use of for table (b) Introduction and Placement of a table (c) Format of a table- Numbering, Title, Units and Footnotes.
- 4.3 Figures- (a) Need and use of Figures (b) Placement of Figures, (c) Numbering and Caption (d) Preparation of Statistical Diagrams
- 4.4 Laboratory safety-
 - 4.4.1. Harzards – (a) Biohazardous (b) Chemical (c) Fire (d) Electrical (e) Radiation
 - 4.4.2. Safety Measures- (a) Personal- PPE (b) Laboratory animals and plants Safety (d) Disposal of Biohazardous and Chemical waste

Unit 5 : Manuscript for publication and Presentation (18 Hours)

- 5.1. Format of research articles – (a) Writing Reviews (b) Scientific article (c) short communication.
- .2. Manuscripts for presentation – (a) Oral (b) Poster presentation
- 5.3. Indexing and abstracting- (a) indexes and evaluation tools (h-index, Page Rank, *Impact Factor*) (b) Evaluation of the Impact Factor (c) Collective platforms with Free Access (d) The use of bibliometrics in research - Citation Research, Citation Indexing, Plagiarism, tailored research and retraction.

TEXT BOOKS:

1. Kothari, C.R. and Gaurav Garg. 2020. *Research Methodology methods and Techniques*, New Age International Publishers, Bangaluru, India.
2. Gurumani, N. 2011. *Research Methodology for Biological sciences*, MJP publishers, Chennai, Tamil Nadu, India.
3. Willard Hobart, H., Merritt Lynne, L. and Dean John A.1965. *Instrumental Methods of Analysis*. DVan Nostrand Co., New York.
4. Daniel, W.W. 1983. *Biostatistics: A Foundation for Analysis in the Health Science*. John Wiley and Sons Inc., New York.
5. Gurumani, N. 2004. *An Introduction to Bio Statistics*. MJP Publishers, Chennai, Tamil Nadu, India.

REFERENCE BOOK:

1. Misra, R.P. 2000. *Research Methodology – A handbook, Concept*. Publg Company, New Delhi, India.

ELECTIVE –IV- FORESTRY AND CONSERVATION BIOLOGY

Semester: IV

Course Code: P20BY4:5

Credits: 4

Hours/Week: 6

SYLLABUS:

Unit – 1: Forest and its Values

(18 HOURS)

General introduction to Forest.

1.1. Forest Types

1.1.1. (a.)tropical, (b.)temperate, (c.)evergreen, (d.)semi-evergreen and (e.) deciduous.

1.2. World Forest Cover.

1.3. Forest Resources of World and in India

1.3.1. Major and minor forest products

1.3.2. Wood and Non Wood forest products

Unit – 2: Deforestation and Forest management

(18 HOURS)

2.0.1. Causes and Effect (ecological, environmental, sociological and economical

2.0.2. Forest Degradation in India.

2.1. Sustainable Forest Management

2.2. Afforestation programme

2.2.1. silviculture

2.2.2. Agroforestry,

2.2.3. social forestry

2.2.4. People's movement

2.3. Monitoring the establishment of forest.

2.4. Integrated forest management

2.4.1. Wasteland reclamation using VAM and soil microbes,

2.4.2. Prevention of soil erosion

2.5. Forest trade Management.

Unit – 3: Sustainable Development

(18 HOURS)

Introduction, Parameter and Approaches to the Study of Sustainable Development.

3.2. Issues and Challenges

3.2.1. Developmental Issues

3.2.2. Natural Resource Exploitation

3.2.3. Patterns of Industrialisation.

3.3. Initiatives towards Sustainable Development

3.3.1. State, Regional, Global, Civil and Community Initiatives.

3.4. Resource management:

3.4.1. Meaning & concept.

3.4.2. Management of Agricultural system. 3.4.3. Waste resources.

Unit – 4: Threats in forest management

(18 HOURS)

Forest fragmentation.

4.2. Monoculture and its limitations

4.3. Alien and invasive species.

4.4. Restoration ecology and invasive species management.

4.5. Conservation strategies for non-renewable and renewable energy resources- Bioenergy.

4.6. Categories of protection types

4.6.1. Wildlife Management & conservation efforts for threatened species.

4.6.2. IUCN, WWF and CITES.

4.6.3. Environmental priorities in India.

4.7. Soil conservation.

4.7.1. Rural and urban planning.

4.7.2. Land use pattern for India.

4.8. Indian policies and legislature on conservation of resources.

Unit – 5: Eco-tourism

(18 HOURS)

5.1. Introduction:

5.1.1. Ecotourism- Definition

5.1.2. History and principles of tourism,

5.1.3. Ecotourism marketing,

5.2. Economics and benefits of ecotourism

5.3. Cultural issues and negative aspects of ecotourism,

5.4. Ecotourism companies

5.5. Environmental Impacts of Tourism

5.6. Ecotourism in India.

Text Books:

1. Hunter, Jr. and Malcolm, L.1990. *Wildlife, Forests and Forestry; Principles of Managing Forests for Biological Diversity*. Prentice-Hall Inc. New Jersey.

2. Shukla, P.C. and Chandal.2009. *A Textbook of Plant Ecology*. S. Chand and Company Ltd., New Delhi, India.

3. Honey and Martha.2008. *Ecotourism and Sustainable Development: Who Owns Paradise?* (2nd Edt.) Washington, DC.

4. Weaver, D.2008. *Ecotourism* (2nd ed.). John Wiley & Sons Australia, Ltd., Australia.

5. Peter. P. Rogers , Kazi. F. Jalal, John. A. Boyd. 2008. *An Introduction to Sustainable Development*. Published by Earth scan Ltd.

6. Agarwal, V.G. 1985. *Forests in India*. Oxford and IBH, New Delhi, India.

7. Dutta, A. 2001. *Biodiversity and Ecosystem Conservation*. Kalyani Publisher, Kolkata, India.

REFERENCE BOOKS:

1. Jha, L.K. 1997. *Natural Resource Management*. APH Publishing Corporation, New Delhi, India.

2. Oliver S. Owen. 1980. *Natural Resources conservation - An Ecological approach* (3rd Ed.), Macmillan Publishing Co. Inc. New York.