

Holy Cross College (Autonomous), Nagercoil
Accredited with A⁺ by NAAC IV cycle – CGPA 3.35
Nagercoil, Kanyakumari District, TamilNadu.

Affiliated to

ManonmaniamSundaranar University, Tirunelveli



UG Syllabus

Department of Botany

Semester V&VI

(With effect from the academic year 2020-2021)

DEPARTMENT OF BOTANY
With effect from the academic year 2020 – 2021



Vision

Imbibing the spirit of the Holy Cross, the institution envisions a harmonious society by empowering women for global competency and ecological sustainability through holistic approach with innovative skills.

Mission

1. To provide quality education and to promote scholarly activities catering to global competencies.
2. To nurture participatory leadership to enhance social consciousness and social responsibility.
3. To uphold ethical values of honesty, personal accountability and transparency through professional commitment.
4. To create global professionals and entrepreneurs with innovative spirit and zeal.
5. To create empowered women of competence, commitment and compassion.
6. To instill in students the awareness of interconnectedness between man and nature

Programme Educational Objectives (PEOs)

PEO-1	The graduates will apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.
PEO-2	The graduates pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.
PEO-3	The graduates acquire basic and specialized science skills that instill qualities of self-confidence and self-reliance that make them contribute valuably in the biological issues of national and international interest.

Programme Outcomes(POs)

PO	Upon completion of B.Sc Programme, the graduates will be able to:
PO – 1	utilize scientific knowledge to pursue higher studies in the relevant field.
PO – 2	create innovative ideas to enhance entrepreneurial skills for economic independence.
PO – 3	face challenging competitive examinations that offer rewarding careers.
PO – 4	reflect upon green initiatives and take responsible steps to build a sustainable environment.
PO – 5	handle ethical issues with social responsibility.
PO – 6	communicate effectively and collaborate successfully with peers to become competent professionals.

Programme Specific Outcomes (PSOs)

PSOs No.	Upon completion of B.Sc. Degree Programme, the graduates of Botany will be able to :	PO Addressed
PSO – 1	develop a strong and competent knowledge in Botany.	1
PSO – 2	communicate appropriately and effectively in science and also interact productively with people from diverse background.	6
PSO – 3	understand the basic professional skills through various laboratory technical training, to analyze the relevant biological situations.	2
PSO – 4	create green environment to protect nature for future sustenance.	4
PSO – 5	seek entrepreneurship through skill based, value added and related courses.	2
PSO – 6	understand the professional, ethical, legal and social issues related to gender.	5
PSO – 7	integrate the related topics from other branches of science to carry out projects to have a successful career.	3

Eligibility Norms for Admission

Those who seek admission to B.Sc. Botany Course must have passed Higher Secondary Examination conducted by the Board of Higher secondary Examination, Tamil Nadu with Botany or Biology as one of the subjects or any other examinations recognized and approved by the Syndicate of ManonmaniamSundaranar University, Tirunelveli.

Duration of the Programme:3years

Medium of Instruction:English

Passing Minimum

A minimum of 40% in the external examination and an aggregate of minimum 40% is required. There is no minimum pass mark for the continuous internal assessment.

Components of the B.Sc. Botany programme

Part III (Major and Allied)

Major	Core – Theory papers	10x100	1000
	Practical (Core applied)	5x100	500
	Elective - Theory papers	3x 100	300
	Project	1x100	100
	Total marks		1900
Allied (I & II)	Theory	4x100	400
	Practical	2x100	200
	Total marks		600
Part III - Total marks			2500

Major&Allied Practical carry 100 marks each.

Practical examinations will be conducted at the end of even semesters for major and allied

Course Structure
Distribution of Hours and Credits

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI	Total	
							Hours	Credits
Part I- Language	6 (4)	6 (4)	6 (4)	6 (4)	-	-	24	16
Part II- English	6 (4)	6 (4)	6 (4)	6 (4)	-	-	24	16
Part-III								
Major Core – Theory	4(4)	4(4)	4(4)	4(4)	6(6)+ 6(6)+ 6(5)	6(6)+ 6(6)+ 6(5)	52	50
Major – Practical	2(-)	2(2)	2(-)	2(2)	2(-)+ 2(-)+ 2(-)	2(2)+ 2(2)+ 2(2)	20	10
Elective/ Project	-	-	4(3)	4(3)	4(3)	4(3)	16	12
Allied –Theory	4(3)	4(3)	4(3)	4(3)	-	-	16	12
AlliedPractical	2(-)	2(2)	2(-)	2(2)	-	-	8	4
Part IV								
Add on Course(Profession al English)	2(2)	2(2)	2(2)	2(2)	-	-	8	8
Non Major Elective (NME)	2(2)	2(2)					4	4
SEC(Skill Enhancement Course)	2(2)	2(2)	-	-		2(2)	6	6
Ability Enhancement Course (AEC)					2(2)		2	2
Total	30 (21)	30 (25)	30 (20)	30 (24)	30 (22)	30 (28)	180	140

Non -academic Courses								
Part V								
FC –I (Values for Life)	-	(1)					-	1
FC– II(Personality Development)			-	(1)			-	1
FC–III (Human Rights Education)					(1)		-	1
FC –IV (Gender Equity Studies)						(1)	-	1
SLP-Community Engagement Course		-	(2)				-	2
SLP-Extension Activity (RUN)			-	(2)				2
STP - Clubs & Committees / NSS	-	-	-	(2)			-	2

Total number of Hours = 180

Total number of Compulsory Credits =140+10

- Non - academic Courses are mandatory and conducted outside the regular hours
- Skill Development Programme (Mandatory Certificate Course – 60 hours) is offered in the first year for all the students.

Courses Offered

Semester	Course	Course Code	Title of the Course	Hours/Week	Credits	
I	Part I	TL2011/ FL2111	Language: Tamil / French	6	4	
	Part II	GE2111	General English	6	4	
	Part III	BC2011	Major Core I :Algae, Fungi and Lichens	4	4	
		BC20P1	Major Practical I :Algae, Fungi and Lichens	2	-	
		BA2011	Allied I:Chemistry of Life	4	3	
		BA20P1	Allied I Practical:Chemistry of Life	2	-	
	Part IV	ALS201	Add- on Course Professional English for Life Sciences	2	2	
		BNM201	Non-Major Elective (NME):Gardening and Floriculture	2	2	
		SEC201/ SEC202	Skill Enhancement Course: Meditation and Exercise / Computer Literacy	2	2	
	Part V	FCV201	Foundation Course I: Values for Life	-	-	
		STP201	Student Training Programme (STP) : Clubs & Committees/NSS	-	-	
	II	Part I	TL2021/ FL2121	Language: Tamil / French	6	4
		Part II	GE2121	General English	6	4
PartIII		BC2021	Major Core II:Plant Anatomy and Developmental Botany	4	4	
		BC20P1	Major Practical I: Algae, Fungi and Lichens &Plant Anatomy and Developmental Botany	2	2	
		BA2021	Allied I:Taxonomy of Angiosperms and Herbal Technology	4	3	

		BA20P1	Allied I Practical:Chemistry of life & Taxonomy of Angiosperms and Herbal Technology	2	2
	Part IV	ALS202	Add -on Course: Professional English for Life Sciences	2	2
		BNM202	Non-Major Elective (NME) : Biofertilizers, Biofuels and Biopesticides	2	2
		SEC201/ SEC202	Skill Enhancement Course :Meditation and Exercise / Computer Literacy	2	2
	Part V	FCV201	Foundation Course I : Values for Life	-	1
		SLP201	Service Learning Programme (SLP): Community Engagement Course	-	-
		STP201	Student Training Programme (STP) : Clubs & Committees/NSS	-	-
III	Part I	TL2031/ FL2031	Language: Tamil / French	6	4
	Part II	GE2031	General English	6	4
	Part III	BC2031	Major Core III:Archegoniate	4	4
		BC2032	Major: Elective I (a) Herbal Botany	4	3
		BC2033	(b) Nursery and Gardening		
		BC2034	(c) Agricultural Botany		
		BC20P2	Major Practical II :Archegoniate	2	-
		BA2031	Allied II : Theory: Plant Diversity -I (Algae, Fungi, Bryophyta and Pteridophyta)	4	3
		BA20P2	Allied Practical II : Plant Diversity -I	2	-
Part IV	ALS203	Add -on Course :Professional English for Life Sciences	2	2	
Part V	FCV202	Foundation Course II : Personality	-	-	

			Development		
		SLP201	Service Learning Programme (SLP) : Community Engagement Course	-	2
		SLP202	Service Learning Programme (SLP) : RUN	-	-
		STP201	Student Training Programme (STP): Clubs & Committees/NSS	-	-
IV	Part I	TL2041/ FL2041	Language: Tamil / French	6	4
	Part II	GE2041	General English	6	4
	Part III	BC2041	Major Core IV :Plant Ecology and Phytogeography	4	4
		BC2042	Major : Elective II (a) Biological Resources		
		BC2043	(b) Food Science	4	3
		BC2044	(c) Biodiversity and Human Welfare		
		BC20P2	Major Practical II : Archegoniate &Plant Ecology and Phytogeography	2	2
		BA2041	Allied II :Theory: Plant Diversity - II(Gymnosperms and Angiosperms) and Plant Physiology	4	3
		BA20P2	Allied II Practical: Plant Diversity – I & II and Plant Physiology	2	2
	Part IV	ALS204	Add - on Course :Professional English for Life Sciences	2	2
	Part V	FCV202	Foundation Course II : Personality Development	-	1
		SLP202	Service Learning Programme (SLP) : RUN	-	2
		STP201	Student Training Programme (STP) :Clubs & Committees/NSS	-	2
V	Part III	BC2051	Major Core V :Taxonomy of	6	6

			Angiosperms and Economic Botany		
		BC2052	Major Core VI :Biochemistry and Biophysics	6	6
		BC2053	Major Core VII :Microbiology and Plant Pathology	6	5
		BC20PR	Major Elective III : Project	4	3
		BC20P3	Major Practical III :Taxonomy and Economic Botany	2	-
		BC20P3	Major Practical III : Biochemistry and Biophysics	2	-
		BC20P5	Major Practical V :Microbiology and Plant Pathology	2	-
	Part IV	AEC201	Ability Enhancement Course (AEC) Environmental Studies	2	2
	Part V	FCV203	Foundation Course III : Human Rights Education	-	1
VI	Part III	BC2061	Major Core VIII :Genetics, Biostatistics and Bioinformatics	6	6
		BC2062	Major Core IX :Biotechnology and Molecular Biology	6	6
		BC2063	Major Core X :Plant Physiology and Metabolism	6	5
		BC2064	Major : Elective IV		
		BC2065	(a) Marine Botany		
		BC2066	(b) Organic Farming	4	3
		BC2066	(c) Ecotourism		
		BC20P3	Major Practical III : Taxonomy and Economic Botany &Biochemistry and Biophysics	-	2
		BC20P4	Major Practical IV :Genetics, Biostatistics and Bioinformatics & Biotechnology and Molecular	4	2

			Biology		
		BC20P5	Major PracticalV :Microbiology and Plant Pathology &Plant Physiology and Metabolism	2	2
	Part IV	SEC203	Skill Enhancement Course (SEC) :Global Environmental Issues	2	2
	Part V	FCV204	Foundation Course IV : Gender Equity Studies	-	1
			TOTAL	180	140+10

Self-Learning Courses - Extra Credit Course

Semester	Course Code	Title of the Course	Credit
III/ V	BC20S1	Plant Resource Utilization	2
IV/VI	BC20S2	Algal Biotechnology	2
III – VI		Online Course (SWAYAM / NPTEL)	2

Value Added Courses (Mandatory)

Semester	CourseCode	Title of the Course	Total hours
I/II	VAB201	Mushroom Culture Technology	30
III/IV	VAB202	Food Preservation Technology	30

Semester - I

Algae, Fungi and Lichens

Sub. Code: BC2011

No. of hours per week	Credit	Total no. of hours	Marks
4	4	60	100

- Objectives:**
- 1.To understand the salient features of different classes of Algae and Fungi
 2. To study in detail the different genera belonging to various classes of Algae, Fungi, Lichens and their economic importance.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify the salient features of different classes of Algae, Fungi and Lichens and their adaptive strategies	PSO - 1	R
CO - 2	understand the importance of lower plants to the economy and environment	PSO - 4	U
CO - 3	interpret the values of AM Fungi	PSO - 3	Ap
CO -4	correlate the structure, reproduction and life cycle of different classes of Algae and Fungi	PSO - 1	E
CO -5	differentiate diverse group of Algae and Fungi based on their hierarchy	PSO - 5	An

Unit I

Algae: Classification of Algae according to Fritsch (1945). General Characters, Salient features of the classes, occurrence, structure, reproduction and life cycle of the following (Excluding developmental studies)

Cyanophyceae– *Nostoc*

Chlorophyceae- *Volvox*, *Caulerpa*

Phaeophyceae- *Sargassum*

Unit II

Rhodophyceae- *Gracilaria*

Xanthophyceae – *Vaucheria*

Bacillariophyceae – *Diatoms*

Economical and Ecological importance of Algae

Unit III

Fungi: Classification of fungi according to Alexopoulos and Mims (1979). General characters, Salient features of the classes, occurrence, structure, reproduction and life cycle of the following (Excluding developmental studies)

Oomycetes - *Albugo*

Zygomycetes - *Rhizopus*

Economic importance of Fungi

Unit IV

Ascomycetes - *Aspergillus, Peziza*

Basidiomycetes - *Polyporus*

General account on Glomeromycota-VAM Fungi

Unit V

Lichens: General characters of Lichens, Classification of Lichens

Ascolichen- *Usnea*

Economic importance of Lichens

Text Book:

1. Pandey, B.P. (2013). *College Botany* Vol I. New Delhi: S. Chand & Company.

Reference Books:

1. Vashishta, B.R. (1997). *Algae*. New Delhi: S. Chand & Company.
2. Vashishta, B.R. (1993). *Fungi*. New Delhi: S. Chand & Company.
3. Fritsch, F.E. (1972). *The Structure and Reproduction of Algae* Vol. I & II. London: Cambridge University Press.
4. Sharma, O.P. (1997). *Text book of Algae*. New Delhi: Tata Mc Graw- Hill Publications.
5. Dubey, H.C. (1993). *Introduction to Fungi*. New Delhi: Vikas Publishing House.

Semester - I
Major Practical - I
Algae, Fungi and Lichens
Sub. Code: BC20P1

No. of hours per week	Credit	Total no. of hours	Marks
2	-	30	-

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	preparation of plant material for microscopic observation	PSO - 3	Cr
CO - 2	draw appropriate anatomical diagrams from the sectioned plant material using microscope	PSO - 3	An
CO - 3	identify different microalgae from water bodies	PSO - 1	U
CO - 4	identify the microscopic structures of Algae, Fungi and Lichens	PSO - 1	U
CO - 5	record the locally available seaweeds	PSO - 1	U

To make suitable micro preparations of types prescribed in the syllabus

Caulerpa – Rhizome

Sargassum – Stipe, 'leaf'

Gracilaria– Thallus

Albugo – Conidia

Peziza -Apothecium

Puccinia – Uredosorus and Teleutosorus

Lichens – Thallus

To identify the Specimens

Nostoc – Filament

Volvox – Vegetative colony with daughter colonies, antheridium and oogonium

Sargassum – Entire thallus, Male and Female Conceptacles

Gracilaria– Thallus with cystocarp

Vaucheria– Sexual reproduction

Diatoms- Pennate and Centric

Algal mixture

Aspergillus – Conidia

Rhizopus - Conidia

Puccinia – Aecidium and pycnidium

Lichens – Apothecium and Soredium

Algal Field Visit- Submission of field report with 10 Geotagged photographs- 5 marks

(Continuous assessment).

Semester - I

Allied - Chemistry of Life

Sub. Code: BA2011

No. of hours per week	Credit	Total no. of hours	Marks
4	3	60	100

Objectives: 1.To study the structure and functions of cell organelles and biomolecules

2. To learn the different techniques in cell biology

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO – 1	learn the structure, chemistry and functions of cellular organelles and non-living inclusions	PSO - 1	R
CO – 2	understand the structure, properties and fundamentals of biomolecules	PSO - 1	U
CO – 3	identify the characteristics and stages of mitosis, meiosis and cell cycle	PSO - 1	U
CO – 4	compare the beneficial effects of vitamin and mineral supplements in the diet	PSO - 2	An
CO – 5	learn the technique of Cell biology	PSO - 7	An

Unit I

Cell – Structure: Prokaryotic and Eukaryotic; difference between Prokaryotic and Eukaryotic cell. Structure of plant cell, chemical composition and functions of the following: Plasma membrane (fluid mosaic model), Chloroplast and Mitochondria

Unit II

Ultrastructure and functions of nucleus. Cell division – cell cycle, mitosis and meiosis - significance.

Non living inclusions – starch grains, aleurone grain, cystolith and raphide.

Unit III

Chemical bonds – types (co-ordinate, covalent, hydrogen); Carbohydrate classification; Monosaccharides: Structure and properties of glucose. Disaccharides: Structure and properties of sucrose. Polysaccharides: Structure and properties of starch.

Unit IV

Protein: Structure– primary, secondary, tertiary (myoglobin) and quaternary (hemoglobin). Vitamins - importance, sources, deficiency symptoms of water soluble and fat soluble vitamins.

Lipids -General account of simple lipids (Triglycerides), compound lipids (Phospholipids) and derived lipids (Cholesterol).

Unit V

Cellular Photosynthesis- Mechanism of photosynthesis, pigment systems, light dependent reactions (cyclic and non-cyclic), C₃ Cycle. Factors affecting photosynthesis.

Defense mechanism in plants.

Text Books:

1. Verma, P.S, & Agarwal, V.K.S. (2004). *Cell Biology*. New Delhi: S. Chand and Company Ltd.,
2. Jain, J.L. (2000). *Fundamentals of Biochemistry*. New Delhi: S. Chand and Co.

Reference Books:

1. Powar, C.B. (2005). *Cell Biology*. New Delhi: Himalaya Publishing House.
2. De Robertis, E.D.P., & De Robertis, D.M.P. (1980). *Cell and Molecular Biology*. Philadelphia: Saunders College
3. Gupta, P.K. (1997). *Cytology, Genetics and Evolution*. Meerut: Rastogi Publications.

4. Conn, E.J. and Stumpf, P.K. (2009). *Outlines of Biochemistry*. (5th ed.) New Jersey: Wiley Eastern Ltd.,
5. Lehninger, A.L. (2002). *Principles of Biochemistry*. New Delhi: CBS Publishers and Distribution,
6. Arun Mittal, C. (2002). *Biochemistry*. New Delhi: A.P.H. Publishing Corporation.
7. Sathyanarayana, U. and Chakrapani, U. (1999). *Biochemistry*. Kolkata: Books and Allied (P) Ltd.
8. Vashista, B.R R. (1997). *The Plant Anatomy*, Chand and Co., New Delhi.

Allied Practical - I

Chemistry of Life

Sub. Code: BA20P1

No. of hours per week	Credit	Total no. of hours	Marks
2	-	30	-

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	identify electron micrographs of the cell organelles	PSO - 7	U
CO - 2	prepare root tip squash of onion to identify the various stages of mitosis	PSO - 3	E
CO - 3	know the importance of non -living inclusions in plant cells	PSO - 5	U
CO - 4	Know the effect of transpiration and photosynthesis	PSO - 7	An

1. To identify electron micrographs of the cell organelles.
2. To prepare root tip squash of onion and to identify the various stages of mitosis.
3. Sectioning, staining, mounting and identification of nonliving inclusions (Cystolith, Raphide, Starch Grain and Aleurone grain)
4. Demonstration only
 - a. Transpiration pull

b. Oxygen evolved during photosynthesis

c. Light- screen experiment

Semester - I

Gardening and Floriculture (NMEC)

Sub. Code: BNM201

No. of hours per week	Credit	Total no. of hours	Marks
2	2	30	100

Objectives: 1. To know the techniques of gardening.

2. To evaluate the importance of floriculture and ornamental plant cultivation on economy.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
1	understand the importance of nursery management and gardening.	PSO - 5	Un
2	compare the different methods of vegetative propagation in order to propagate ornamental and commercial flowers.	PSO- 1	Ev
3	analyze the different methods of weed control and harvest treatments of horticultural crops.	PSO- 4	An
4	design methods to grow a variety of garden plants in a diverse set of environment to become an entrepreneur.	PSO - 5	Ap

Unit 1:

Garden Nursery Structures – Nursery Bed, Mist Chamber, Manures and Vermicompost.

Unit II

Plant Propagation: Asexual methods - Air layering and Veneer Grafting. Micropropagation - Induction of rooting and flowering.

Unit III

Green houses for tropical countries – Pot mixture, Pot culture, Packaging and Marketing of Nursery Stock

Unit IV:

Indoor Gardening: Layout of lawns, Rockery, Bonsai and Hanging basket.

Unit V:

Commercial Floriculture: Cultivation of cut flowers - Rose and Orchids. Flower arrangements; Methods to prolong vase life

Text Books:

1. Randhawa, G.S. and Mukhopadhyay A. (1986). *Floriculture*. New Delhi: Mac Milan India Ltd.
2. Kumar, N. (1986). *Introduction to Horticulture*. Nagercoil: Rajalakshmi Publishers

Reference:

1. Ray, R. Larsen. (2013). *Introduction to Floriculture*. London: Academic Press.
2. Charles. P. Griner. (2011). *Floriculture – Designing and Merchandising*. U.S.: Cenage Publishers.
3. Rao K.M. (1991). *Text book of Horticulture*. New Delhi: Mac Milan India Ltd.
4. Sheela V.L. (2011). *Horticulture*. Chennai: M.P.J. Publishers.
5. Sandhu, M.K. (1989). *Plant Propagation*. New Delhi: Wiley Eastern Ltd.

Semester - II**Plant Anatomy and Developmental Botany**

Sub. Code: BC2021

No. of hours per week	Credit	Total no. of hours	Marks
4	4	60	100

Objective: 1. To know the internal structure of plants.

2. To learn the structure and development of reproductive units in higher plants.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall the structure and functions of meristem, simple and complex tissues.	PSO - 1	R

CO - 2	differentiate primary and secondary structures.	PSO - 1	U
CO - 3	examine the nodal anatomy types.	PSO - 1	An
CO - 4	interpret the different types of endosperms.	PSO - 1	U
CO - 5	learn about double fertilization and their significance.	PSO - 1	U
CO - 6	understand the basic knowledge of apomixis and polyembryony in the field of crop improvement.	PSO - 1	Ev

Unit I

Meristems – Classification (origin, position and function); Evolution of concept of organization of shoot apex (Histogen theory, Tunica Corpus theory). Organization of root apex (Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap. Tissues – Structure and function of simple tissue (parenchyma, collenchyma and sclerenchyma) and complex tissue (xylem and phloem). Types of vascular bundles.

Unit II

Primary growth; Primary structure of dicot and monocot stem, root and leaf. Secondary growth in stem and root – Formation of cambial ring, activity of cambial ring, secondary vascular tissue, formation of periderm, lenticels, dendrochronology, annual ring, Wood (heartwood and sapwood).

Unit III

Anomalous secondary thickening in dicot stem (*Boerhaavia*) and monocot stem (*Dracaena*). Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni- and multicellular, glandular and nonglandular, two examples of each), stomata and its types; Nodal anatomy types - unilacunar (*Justicia*), trilacunar (*Azadirachta*) and multilacunar (*Aralia*), Hydathodes and laticifers.

Unit IV

Embryology – Structure of anther; Structure of microsporangium, microsporogenesis, structure of pollen; development of male gametophyte. Structure and types of ovules; Structure of megasporangium, megasporogenesis and development of female gametophyte.

Unit V

Types of embryo sac – Monosporic – Polygonum type. Pollination mechanisms and adaptations. Fertilization, endosperm - types- nuclear, cellular and helobial, ruminant

endosperm, perisperm. Development of embryo in dicot (*Capsella*) and monocot (*Luzula*).
Apomixis and polyembryony.

Text Books:

1. Vashista, B.R. (1997). *The Plant Anatomy*. New Delhi: S. Chand & Co.
2. Bhojwani, S.S., & Bhatnagar, S.P. (2011). *Embryology of Angiosperms*. (5th ed.). New Delhi: Vikas Publication House Pvt. Ltd.

Reference Books:

1. Mauseth, J.D. (1988). *Plant Anatomy*. USA: The Benjamin/Cummings Publisher.
2. Pandey, B.P. (1982). *Plant Anatomy*. New Delhi: S. Chand & Co.
3. Fahn, A. (1987). *Plant Anatomy*. New York: Maxwell House.
4. Arthur J Eames., & Laurence H Macdaniels. (2005). *An Introduction to Plant Anatomy*. New Delhi: Tata McGraw-Hill Publishing Company.
5. Maheswari, P. (1976). *An introduction to the embryology of Angiosperms*, New Delhi: Tata McGraw Hill Publishing Company.

Major Practical – I

Plant Anatomy and Developmental Botany

Sub. Code: BC20P1

Number of Hours Per week	Number of Credit	Total Number of Hours	Marks
2	-	30	-

CO	Upon completion of this course the students will be able to :	PSO address ed	CL
CO – 1	observe and identify different types of tissues and stomata.	PSO - 3	U
CO – 2	prepare plant material for microscopic observation.	PSO - 7	C
CO – 3	draw appropriate anatomical diagrams from the sectioned plant material using microscope.	PSO - 3	An
CO – 4	differentiate and draw diagrams of nodes.	PSO - 3	An

CO – 5	observe and identify the slides of different stages of microsporogenesis.	PSO - 3	U
CO – 6	dissect and display the different stages of <i>Tridax</i> embryo.	PSO - 3	E

1. To observe and identify different types of tissues
2. Sectioning, staining, mounting and identification of primary structure of dicot stem, dicot root, monocot stem and monocot root; Dicot and monocot leaf.
3. Normal secondary thickening of dicot stem and dicot root.
4. Anomalous secondary thickening – Dicot stem (*Boerhaavia*) and monocot stem (*Dracaena*)
5. Nodal types – Unilacunar, trilacunar and multilacunar.
6. Stomatal types – anomocytic, anisocytic, paracytic, diacytic and graminaceous.
7. To observe and identify the slides of
 - i) T.S of Anther - Sporogenous, Tetrad and Mature
 - ii) L.S of Ovule – Orthotropous and Anatropous
8. Photomicrograph of -Dicot Embryo
 - Monocot Embryo
 - Apomixis
 - ii) Polyembryony
9. Dissection of *Tridax* embryo (Globular or Cordate stage).

Semester - II

Taxonomy of Angiosperms and Herbal Technology

Sub. Code: BA2021

No. of hours per week	Credit	Total no. of hours	Marks
4	3	60	100

- Objectives:**
1. To impart basic knowledge of morphology to understand Taxonomy.
 2. To study the vegetative and floral characters of Angiosperm families.
 3. To understand the ancient medicinal practices and its importance.
 4. To recognize and utilize medicinal plants.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	understand the basic knowledge of taxonomy by learning selected families of angiosperms.	PSO – 1	R
CO - 2	understand the characters of the families according to Bentham & Hooker's system of Classification.	PSO – 1	U
CO - 3	improve the awareness and appreciation of traditional medicinal practices.	PSO – 2	Ap
CO - 4	apply the basic medicinal plants and its utilization.	PSO – 7	An
CO - 5	create new strategies to enhance growth of medicinal herbs considering the practical issues pertinent to India.	PSO – 4	Cr
CO - 6	evaluate the drug adulteration through the biological testing.	PSO – 7	An

Unit I

Brief account of morphology: Root, stem, leaf, inflorescence and fruits. Classification – Bentham & Hooker, Binomial nomenclature.

Unit II

Study of the following families and their economic importance - Rutaceae, Apiaceae, Lamiaceae, Euphorbiaceae and Liliaceae.

Unit III:

Herbal medicines-History and scope: Knowledge on-Ayurveda, Siddha, Unani and Homeopathy. Herbal preparation: decoction, extract, infusions, oils, shampoos and powders.

Unit IV:

Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withaniasomnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster).

Unit V:

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).

Text Books:

1. Pandey, B.P. (1997). *Taxonomy of Angiosperms*. New Delhi: S. Chand & Co.
2. Kokate, C.K., Purohit, A.P. and Gokhale. S.B. (1999). *Pharmacognosy*. New Delhi: NiraliPrakashan

Reference Books:

1. Singh., and Jain. (1997). *Taxonomy of Angiosperms*. Meerut: Rastogi Publications.
2. Agnes Arber, (1999). *Herbal Plants and Drugs*. Jaipur: Mangal Deep Publications.
3. Kanny Lall Dey and Raj Bahadur (1984). *The indigenous drugs of India*. Dehradun: International Book Distributors.
4. Sivarajan, V.V. Balachandran and Indra. (1994). *Ayurvedic drugs and their plant source*.
New Delhi: Oxford IBH publishing Co.

Semester - II

Allied Practical - I

Taxonomy of Angiosperms and Herbal Technology

Sub. Code: BA20P1

No. of hours per week	Credit	Total no. of hours	Marks
2	-	30	-

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	dissect and display the floral parts of the families studied and draw floral parts and write floral formula.	PSO - 1	An

CO - 2	assign the plant provided to the respective families.	PSO - 3	E
CO - 3	know the relevance of herbal drugs in Indian system of medicine.	PSO - 7	U
CO - 4	analyze the phytochemicals present in plant parts.	PSO - 7	An

1. To make dissections of the floral parts of the families prescribed in the syllabus and to make drawings to bring out the salient features including floral diagram and floral formula.
2. Assigning plants to their respective families.
3. Spotters: Fruit types; inflorescence types and medicinal plants prescribed in the syllabus
4. Demonstration Only: Basic qualitative phytochemical analysis

Semester - II

Biofertilizers, Biofuels and Biopesticides (NMEC)

Sub. Code: BNM202

No. of hours per week	Credit	Total no. of hours	Marks
2	2	30	100

- Objectives:**
1. To enable the students to acquire knowledge on the importance of biological resources
 2. To be self-employable.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	design novel mechanisms for the sustainable utilization of natural resources.	PSO – 4	Ap
CO - 2	understand the role of microbes in bio - composting.	PSO – 3	An
CO – 3	utilize the technique studied for biofuel production using suitable production.	PSO -4	C

CO – 4	learn different skills in bioproduct processing to become an entrepreneur.	PSO – 5	Ap
CO – 5	know the efficacy of biocontrol mechanism over chemical application.	PSO – 4	U

UNIT-I

Biofertilizer: Scope and importance of biofertilizers. Reasons for preference of biofertilizer to chemical fertilizer. Biofertilizers using nitrogen fixing microbes, Mass Multiplication of *Azolla*.

UNIT-II

Biofuel Production: Major algal species for biofuel production, downstream processing for the biofuel production, advantages of biofuel production.

UNIT-III

Vesicular Arbuscular Mycorrhizae (VAM) –Isolation, multiplication, application Carrier-based inoculants, quality control, agronomic importance. Vermicomposting- Methods and preparation of vermicomposting and its application.

UNIT -IV

Biopesticides: Advantages and disadvantages of biopesticides; biological methods of pest control. Mode of action of *Bacillus thuringiensis*.

UNIT-V

Biocontrol- Microbial control of plant pathogens- *Trichoderma*.

Biological Control – Use of Baculovirus, protozoa & fungi in biological control.

Text Book:

Ignacimuthu, S. (2012). *Biotechnology – An introduction*. U.K.: Alpha Science International Ltd;

Reference Books

1. Norris, J. R., Read, D. J. and Verma, A. K. (1992). *Methods in Microbiology*. Vol. XXIV. London: Academic Press.
2. Whitton, B.A and Carr, N.G. (1982). *Biology of Cyanobacteria*. Oxford: Blackwell Scientific
3. John Jothi Prakash, E. (2004). *Outlines of Plant Biotechnology*. New Delhi: Emkay Publications
4. Sathe, T.V. (2004). *Vermiculture and Organic Farming*. New Delhi: Daya publishers.

5. Subha Rao, N.S. (2000). *Soil Microbiology*. New Delhi: Oxford & IBH Publishers,
6. Lakshman, H.C and Channabasava, A. (2014) *Biofertilizers and Biopesticides*. Jaipur: Pointer Publishers
7. Subba Rao N. S. (1982). *Advances in Agricultural Microbiology*. Oxford: Butterworth-Heinemann

Semester - III

Major Core III - Archegoniate

Sub. Code: BC2031

Number of Hours per Week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

- Objectives:**
1. To acquire knowledge on early land plants.
 2. To understand the life cycle patterns of archegoniate.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	describe the general characters of early land plants	PSO - 1	U
CO - 2	interpret the ecological and economic importance of archegoniate	PSO - 4	Ap
CO - 3	describe the external, internal and reproduction of archegoniate	PSO - 7	U
CO - 4	differentiate life cycle patterns of archegoniate	PSO - 1	An
CO - 5	classify Cryptogams and comment on the stelar evolution in pteridophytes	PSO - 1	U
CO - 6	compare the fossil members of pteridophytes and gymnosperms	PSO - 1	An

Unit I

Unifying features of Bryophytes, transition to land habit, classification by Rothmaler (1951). Distribution, systematic position, morphology, anatomy, reproduction and life cycle of *Marchantia* and *Polytrichum* (Developmental details not to be included). **Ecological and economic importance of Bryophytes.**

Unit II

General characteristics of Pteridophytes, classification by Smith (1955) and life cycle patterns. Distribution, systematic position, morphology, anatomy, reproduction and life cycle of *Psilotum* (Developmental details not to be included).

Unit III

Distribution, systematic position, morphology, anatomy, reproduction and life cycle of *Selaginella* and *Marsilea* (Developmental details not to be included). Heterospory, seed habit, stelar evolution and types of stele. **Ecological and economical importance of Pteridophytes.**

Unit IV

General characteristics of Gymnosperms, classification by Chamberlain (1935). Distribution, systematic position, morphology, anatomy and reproduction of *Pinus* (Developmental details not to be included). **Ecological and economical importance of Gymnosperms.**

Unit V

Geological time scale. Fossils –Types and methods of fossilization and importance of fossils. Distribution, systematic position, morphology, anatomy and reproduction of *Rhynia* and *Lyginopteris*.

Text Books:

1. Vashista, P.C. (1997). *Bryophyta*. New Delhi: S. Chand and Co.
2. Vashista, P.C. (1997). *Pteridophyta*. New Delhi: S. Chand and Co.
3. Vashista, P.C. (1997). *Gymnosperms*. New Delhi: S. Chand and Co.

Reference:

1. Parihar, N.S. (1967). *Bryophyta*. Allahabad: Central Book Depot Publications.
2. Watson, E.V. (1974). *Structure and life cycle of Bryophytes*. New Delhi: B.I. Publications.
3. Srivastava, H.N. (1990). *Fundamentals of Pteridophytes*. Jalandhar: Pradeep Publications.

4. Rashid, A. (1990). *An Introduction to Pteridophytes*. New Delhi: Vikas Publications.
5. Sharma, O.P. (2006). *Text Book of Pteridophyta*. New Delhi: Macmillan Publishers India Ltd.
6. Chamberlain, C.J. (2000). *Gymnosperms*. New Delhi: CBS Publishers and Distributors.
7. Pandey, S.N., Misra, S.P.& Trivedi, P.A. (1998). *Text book of Botany*. Vol. II. New Delhi: Vikas Publishing Pvt Ltd.
8. Mishra, S.R. (2010). *Text book of Paleobotany*. New Delhi: Discovery publishing Pvt. Ltd.

Semester – III

Major Elective – I (a) Herbal Botany

Sub. Code: BC2032

Number of Hours Per Week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

- Objectives:**
1. Encourage, protect and safeguard the patent rights and Intellectual Property Rights
 2. Serve as a source of supply of improved plants not readily available from other agencies

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	develop skills to grow herbs and empower entrepreneurship	PSO - 5	C
CO - 2	compare the side effects of allopathic medicine with native medicine	PSO - 3	An
CO - 3	compare the different types of indigenous medicine	PSO - 2	An
CO - 4	incorporate the novel values of herbs as food supplement	PSO - 5	Ap
CO - 5	understand the chemical constituents of important medicinal herbs.	PSO - 4	U
CO - 6	demonstrate the use of locally available medicinal plants	PSO - 7	U

UNIT I

Herbal medicines-History and scope: Knowledge on-Ayurveda, Siddha, Unani and Homeopathy. Brief knowledge on Ethnomedicine, Ethnomedicinal plants of Kanyakumari District.

UNIT II

Folk medicines including grandmother medicinal practices (Home remedies) for common ailments like cold, fever, cough, diarrhoea Skin and hair care: Herbal preparation, decoction, extract, infusions, oils, shampoos and powders.

UNIT III

Botanical name, family, morphology of medicinally importance of useful parts, active principles and utilization of the following medicinal herbs: *Catharanthus roseus*, *Withania somnifera*, *Clerodendrum phlomidis* and *Centella asiatica*. Drug yielding plants: therapeutic and habit forming drugs with special reference to *Cinchona*, *Rauwolfia* and *Cannabis*.

UNIT IV

Evaluation and standardization of herbal drugs. Physio chemical properties - Ash, Fluorescence analysis. Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, terpenoids and phenolic compounds). Adulteration: Identification of five common herbal adulterants.

UNIT V

Cultivation, harvesting, processing, storage, marketing and utilization of medicinal plants Seed- *Strychnos nux-vomica*, Stem- *Adathoda vasica*, Rhizome – *Acorus calamus*. Conservation of medicinal plants: *in situ* and *ex situ*. Masticatories and fumitories. Tobacco and health hazards.

Text Book:

1. Kokate, C.K., Purohit, A.P. and Gokhale. S.B. (1999). *Pharmacognosy*. New Delhi: NiraliPrakashan.

Reference:

1. Agnes Arber,(1999).*Herbal Plants and Drugs*. Jaipur:Mangal Deep Publications.
2. KannyLallDey and Raj Bahadur(1984). *The indigenous drugs of India*. Dehradun: InternationalBook Distributors.
3. Sivarajan, V.V. Balachandran and Indra.(1994). *Ayurvedic drugs and their plant source*.
4. New Delhi: Oxford IBH publishing Co.

5. Light Miller and Bryan Miller (2012). *Ayurveda and Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing*. New Delhi: Motilal Banarsidass Publishers Pvt. Ltd.
6. [Vasant Balaji Athavale](#) (2009). *Basic Principles of Ayurveda*. New Delhi: Chaukhamba Sanskrit Pratishtan Publishers.
7. Wendy Applequist, (2006). *The Identification of Medicinal Plants*. Austin: American Botanical council.

Semester - III

Major Elective – I (b) Nursery and Gardening

Sub. Code: BC2033

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

Objectives: 1. Create a successful, sustainable garden using organic methods
 2. Encouraging the students to develop valuable new life skill by creating their own seed bed

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	incorporate lab to land programme by raising home garden and nurseries	PSO - 5	Ap
CO - 2	evaluate seed dormancy	PSO - 4	E
CO - 3	practice the different techniques in propagating horticultural plants	PSO - 5	Ap
CO - 4	explain the needed fertilizers in soil management	PSO - 7	U
CO - 5	understand the external factors necessary for plant growth	PSO - 3	U
CO - 6	explain the cultivation of different vegetable	PSO - 5	U

UNIT I

Nursery: definition, objectives and scope and building up of infrastructure for nursery,

planning and seasonal activities - Planting - direct seeding and transplants.

Nursery practices for some important crops – Coconut, Arecanut, Pepper and Cardamom.

UNIT II

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 III

Vegetative propagation: Layering - air and ground layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings.

Hardening of plants – greenhouse, mist chamber, shade house and glass house.

UNIT IV

Gardening: definition and scope, types of gardens- formal (Mughal) and informal (Japanese)

Special types of gardens – Rock garden, water garden, Bog or Marsh garden, Sunken garden and roof garden.

Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.

UNIT V

Cultivation of vegetable crops – Tomato, Brinjal. Root Crops – Radish, Carrot. Cucurbits- Cucumber, Bitter gourd. Storage and marketing procedures.

Text Book:

1. Kumar, N.(1997). *Introduction to Horticulture*. Nagercoil: Rajalakshmi Publications.

Reference:

1. Bose, T.K. and Mukherjee, D. (1972). *Gardening in India*. New Delhi: Oxford & IBH Publishing Co.
2. Sandhu, M.K.(1989). *Plant Propagation*. Bangalore: Wile Eastern Ltd.
3. Janick Jules.(1979). *Horticultural Science* (3rd Ed.), SanFrancisco: W.H. Freeman and Co.
4. Agarwal, P.K. (1993). *Hand Book of Seed Technology*. New Delhi: Dept. of Agriculture and Co-operation, National Seed Corporation Ltd.
5. Sheela, V.L. (2011). *Horticulture*. Chennai: MJP Publishers.

Semester - III
Major Elective – I (c) Agricultural Botany

Sub. Code: BC2034

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

- Objectives:** 1.To study the various parameters and their influence on agriculture
2. To give student elementary information on basic agronomic principles and practices.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	understand form , function and process within the plant	PSO - 1	U
CO - 2	analyse seed technology	PSO - 3	An
CO - 3	understand the physiological process within the plants inorder to appreciate the diversity in plants and crops	PSO - 7	U
CO - 4	choose crops for different environments	PSO - 5	E
CO - 5	identify the factors affecting the crops	PSO - 1	R
CO - 6	develop skills by cultivating cereals and pulse	PSO - 5	C

UNIT I

Introduction to agriculture, Classification of crops, Crop rotation-principles, limitation, advantages, rotational intensity, cropping scheme, cropping intensity. Cropping system – intercropping, mixed cropping, multiple cropping and relay cropping.

UNIT II

Cultivation – area, soil, seed rate requirements, manuring, weed management and harvest of the following:

- a. Cereals and Millets: Rice and Maize
- b. Pulses: Green gram and Horse gram

c. Oil Seeds: Ground nut and Sesame

UNIT III

Seed technology: Seed Viability, Dormancy, Methods of breaking dormancy, seed processing, Seed treatment for storage and seed certification

UNIT IV

Factors affecting agriculture: Biotic: Insects, Pests, Rodents, Weeds. Abiotic: Soil, Wind, Water, Atmospheric air, Humidity, Temperature. Structure and Composition of earth, Altitude and Latitude.

UNIT V

Beneficial microorganisms in Agriculture; Brief account on Biofertilizer, microbial insecticides, microbial agents for control of plant diseases, Modern agriculture- Implements and practices. Implication of GMO crops.

Text Book:

1. Chandrasekaran, B. Annadurai, K. Somasundaram, E. (2010). *A textbook of Agronomy*. New Delhi: New Age International Publishers.

Reference:

1. Agarwal, R.L.(1976).*Seed Technology*. New Delhi: IBH Publishing Co.
2. Meeting, Jr., F.B. (1992). *Soil Microbial Ecology: Application in Agricultural and Environmental Management*. New York: Marcel Dekker Inc.
3. Kochhar, S.L. (1986).*Economic Botany in the Tropics*. Chennai: Macmillan India Ltd.
4. Satyanarayana, U. (2008). *Biotechnology*. Kolkata: Books and Allied (P) Ltd.
5. Rajni Gupta., and Mukherji, K.G. (2001). *Microbial Technology*. New Delhi: A.P.H Publishing Corporation.

Major Practical Paper - III

Archegoniate

Sub Code: BC20P3

To be conducted during the Semester - III

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
2	-	30	50

Objectives:

1. To learn the technique of preparing plant material for microscopic observation
2. To compare morphological and anatomical features of the lower and higher land plants

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	identify the archegoniate from their morphological features	PSO - 1	K2(U)
CO – 2	examine the internal anatomy of few bryophytes, pteridophytes and gymnosperms	PSO - 7	K4(An)
CO – 3	prepare plant material for microscopic observation	PSO - 9	K4(An)
CO – 4	gain knowledge on fossil plants	PSO - 8	K1(R)
CO – 5	identify the archegoniate plants through field visit	PSO - 3	K5(E)

Archegoniate(Bryophytes, Pteridophytes and Gymnosperms)

Morphological and Anatomical study of the following:

1. Bryophytes: *Marchantia* –Dorsal view, Ventral view, T.S of the thallus
Slides – Antheridiophore, Archegoniophore, Sporophyte
Polytricum – Habit,
Slides – Antheridiophore, Archegoniophore, Sporophyte

2. Pteridophytes: *Psilotum* – Habit, T.S of stem
Slide - T.S of Synangium,
3. Pteridophytes: *Selaginella* – Habit, T.S of stem, Rhizophore
Slide – L.S of cone
Marsilea – Habit,C.S. of petiole, rhizome
Slide – Sporocarp V.S
4. Gymnosperms: *Pinus* – Twig, T.S. of stem, needle
Slide – male cone L.S, Female cone L.S
Entire male & female cone
6. Paleobotany: *Rhynia*(fossil)
Lyginopteris (fossil)slide

Semester - III

Allied –II- Theory

Taxonomy of Angiosperms and Plant Physiology

Sub. Code: BA2031

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

- Objectives:**
1. To impart basic knowledge of morphology to understand taxonomy
 2. To understand importance of water and its relation to the plants
 3. To organize awareness programme about economic importance of plants and its conservation

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall the main features of angiosperms	PSO - 1	R
CO - 2	understand the respiratory processes carried out by plants	PSO - 7	U

CO - 3	apply their physical and biochemical knowledge to evaluate the processes involved in photosynthesis	PSO - 7	Ap
CO - 4	analyze the various processes involving in water uptake and transport in plants.	PSO - 3	An
CO - 5	classify the different plants by the natural, artificial and phylogenetic classification	PSO - 6	An
CO - 6	interpret the role of growth hormones in plants	PSO - 1	Cr

UNIT I

Morphology: Leaf - phyllotaxy, simple and compound leaf, venation. Inflorescence types. Fruit types

UNIT II

Taxonomy: Bentham & Hooker's classification. Study of the following families and their economic importance- Rutaceae, Lamiaceae, Euphorbiaceae and Poaceae.

UNIT III

Plant Physiology: Water relations - Importance of water to plant life - imbibition, diffusion, osmosis and plasmolysis. Absorption of water movement-Symplast and apoplast, passive and active mechanisms (Starch-glucose interconversion theory and K⁺ ion theory). Transpiration-Types and stomatal mechanism.

UNIT IV

Photosynthesis: pigment systems, mechanism of photosynthesis: light dependent (cyclic and non-cyclic photophosphorylation) light independent (C₃ cycle). Factors affecting photosynthesis.

UNIT V

Respiration: Glycolysis, anaerobic (Fermentation), aerobic (Kreb's cycle), Electron Transport System and Oxidative phosphorylation. Factors affecting respiration.

Phyto hormones – physiological role of auxins, gibberellins and ethylene.

Text Books:

1. Pandey, B.P. (1997). *Taxonomy of Angiosperms*. New Delhi: S. Chand and Company Ltd.
2. Jain V. K. (2006). *Fundamentals of Plant Physiology*. New Delhi: S. Chand and Company Ltd.

ReferenceBooks:

1. Lawrence G.H.M. (1951).*Taxonomy of Vascular Plants*.New York:Mac Milan Company.
2. Singh, V and Jain, D.K. (1997).*Taxonomy of Angiosperms*. New Delhi: Rastogi Publications.
3. Noggle Ray, G. and George, J. Fritz. (2002).*Introductory Plant Physiology*. New Delhi: Prentice Hall of India, Pvt.Ltd.
4. Purohit, S.S. (2005).*Plant Physiology*. Jodhpur: Sarswati Purohit Publishers.
5. Srivastava, H.N. (2002). *Plant Physiology*. Jalandhar: Pradeep Publications.
6. Pandey, K.K and Sinha, B.K.(1988). *Plant Physiology*. New Delhi: Vikas Publications.

Semester - III**Allied Practical - II****Taxonomy of Angiosperms and Plant Physiology****Sub Code: BA20P2**

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
2	-	-	-

Taxonomy of Angiosperms and Plant Physiology (To be conducted during semester III)

1. To make dissections of the floral parts of the families prescribed in the syllabus and
2. To make drawings to bring out the salient features including floral diagram and floral formula.
3. Assigning plants to their respective families.
4. Demonstration only
 - a. Transpiration pull
 - b. Oxygen evolved during photosynthesis
 - c. Light- screen experiment
 - d. Khune's apparatus
 - e. Ascent of sap

Semester - IV

Major Core – IV Plant Ecology and Phytogeography

Sub. Code: BC2041

Number of Hours Per Week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

Objectives: 1. To understand the ecological groups and their interactions
2. To learn and create awareness about environmental problems at local, national and international levels

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	explicate the ecological interconnectedness between soil texture and water in plants	PSO - 7	U
CO - 2	compare the relationships between the different ecological groups	PSO - 9	An
CO - 3	develop an appreciation of nature through direct experience with local ecosystems.	PSO - 7	C
CO - 4	learn techniques for gathering data in the field and presenting the scientific information in figures and tables.	PSO - 3	An
CO - 5	create an awareness to safeguard endemic and native plants and for sustainable utilization of natural resources	PSO - 4	C
CO - 6	become employable in relevant areas related to ecology	PSO - 5	Ap

UNIT I

Soil - importance; origin; types, formation; composition; physical, chemical and biological components; Soil profile; Role of climate in soil development.

UNIT II

Water -importance: states of water in the environment; atmospheric moisture; precipitation types (rain, fog, snow, hail, dew); water in soil; water table; water bodies: aquifers, water shed management.

UNIT III

Ecological groups: study of hydrophytes, xerophytes and halophytes with reference to their morphological, anatomical and physiological adaptations; Study of vegetation- Quadrat and Transect.

UNIT IV

Ecosystem: Fresh water (pond) ecosystem; marine ecosystem; trophic organization, basic source of energy, autotrophy, heterotrophy, food chains and webs, ecological pyramids. Plant interactions- symbiosis, commensalism, parasitism.

UNIT V

Phytogeography- principles of phytogeography; Types of plants distribution - continuous, discontinuous and endemic. Plate tectonics, Continental drift, theory of land bridges, age and area hypothesis. Centers of origin of cultivated crops.

Text book:

1. Sharma, P.D. (2010). *Ecology and Environment*. 8th (ed.). Meerut: Rastogi Publications.

Reference:

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

Semester - IV

Major Elective – II (a) Biological Resources

Sub. Code: BC2042

Number of Hours Per Week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

Objectives: 1. To know the potentiality of major biomass systems, both for "green energy" and for other renewable resources

2. Utilize and apply the methods to keep the planet healthy

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	realise the vast expansion of biomass systems, both for "green energy" and for other renewable resources	PSO - 4	U
CO - 2	understand the nutritive value of Single Cell Protein and learnt the techniques of producing SCP from microorganisms	PSO - 2	U
CO - 3	recognize the need to protect and conserve Mother Nature	PSO - 4	An
CO - 4	find ways to have sustainable management of natural resources	PSO - 4	E
CO - 5	gain awareness of career options in the biological sciences	PSO - 9	C

UNIT I

Biofertilizers: Scope and importance. Bacterial Fertilizer – *Rhizobium* – mass production and uses. Cyanobacteria, Biofertilizer- *Nostoc* - mass production and application. *Azolla*- mass production and application. Vermicompost – Mass production and application

UNIT II

Single Cell Protein and Mycoprotein: Sources of single cell protein, Nutritive value of single cell protein. Mass Cultivation of *Spirulina*. Mushroom Cultivation-*Pleurotus* and *Agaricus*, nutritional values and value added products.

UNIT III

Forest cover, forest resources – Utility and Values of forests: Commercial benefits, ecological benefits and aesthetic benefits

UNITIV

Biofuels:Importance of biofuel, Biodiesel Production –*Pongamia*and*Jatropha*. Alcohols – the liquid fuel- ethanol production. Gaseous fuels: Biogas production and Hydrogen fuel.

UNIT V

Biopesticides: Introduction, desirable qualities of biopesticides. Microbial Pesticides – fungi, viruses and bacteria. Advantages and disadvantages of Microbial Pesticides, Application of Biopesticides.

Text Book:

1. Dubey, R.C. (2006). *Text Book of Biotechnology*. New Delhi: S. Chand & Company Ltd.

Reference Books:

1. Ramawat, K.G. (2003). *Plant Biotechnology*. New Delhi: S. Chand & Company.
2. Adrian Slater., Nigel Scott., and Mark Fowler. (2003). *Plant Biotechnology*. New York: Oxford University Press.
3. Satyanarayana, U. (2008). *Biotechnology*. Kolkata: Books and Allied (P) Ltd.
4. Rajni Gupta., and Mukherji, K.G. (2001). *Microbial Technology*. New Delhi: A.P.H Publishing Corporation.
5. Aneja, K. R. (2002). *Experiments in Microbiology, Plant Pathology and Biotechnology*, New Delhi: New Age International Pvt. Ltd.

Semester - IV

Elective - II (b) Food Science

Sub. Code: BC2043

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

Objectives: 1. To learn about the importance, constituents and health practices of food and balanced diet.

2. To obtain knowledge about fermented food products.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	list the different constituents of food, methods of cooking and preservation	PSO - 5	R

CO - 2	demonstrate the side effects of food additives	PSO - 3	Ap
CO - 3	prepare value - added products of milk and vegetables	PSO - 5	C
CO - 4	explain the industrial production of beer, ethyl alcohol, vinegar and amylase	PSO - 5	U
CO - 5	design balanced diet	PSO - 8	C
CO - 6	test for detection of food adulterants and colourants	PSO - 3	E

UNIT I

Food science – Definition, aim, constituents of food and their value. Energy value of balanced diet, carbohydrates, proteins, fats, enzymes and vitamins.

Cooking- Objectives of cooking, Preliminary preparations, Cooking methods, (Moist heat methods, Dry heat methods, Microwave cooking, Solar cooking).

UNIT II

Food colourants: Natural, Artificial and Special flavours: Spices and Condiments.

Food additives – Sweetners, Emulsifiers and Stabilisers, Antioxidants, Flavour improvers. Safety measures of food additives.

UNIT III

Fermented milk products – butter, yoghurt, cheese. Fermented vegetable products- sauerkraut, cucumber, Fermented meat products- Sausage and Dried Fish.

UNIT IV

Food preservation: Principle, Food spoilage, Methods of food preservation – preservation by low and high temperature, Pasteurization, Canned food.

UNIT V

Industrial production of the following:

Alcoholic beverages - Beer, Wine, Ethyl alcohol

Non alcoholic beverages -Vinegar, Coffee, Tea.

Text Book:

1. Sumathi, R.Madamti and Rajagopal,M.V.(2012). *Fundamentals of Food and Nutrition*. Kochi:

New Age Publishers.

Reference Books:

1. Adams, M.R. and Moss, M.O. (2003). *Food microbiology*. (3rded.) New Delhi: Panima Publishing Corporation.
2. Sivasankar, B. (2002). *Food processing and Preservation*. New Delhi: Prentice Hall of India Pvt. Ltd.
3. El-Mansi, E.M.T and Bryce, C.F.A. (2002). *Fermentation Microbiology and Biotechnology*. USA: Taylor and Francis Group.
4. Srilakshmi, B. (2010). *Food Science*. (5th ed.). New Delhi: New Age International Pvt. Ltd.
5. Norman. A Potter and Joseph. H Hotchkiss. *Food Science*. (5th ed.). New Delhi: CBS Publishers & Distributers Pvt. Ltd.
6. AnandanKumaravelan, R. (2005). *Environmental Science and Engineering*, Chennai: Seitech publication, (India) Pvt. Ltd.

Semester - IV**Elective – II (c) Biodiversity and Human Welfare****Sub. Code: BC2044**

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

- Objectives:** 1. To understand the biodiversity and its importance.
2. To utilize the plants for human use.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	record the biodiversity taxa at different region	PSO - 4	R
CO - 2	assemble with any biodiversity management organizations at national or international level	PSO - 7	C
CO - 3	organize biodiversity awareness programmes	PSO - 7	C

CO - 4	apply the knowledge on conservation in day to day life	PSO - 4	Ap
CO - 5	assess the value of biodiversity through valid methodologies	PSO - 7	E
CO - 6	categorize the hot spots of biodiversity in national level	PSO - 6	An

UNIT I

Bio diversity and its scope- genetic diversity, species diversity, biodiversity at the ecosystem level, agro biodiversity and cultivated plant taxa, wild taxa. Values of biodiversity; Ethical and aesthetic values of biodiversity.

UNIT II

Biodiversity Hot spots- History of hotspots, evolution of hotspots, Critical role of hotspots in species richness and endemism, Biodiversity in tropics, National biodiversity hotspots, hottest biospots of Western Ghats, Biodiversity of Tamilnadu

UNIT III

Economical values of biodiversity- plants, animals and microbes. Loss of genetic diversity, loss of species diversity, loss of ecosystem diversity, loss of agro biodiversity, consequences and implications; projected scenario for biodiversity loss.

UNIT IV

Organizations associated with biodiversity management- IUCN, UNEP, UNESCO, WWF, NBPGR; National Biodiversity Authority, Nature Conservation Foundation, The Nature Conservancy Environmental summit- PARIS 2015

UNIT V

Conservation- Role of NGOs in biodiversity conservation, Conservation of genetic diversity, species diversity and ecosystem diversity, *in situ* and *ex situ* conservation, social approaches for conservation, biodiversity awareness programmes, sustainable development.

Text Book:

1. Singh, J.S, Singh, S.P. and Gupta, S. (2006). *Ecology Environment and Resource Conservation*. New Delhi: Anamaya Publications.

Reference:

1. Krishnamurthy, K.V.(2004). *An Advanced Text Book of Biodiversity - Principles and Practices*. New Delhi:Oxford and IBH Publications Co. Pvt. Ltd.
2. Odum, E.P. (2005). *Fundamentals of Ecology*. (5thed.). New Delhi:Cengage Learning India Pvt. Ltd.

3. Trivedi, P. Trivedi, R. and Gurdeep Raj.(2002).*Environmental Ecology*.New Delhi: Akashdeep Publishing House.
4. Kasturi Reddy.(2010).*Biodiversity and Land Conservation*. New Delhi: Pacific Publication.
5. Rao, M. K.(2011).*Environmental and ClimateChange*. New Delhi:Manglam Publications.
6. Tyler Miller, G. and Scott.E. Spoolman (2013). *Environmental Studies*. United States: Cengage Publishers

Semester - III

Major Practical Paper - III

Archegoniate

Sub Code: BC20P3

To be conducted during the Semester - III

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
-	2	-	50

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	identify thallophytes given in the prescribed syllabus using study guides	PSO - 1	R
CO - 2	distinguish thallophytes from angiosperms	PSO - 7	U
CO - 3	practice the preparation of plant material for microscopic observation	PSO - 5	Ap
CO - 4	draw appropriate anatomical diagrams from the sectioning of plant material using microscope	PSO - 5	An
CO - 5	assess the archegonial plants easily through field trip	PSO - 9	E
CO - 6	identify the fossil slides	PSO - 3	R

Archegoniate(Bryophytes, Pteridophytes and Gymnosperms)

Morphological and Anatomical study of the following:

1. Bryophytes: *Marchantia* –Dorsal view, Ventral view, T.S of the thallus
Slides – Antheridiophore, Archegoniophore, Sporophyte

Polytricum – Habit,

Slides – Antheridiophore, Archegoniophore, Sporophyte

2. Pteridophytes:

Psilotum – Habit, T.S of stem

Slide, T.S of Synangium,

Selaginella – Habit, T.S of stem, Rhizophore

Slide – L.S of cone

Marsilea – Habit, C.S. of petiole, rhizome

Slide – Sporocarp V.S

Rhynia(fossil) slide

3. Gymnosperms: *Pinus* – Twig, T.S. of stem, needle

Slide – male cone L.S, Female cone L.S

Entire male & female cone

Lyginopteris (fossil)

Semester - IV

Major Practical Paper - IV

Plant Ecology and Phytogeography

Sub Code: BC20P4

To be conducted during the Semester - IV

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
2	2	30	50

CO	Upon completion of this course the students will be able to :	PSO addresssed	CL
CO - 1	record the locally available Hydrophytes, Xerophytes and Halophytes	PSO - 1	R
CO - 2	construct a quadrat for vegetative analysis.	PSO - 4	Cr
CO - 3	demonstrate the measurement of soil permeability	PSO - 3	Ap

CO - 4	practice the preparation of plant material for microscopic observation	PSO - 5	Ap
CO - 5	distinguish the phytogeography models	PSO - 7	An
CO - 6	develop practical skills to visit field for individual/group work	PSO - 9	An

Plant Ecology

1. Methods of studying vegetation – Quadrat and Belt transect
2. Morphology of locally available Hydrophytes, Xerophytes and Halophytes
3. To make suitable micropreparations of:
 - a. *Hydrilla* stem T.S.
 - b. *Eichhornia* petiole T.S.
 - c. Phylloclade T.S. (*Casuarina*)
 - d. Phyllode T.S. (*Parkinsonia, Acacia*)
4. Demonstration – soil permeability – (Percolation and soil holding capacity).
5. Models –Related to phytogeography
6. Field visit – One day.

Semester - IV

Allied II - Theory : Plant Diversity - II (Gymnosperms, Angiosperms and Plant Physiology)

Sub. Code: BA2041

No. of hours per week	Credit	Total no. of hours	Marks
4	4	60	100

- Objectives:**
1. To understand the structure and purpose of basic organelles of plant cells
 3. To classify meristems and explain the internal structure of root and shoot

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recognize the feature of plant anatomy: at the cell, tissue and organ level	PSO - 1	R
CO - 2	differentiate Prokaryotes from Eukaryotes	PSO - 7	U
CO - 3	know the complexity of xylem and phloem.	PSO - 1	U
CO - 4	compare and contrast the organization of mitotic and meiotic cell division in plant and to learn about cell cycle	PSO - 3	E
CO - 5	compare the structure and functions of living and non - living inclusions in plants	PSO - 3	E
CO - 6	understand about the difference between the primary and secondary structures of plant.	PSO - 3	U

UNIT I

Cell - Prokaryotic and Eukaryotic; Structure of plant cell, chemical composition and functions of the following - Plasma membrane (fluid mosaic model), Chloroplast and Mitochondria

UNIT II

Ultrastructure and functions of nucleus. Cell division – cell cycle, mitosis and meiosis - significance. Non living inclusions – starch grains, aleurone grain, cystolith and raphide.

UNIT III

Tissues – Meristems – Classification (origin, position and function); Characteristic features of meristematic tissues, Difference between meristematic and Permanent tissues Permanent Tissues–structure and functions of simple permanent tissues – parenchyma, collenchyma, sclerenchyma

UNIT IV

Structure and functions of complex tissues – xylem and phloem.

Study the internal structure of the following:

(a) Primary structure of dicot stem and root.

UNIT V

(b) Primary structure of monocot stem and root.

(c) Dicot leaf and monocot leaf.

(d) Normal secondary thickening in dicot stem.

Text Books:

1. Verma, P.S. and Agarwal, V.K.S. (2004). *Cell Biology*. New Delhi: S. Chand and Company Ltd.
2. Vashista, B.R.R. (1997). *The Plant Anatomy*. New Delhi: S. Chand and Co. Ltd.

Reference Books:

1. Powar, C.B. (2005). *Cell Biology*. New Delhi: Himalaya Publishing House.
2. De Robertis, E.D.P. and De Robertis, D.M.P. (1980). *Cell and Molecular Biology*. Philadelphia: Saunders College.
3. Gupta, P.K. (1997). *Cytology, Genetics and Evolution*. Meerut: Rastogi Publications.
4. Esau, K. (1953). *Plant Anatomy*. New York: Wiley Publication Co.
5. Pandey, B.P. (1982). *Plant Anatomy*. New Delhi: S. Chand and Company Ltd.
6. Arthur J Eames and Laurence H McDaniels. (2005). *An Introduction to Plant Anatomy*. New Delhi: Tata McGraw-Hill.

Semester - IV

Allied Practical - II

Taxonomy of Angiosperms and Plant Physiology; Cell Biology and Plant Anatomy

Sub Code: BA20P2

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
2	2	30	100

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	dissect the floral parts of the prescribed families and explain with appropriate diagrams	PSO - 7	R
CO - 2	identify electron micrographs of the cell organelles and tissues	PSO - 3	U
CO - 3	draw the anatomical structures of plant parts	PSO - 3	An
CO - 4	detect the tissues and stomatal types	PSO - 3	An
CO - 5	set - up the experiments to show physiological process	PSO - 1	U
CO - 6	examine the non living inclusions	PSO - 7	Ap

Taxonomy of Angiosperms and Plant Physiology (To be conducted during semester III)

1. To make dissections of the floral parts of the families prescribed in the syllabus and
2. To make drawings to bring out the salient features including floral diagram and floral formula.
3. Assigning plants to their respective families.
4. Demonstration only
 - a. Transpiration pull
 - b. Oxygen evolved during photosynthesis
 - c. Light- screen experiment
 - d. Khune's apparatus
 - e. Ascent of Sap

Cell Biology and Plant Anatomy (To be conducted during semester IV)

1. To identify electron micrographs of the cell organelles and non living inclusions.
2. To observe and identify different types of tissues
3. Sectioning, staining, mounting and identification of primary structure of dicot stem, dicot root, monocot stem and monocot root.
4. . Sectioning, staining, mounting and identification of Dicot and Monocot leaf.
5. Stomatal types – anomocytic, anisocytic, paracytic, diacytic and graminaceous

Self Learning Course (III /V)

Plant Resource Utilization

Sub. Code: BC20S1

Sub. Code: BC20S2 Semester	Course Code	Name of the Course	Credit	Total hours	Marks
IV	BC17S2	Plant Resource Utilization	2	30	100

Objectives: 1. To enable the students to acquire knowledge in plant resources.

2. To gain interest in value added crops.

UNIT I

Utilization: Cereals - wheat and rice; Role of dwarf varieties in green revolution; Legumes - green gram, black gram and dhal.

Fibre - cotton

Sustainable practices for food production

UNIT II

Sugars and Starch: Sugarcane - products and by-products of sugarcane industry; Potato - propagation methods - value added products.

Spices: Listing of important spices, their family and part used; with special reference to fennel, saffron, clove, turmeric and all spice.

UNIT III

Beverages: Tea, coffee and cocoa - their processing and some common adulterants.

Oils and Fats: General description with details to groundnut, coconut and sesame; their use related health implications.

UNIT IV

Natural Rubber - Para rubber, tapping and processing, various substitutes of Para rubber.

Drug yielding plants. Therapeutic and habit forming drugs with special reference to Cinchona, Rauvolfia and Cannabis. Masticatories and fumitories: Tobacco and health hazards.

UNIT V

Single cell protein – Spirulina – mass cultivation, processing - value added products. Blue green algae – Rhizobium - mass cultivation, role as biofertilizers.

Role of microbes in biomining and in oil spills.

Text Book:

1. Kochhar, S.L., (2011). Economic Botany in the Tropics. (4th ed.). New Delhi: MacMillan Publishers IndiaLtd.

References:

1. Pandey,B.P. (1999). Taxonomy of Angiosperms. New Delhi: S. Chand & Company Pvt. Ltd.
2. Chandrasekaran, B., Annadurai, K. and Somasundaram, E. (2010). A Text Book of Agronomy.New Delhi: New Age International Publishers.
3. Vashista, P.C. (1997). Taxonomy of Angiosperms. New Delhi: S. Chand & Co.

Self-learning Course - IV

Algal Biotechnology

Sub. Code: BC20S2

Sub. Code: BC20S2 Semester	Course Code	Name of the Course	Credit	Total hours	Total Marks
IV	BC20S2	Algal Biotechnology	2	30	100

- Objectives:**
1. Understand the potentiality of algal resources
 2. Develop skill to become employable

Unit I

Introduction to algal biotechnology, Resource potential of algae; commercial utility of

algae. Algae as a source of food and feed; Algae as a source of pigments, fine chemicals, fuel and bio-fertilizers.

Unit II

Uses (economic and medicinal) of the following algae:

Cyanophyceae: *Spirulina* and *Nostoc*

Chlorophyceae: *Chlorella* and *Ulva*

Phaeophyceae: *Sargassum* and *Laminaria*

Rhodophyceae: *Gracilaria* and *Gelidium*

Unit III

Cultivation of seaweeds: Strain selection; Culture media; indoor cultivation methods

Measurement of algal growth. Large-scale cultivation of algae Harvesting, Drying and marketing.

Unit IV

Bio-fertilizers: Blue-green algal bio-fertilizers, Methods of preparation, application and its advantages over inorganic fertilizers.

Unit V

Biodiesel from algae: algae producing biodiesel; Advantages over other sources of biodiesel; Cultivation and extraction methods. Phycoremediation. Role of algae in nano biotechnology.

Text Book

1. Dubey, R.C. (2006). Text Book of Biotechnology. New Delhi: S. Chand & Company Ltd.

Reference Books

1. Tait, R.V. (2013). Elements of Marine Ecology. U.K.: Butterworth and co (Publisher) Ltd.
2. Barsanti, Laura and Paolo Gualtieri. (2005). Algae-Anatomy, Biochemistry and Biotechnology. New York: Taylor & Francis.
3. Becker, E.W. (1994). Microalgae-Biotechnology and Microbiology. London: Cambridge University Press.
4. Tivedi, P.C. (2001). Algal Biotechnology. Jaipur: Pointer publishers.
5. Venkataraman, L.V. and Becker, E.W. (1985). Biotechnology and Utilization of Algae – The Indian Experience. New Delhi: Dept. Science and Technology.

Semester - V
Major Core-V Taxonomy of Angiosperms and Economic Botany
Sub. Code: BC2051

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
6	6	90	100

- Objectives:**
1. To know the principles of classification of taxa.
 2. To evaluate the medicinal importance of selected angiosperms.
 3. To acquire knowledge on the botanical vocabulary and taxonomical terminology to identify plants.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO-1	relate the modifications in plant parts.	PSO-1	U
CO-2	differentiate the artificial, natural and phylogenetic classification and learn about ICN rules.	PSO-2	An
CO-3	evaluate the taxonomists of India.	PSO-1	Ev
CO-4	recall the characters of some important families.	PSO-1	R
CO-5	understand the economically important products of plants and their use at various levels.	PSO - 2	U
CO-6	construct digital herbarium and learn about Herbarium techniques.	PSO - 5	C

UNIT I:

Introduction to systematic: Botanical nomenclature: Principles and rules of International Code of Nomenclature (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

Morphology – root, stem, leaf, inflorescence, flower and fruit – their modifications.

UNIT II: Systems of classification; Detailed study on Sexual system-Carolus Linnaeus, Natural System – Bentham and Hooker, Phylogenetic System - APG Classification (2016).

Field inventory: Functions of Herbarium; Virtual herbarium; E-flora; Herbarium techniques.

Contribution to systematic botany by Indian Taxonomists: K.M. Mathew and Hermenegild Santapau.

UNIT III:

Detailed study of the following families with their economic importance: Annonaceae, Rutaceae, Meliaceae, Caesalpiniaceae, Anacardiaceae, Cucurbitaceae, Rubiaceae and Sapotaceae.

UNIT IV:

Apocynaceae, Asclepiadaceae, Lamiaceae, Euphorbiaceae, Amaranthaceae, Cannaceae, Orchidaceae and Poaceae.

UNIT V:

Study of the following groups of plants with special reference to their botanical name, family, morphology of useful part, economic products and uses: Cereals - Paddy, Wheat; Pulses - Green gram, Bengal gram; Tuber crops - Tapioca, Potato; Spices - Pepper, Cardamom; Beverages - Tea, Coffee; Oil yielding plants - Coconut, Groundnut; Fibre yielding plants - Cotton, Coir; Timber yielding plants - Teak, Rose wood; Latex yielding plants - Para rubber, Sapota; Ornamental plants - Rose, Orchids.

Text Book:

1. Sharma O.P. (2013). *Plant Taxonomy*. New Delhi: McGraw Hill Education Pvt. Ltd. New Delhi.
2. Subramanyam, N.S. (1999). *Modern Plant Taxonomy*. New Delhi: Vikas Publishing House.
3. Mondal, A.K. (2005). *Advanced Plant Taxonomy*. New Delhi: New Central Book Agency (P) Ltd.

Reference Books:

1. Singh and Jain (1997). *Taxonomy of Angiosperms*. New Delhi: Rastogi Publications.
2. Pandey, B.P.S. (1997). *Taxonomy of Angiosperms*. New Delhi: S. Chand and Company Ltd.

3. Rendle, A.B. (1979). *The Classification of Flowering Plants* (I &II). London: Cambridge University Press.
4. Pullaiah, T. (2007). *Taxonomy of Angiosperms*.(3rded.).New Delhi: Regency Publication.
5. Roslin, A.S.(2005). *A Text Book on Taxonomy of Flowering Plants*.Nagercoil:Assisi Offset Press.
6. Vashista, P.C.(1985). *Taxonomy of Angiosperms*.New Delhi:Vikas Publications.
7. Lawrence, G.H.M. (1951). *Taxonomy of Vascular Plants*. New York: MacMilan Publishers.
8. Simpson, M.G. (2006). *Plant Systematics*. London: Academic Press.
9. Simpson, B.B. and Conner – Ogorzaly, M(1986). *Economic Botany: Plants in Our World*. New York:McGraw Hill Book Company.

Semester - V

Major – Core VI -Biochemistry and Biophysics

Sub. Code:BC2052

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
6	6	90	100

- Objectives:**
- 1.To understand the structure and properties of bio-molecules.
 2. To reflect on the sources and benefits of vitamins.
 - 3.To learn the emerging field of biophysics and principles of bioenergetics.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO– 1	apply the usage of P ^H and buffers in biological experiments.	PSO–3	Ap
CO– 2	understand the importance of Bio-molecules.	PSO–1	U
CO– 3	describe its biological roles and significance of lipids.	PSO– 1	U
CO– 4	analyze enzyme activity.	PSO–2	An

CO-5	demonstrate thermodynamic principles in biological energy conversion.	PSO-7	E
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UNIT I:

Chemical bonds – types (co-ordinate, covalent, hydrogen); Acids and Bases - pH and Buffer system. Classification of carbohydrates; Monosaccharides: Structure of glucose (linear, open chain, ring form) and fructose, properties of monosaccharides. Disaccharides: Structure and properties of maltose, sucrose and lactose. Polysaccharides: Structure and properties of starch and cellulose.

UNIT II:

Amino acids - classification, structure and properties. Protein – primary, secondary, tertiary (myoglobin) and quaternary (hemoglobin). Protein denaturation and biological roles of proteins. Vitamins: structure, importance, sources, deficiency symptoms of water-soluble vitamins e.g., Thiamine, Riboflavin and Niacin; fat-soluble vitamins e.g., vitamin A- retinol, Vitamin D – Ergosterol.

UNIT III:

Lipids: saturated and unsaturated fatty acids. Classification- structure and properties of simple lipids (waxes and triglycerides), compound lipids (phospholipid and glycolipid) and derived lipids (cholesterol, carotenoids and terpenes).

UNIT IV:

Enzymes: Classification, nomenclature based on IUB, activation energy, active site, cofactors, coenzymes (NAD, CoA), isoenzyme; mechanism of enzyme action (lock and key model, induced - fit theory), enzyme inhibition and factors affecting enzyme activity.

UNIT V:

Photobiology: Dual nature of light and its characteristics. Electromagnetic Spectrum, Action and Absorption spectrum, Emission spectrum – excitation and de-excitation. phosphorescence, fluorescence and bio-luminescence. Bioenergetics: Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as an energy currency molecule.

Text Books:

1. Jain, J.L. (2000). *Fundamentals of Biochemistry*. New Delhi: S. Chand and Co.

2. Mahesh., S. (2003). *Biotechnology, Molecular Biology and Biophysics*. New Delhi: New Age International publishers.

Reference Books:

1. Conn, E.J. and Stumpf, P.K. (2009). *Outlines of Biochemistry*. (5th ed.) New Jersey: Wiley Eastern Ltd.
2. Lehninger, A.L. (2002). *Principles of Biochemistry*. New Delhi: CBS Publishers and Distribution.
3. Arun Mittal, C. (2002). *Biochemistry*. New Delhi: A.P.H. Publishing Corporation.
4. Satyanarayana, U. and Chakrapani, U. (1999). *Biochemistry*. Kolkata: Books and Allied (P) Ltd.
5. Campbell, P.N. and Smith, A.D. (2011). *Biochemistry* (4th ed.). New York: Churchill Livingstone Publishers.

Semester - V

Major Core – VII – Microbiology and Plant Pathology

Sub. Code: BC2053

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
6	5	90	100

- Objectives:**
1. To provide the students with the comprehensive understanding and appreciation for the diversity and significance of microbes on planet earth.
 2. To study the interaction between plant and pathogen and to develop method of disease management.
 3. To know the working principal and mechanism of action of instruments related to microbiology.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO – 1	get an insight on the structure and reproduction of bacteria and viruses.	PSO - 1	U

CO – 2	explore the role and relevance of bacteria and viruses in the field of microbiology.	PSO - 1	An
CO–3	learn the sterilization techniques and preparation of culture media.	PSO–2	Ap
CO– 4	Become an expert in operating microbiological instruments thereby undertaking careers in that field.	PSO - 5	Ap
CO -5	Understand the economic and pathological importance of bacteria, viruses and fungi.	PSO - 1	U

UNIT I:

Introduction to microbial world: Bacteria: General characteristics; Archaeobacteria, Eubacteria, wall-less forms (mycoplasmas). Ultrastructure; Nutritional types of bacteria - autotrophs and heterotrophs, Reproduction and recombination (conjugation, transformation and transduction). Binary fission and endospore. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

UNIT II:

Viruses: General characteristics; classification (Baltimore), structure and replication of DNA virus (T4), lytic and lysogenic cycle; RNA virus (TMV, Corona Virus), viroids and prions. Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, asexual organisms of plant diseases.

UNIT III:

Sterilization of glasswares, preparation of agar medium. Bacterial growth- growth curve- pure culture, batch culture and continuous culture. Physical and chemical agents for controlling microorganisms. Dry and Wet sterilization. Working principles of Autoclave, Laminar Air Flow and Incubator. Contributions to Microbiology: Anton Van Leeuwenhoek, Louis Pasteur and Robert Koch.

UNIT IV:

Food Microbiology: General account of food spoilage through microbes. Food borne infections and preventions – Botulism and Salmonellosis

Dairy microbiology – Sources of milk contamination, Pasteurization technique, Test for grading milk quality

Water microbiology: Potable and non potable water, Municipal sewage treatment process: Primary, Secondary, (aerobic and anaerobic process), chemical treatment: chlorination.

Disposal of treated sewage. (sludge as fertilizer ; irrigation and dilution) Test for detection of coliform bacteria

UNIT V:

Terms and concepts; General symptoms; 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 – Bunchy Top of Banana, Vein clearing in lady's finger. Fungal diseases – Late blight of Potato and Tikka Disease of Groundnut

Text Books:

1. Dubey, R.C and Maheswari, D.K. (2003). *A text Book of Microbiology*. New Delhi: S. Chand and Company.
2. Singh, R.S.(1988). *Introduction to Principles of Plant Pathology*. New Delhi: Oxford and IBH Publishing Company.

Reference Books:

1. Prescott, L.M, Harley, J.P and Klein D.A. (1999). *Microbiology*. New York: McGraw Hill Publications.
2. John Ingraham, L and Catherine Ingraham, A.(2000). *Introduction to Microbiology*. Singapore: Thomson Books.
3. Purohit, S.S. (2006). *Microbiology*. India: Agro Botanical Publishers.
4. Pelzar, M.H, Chan, E.C.S and Erieg, N.R.(1993). *Text Book on Microbiology*. New Delhi: Tata McGraw Hill Pub. Co. Ltd.
5. Mehrotra, R.S. and Ashok Agarwal (2017). *Plant Pathology*. New Delhi: Tata McGraw Hill Publishing Company Ltd.
6. Rangaswami, G.(1998). *Diseases of Crop Plant in India*. New Delhi: Prentice Hall of India Pvt. Ltd.

Semester - VI

Major Core VIII - Genetics, Biostatistics and Bioinformatics

Sub. Code: BC2061

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
6	6	90	100

- Objectives:** 1. To have knowledge of Mendelian and non-Mendelian inheritance.
2. Develop skills in data tabulation, its treatment, analysis and interpretation of data.
3. Introduce the vast repositories of biological data knowledge.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO – 1	understand Mendelian principle and predict genetic inheritance patterns.	PSO - 1	U
CO – 2	analyze the facts of non-Mendelian inheritance and have conceptual knowledge on alleles and their linkage.	PSO - 3	Ap
CO – 3	examine the various stages of cell division and also a clear knowledge on DNA structure.	PSO - 3	U
CO – 4	generate biological interpretations and conclusions from data of scientific research.	PSO - 3	C
CO – 5	develop skills to become employable as professionals in biochemical industries.	PSO - 5	C

UNIT I:

Genetics as a science: History; Experiments of Mendel with *Pisum sativum*, Principles of inheritance, Mendelian laws - monohybrid and dihybrid cross, test cross and back cross. Modification of Mendelian ratio: Incomplete dominance – *Mirabilis jalapa*, Co-dominance – MN blood group in man, Lethal genes: Dominant lethality - Coat colour in Mice, Recessive lethality – Chlorophyll content in Maize. Genetic interaction: Dominant Epistasis – fruit colour in summer squashes, Recessive epistasis – coat colour in mice; Complementary genes – flower colour in sweet pea. Non-epistasis - comb pattern in Fowls.

UNIT II:

Sex Linked inheritance (eye colour in *Drosophila*) Polygenic inheritance with reference to (ear length in maize), Multiple alleles - ABO blood group in man, Rh factor. Non-Mendelian inheritance Extra-chromosomal inheritance: chloroplast mutation – variegation in 4 O'clock plant; mitochondrial mutations in yeast. Maternal effects – shell coiling in snail. Linkage:

Morgan's views on linkage, crossing over – types, mechanism of crossing over and its significance, Holliday model for genetic recombination.

UNIT III:

Cell cycle, Cell division (mitosis and meiosis), Significance of mitosis and meiosis. Chromosomes: Chromosome morphology – (metacentric, submetacentric, acrocentric and telocentric) and Chromosome. Structure. Special type of chromosomes: giant chromosomes (salivary gland chromosomes, Lamp brush chromosomes), supernumerary chromosomes (B chromosome).

Brief account on Nucleic acids; DNA as the genetic material: Griffith's and Avery's transformation experiment, Hershey – Chase bacteriophage experiment, RNA as the carrier of genetic information (Fraenkel-Conrat). DNA Structure (Watson and Crick) Salient features of double helix, Types of RNA: structure and functions of mRNA, rRNA and tRNA.

UNIT IV:

Biostatistics: Importance of statistics in Biology, sampling - random sampling, collection and interpretation of data, tabulation, presentation of data - frequency distribution, frequency curve, frequency polygon, histogram and bar diagrams. Measures of central tendencies - mean, median and mode. Measures of dispersion – standard deviation, standard error, Null hypothesis - Chi - square test.

UNIT V:

Introduction to Bioinformatics: aims and scope and applications- Virtual library, e-books and e- journals. Major areas of biological data bases- classification; primary, secondary, specialized. Importance data bases- NCBI, SWISS-PROT, DDBJ. Tools and softwares in Bioinformatics – similarity search – BLAST – FASTA sequence alignment tools. Application of Bioinformatics.

Text Books:

1. Verma, P.S. Agarwal, V.K., (1994). *Genetics*. New Delhi: S. Chand and Company Ltd.
2. John De Britto. (2011). *Biosatistics*. Sivakasi: Anto Art
3. Mani K and Vijayaraj N. (2003). *Bioinformatics for the Beginners*. Coimbatore: Kalailatheer Achagam.

Reference Books:

1. Gupta P.K. (1997). *Cytology, Genetics and Evolution*. Meerut: Rastogi Publications.
2. Gardner, E.J. Simmons, M.J. Snustad, D.P. (1991). *Principles of Genetics*. (8th ed.)

3. India: John Wiley & Sons Inc.
4. Snustad, D.P. and Simmons, M.J. (2010). *Principles of Genetics*. (5th ed). India: John Wiley & Sons Inc.
5. Klug, W.S. Cummings, M.R., Spencer, C.A. (2009). *Concepts of Genetics*. (9th ed.). U.S.A: Benjamin Cummings Publishers
6. Griffiths, A.J.F. Wessler, S.R. Carroll, S. B. and Doebley, J. W. H. (2010). *Introduction to Genetic Analysis*. (10th ed.). U.S.A: Freeman and Co.
7. Gurumani, N. (2005). *An Introduction to Biostatistics*. (2nd ed.). Chennai: MJP Publishers.
8. Prasad S. (1990). *Elements of Biostatistics*. Meerut: Rastogi Publications.
9. Krane Dan, E. and Raymer M.L. (2004). *Fundamental concepts of Bioinformatics*.
10. New Delhi: Pearson Education.

Semester - VI

Major Core IX - Biotechnology and Molecular Biology

Sub. Code: BC2062

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
6	6	90	100

- Objectives:**
1. To learn and apply the general principles of biotechnology and ensure adequate training in modern biotechnology.
 2. To understand the various steps in DNA replication, protein synthesis and gene regulation in prokaryotes.
 3. To gain knowledge on different types of IPR.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	acquaint the core concepts and fundamentals of plant biotechnology.	PSO – 1	U

CO – 2	develop competency on different types of plant tissue culture.	PSO – 3	Ap
CO – 3	understand the mechanisms of genetic information.	PSO –1	U
CO – 4	get an insight of chromosome abnormalities and related human syndromes.	PSO –7	An
CO – 5	develop skills to become employable as professionals in Biotechnology Industries.	PSO –7	C

UNIT I:

Definition and scope of biotechnology, Principles of recombinant DNA technology, Steps and Applications of rDNA technology; Restriction Enzymes – Nomenclature and Classification; Cloning Vectors - Plasmids, Cosmids, Phagemids and shuttle vectors; DNA cloning - Steps and Applications; Basic techniques – Agarose gel electrophoresis, Northern blotting, Southern blotting and RFLP.

UNIT II:

Scope and importance of plant tissue culture, Totipotency of cells, Tissue culture laboratory-organization and requirements, MS medium composition and preparation; Sterilization techniques; Types of tissue culture - Callus culture, apical meristem culture, Micropropagation and Protoplast culture; Artificial seed: production, applications and limitations; Cryopreservation techniques.

UNIT III:

General Features of DNA Replication: General principles –semi- conservative and semi discontinuous replication; Semi conservative model of replication – Watson and Crick, DNA damage; DNA repair mechanism. Photoreactivation, Mismatch repair; Mutations – Gene mutation and Chromosomal mutation; Mutagens; Chromosomal abnormalities- Down Syndrome and Klinefelter Syndrome.

UNIT IV:

Genetic code and wobble hypothesis; Transcription in prokaryotes and eukaryotes; Assembly of ribosomes; Protein synthesis - initiation, elongation and termination; Gene regulation in Prokaryotes- Operon concept, Lac Operon; Transposons in Prokaryotes and Eukaryotes.

UNIT V:

DNA transfer techniques: Physical method (Microinjection), Chemical method (Calcium phosphate method), Electrical method (Electroporation); Gene transfer in plants – *Agrobacterium* transformation; GM plants – Bt Brinjal, Bt Cotton; Transgenic crops with

improved quality traits in major crops (FlavrSavr tomato, Golden rice). IPR – Scope and different kinds of IPR.

Text Books:

1. Dubey, R.C. (2006). *Text Book of Biotechnology*. New Delhi: S. Chand and Company.
2. Ajoy Paul, (2011). *Text book of Cell and Molecular Biology*. Jaipur: Books and Allied Pvt. Ltd.

Reference Books:

1. Ignacimuthu. S. (1999). *Basic Biotechnology*. New Delhi: Tata McGraw Hill Publishing Company Ltd.
2. Ramawat K.G. (2003). *Plant Biotechnology*. New Delhi: S.Chand and Company.
3. Adrian Slater, Nigel Scott and Mark Fowler. (2003). *Plant Biotechnology*. New York: Oxford University Press.
4. Rajni Gupta and Mukerji K.G. (2001). *Microbial Technology*. New Delhi: A.P.H Publishing Corporation.
5. Chawla, H.S. (2004). *Introduction to Plant Biotechnology*. (2nd ed.). London: Oxford University.
6. David Freifelder. (2002). *Essentials of Molecular Biology*. New Delhi: Narosa Publishing House.
7. William H. Elliot and Daphne C. Elliot. (2001). *Biochemistry and Molecular Biology*. (2nd ed.). London: Oxford University Press.
8. Robert. F. (2003). *Molecular Biology*. (2nd ed.). New Delhi: McGraw Hill Publishers.
9. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). *Molecular Biology of the Gene*.(6th ed.). New York:Pearson Benjamin Cummings Press.

Semester - VI

Major Core X - Plant Physiology and Metabolism

Sub. Code: BC2063

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
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6	5	90	100
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- Objectives:**
1. Comprehend the fundamental concepts of plant physiology.
 2. Describe the physiological mechanisms of plant growth, function, and development.
 3. Recognize and describe how plants respond to their environment.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	understand water relation of plants with respect to various physiological processes.	PSO - 1	U
CO – 2	explain deficiency symptoms of macro and micro nutrients in plants.	PSO –2	U
CO – 3	relate complementary metabolic pathways such as photosynthesis and respiration in energy acquisition.	PSO –1	An
CO – 4	analyse nitrogen metabolism and its significance.	PSO –1	An
CO – 5	assess dormancy and germination in plants.	PSO –1	An

UNIT I:

Plant and cell architecture: Importance of water to plant life; Physical properties of water; Imbibition, diffusion, osmosis and plasmolysis. Concepts of water potential and its components. The Concept of the Soil Plant Atmosphere Continuum (SPAC). Transpiration – Definition, types of transpiration, structure and opening and closing mechanism of stomata; guttation and anti-transpirants. Factors affecting transpiration.

UNIT II:

Mineral nutrition: Essential elements, micro and macronutrients; Criteria of essentiality of elements; General functions, specific role and deficiency symptoms of macronutrients (Nitrogen, Phosphorus, and Potassium) and micronutrients (Iron, Magnesium, Molybdenum and zinc) Absorption and translocation of solutes (organic and inorganic) – active & passive uptake.

Hydroponics, types, aquaponics and significance.

UNIT :III

Photosynthesis: Importance of photosynthesis for food security and environment. Ultrastructure of chloroplast: (a) Light reaction: Radiant energy, photosynthetic apparatus, light harvesting complex; light absorption, composition and characteristics of pigment systems, photosynthetic electron transport, (b) Dark reaction: Carbon dioxide fixation in C₃, C₄ and CAM plants, photorespiration and its significance, factors affecting photosynthesis.

UNIT IV:

Respiration: Ultrastructure of mitochondria. Aerobic and anaerobic respiration; cyanide independent respiration; fermentation; **Glycolysis, Krebs cycle and generation of ATP synthesis through oxidative electron transfer chain (Cytochrome system), chemiosmotic regeneration of ATP, Gluconeogenesis** and factors affecting respiration.

Nitrogen Metabolism: Nitrogen nutrition, organic nitrogen, nitrogen fixation in microbes/legumes, nif genes and NOD factors, nitrate and ammonia assimilation, nitrogenase.

UNIT V:

Plant growth regulators: Growth, Growth curve, Growth and development, Phytochromes and light control, role of phytochrome in tropism, flowering and fruiting. Physiological roles of Auxin, Gibberellin, Abscisic acid and Ethylene. Vernalization– dormancy of seeds, methods of breaking dormancy, mechanism of seed germination, Plant response to environmental stresses - Polyamines, brassinosteroids and their functions.

Text book:

1. Jain V. K. (2006). *Fundamentals of Plant Physiology*. New Delhi: S. Chand and Company Ltd.

Reference Books:

1. Taiz, L., Zeiger, E. Moller, I. M. and Murphy, A. (2015). *Plant physiology and Development* (6th ed.) USA: Sinauer Associates Inc.
2. Hopkins, W.G. Q. and Huner, N.P. A. (2009). *Introduction to Plant Physiology*. (4th ed.) U.S.A: John Wiley and Sons.
3. Bajracharya, D. (1999). *Experiments in Plant Physiology- A Laboratory Manual*. New Delhi: Narosa Publishing House.
4. Pandey, K.K. and Sinha, B.K. (1988). *Plant Physiology*. New Delhi: Vikas Publications.

5. Ross and Salisbury. (2009). *Plant Physiology*. New Delhi: Cengage Learning.

Semester - VI

Elective –IV (a) Marine Botany

Sub. Code:BC2064

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	3	60	100

Objectives: 1. Understand the diversity of marine organisms.

2. Learn about the marine plants and their medicinal property.

3. Acquire knowledge on marine pollution and conservation methods.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	describe the types of marine habitat and their relationship with environment	PSO - 1	R
CO – 2	compare the threats and conservation of seaweeds and sea grasses	PSO –4	An
CO – 3	evaluate how natural events and human activities affect coastal habitats	PSO – 4	Ev
CO – 4	create a broad knowledge about the marine products and their economic value	PSO – 5	C
CO – 5	describe the role of mangroves in conservation of marine flora and fauna.	PSO –4	U

UNIT I:

Classification of marine habitat – pelagic, neritic and oceanic province, benthic – zonation – shore environment – muddy, rocky and sandy, waves and tides deep sea bottom – pelagic deposits. physical and chemical properties of sea water. Salt marshes and sand dune vegetation.

UNIT II:

Marine biodiversity – phytoplankton- Nekton, Benthos. Marine Phytoplankton- Dino - flagellates, Nano-plankton, Ultra-plankton, marine bacteria, marine fungi, marine Lichens. Threats and conservation of seaweeds and sea grasses.

UNIT III:

Marine products: traditional uses - human food and agriculture. Isolation of agar-agar. Scope of the seaweed industry: Brown seaweeds as food, Red seaweeds as food. Medicinal uses of marine seaweeds and sea grasses.

UNIT IV:

Marine pollution: Pollution due to heavy metals - radioactive wastes, thermal, sewage, algal blooms and oil spills – possible remedies – oil eating bacteria – GMO and pollution abatement. Biomagnification.

UNIT V:

Mangroves – Salient features of *Rhizophora* and *Avicennia*. Definition, distribution, stresses on mangroves, regeneration of mangroves, coral reefs – ecology, species interaction, economic importance and conservations.

Text Book:

1. Newell, G.E., and Newell, R.C. (1977). *Marine Plankton- A Practical Guide*. U.K.: Hutchinson and Co Ltd.

Reference Books:

1. Clinton, J. Dawes. (1981). *Marine Botany*. New York: John Wiley and Sons.
2. Tait, R.V. (2013). *Elements of Marine Ecology*. U.K.: Butterworth and Co. (Publisher) Ltd.
3. Pringsheim, E.G. (2016) *Pure Cultures of Algae*. New York: Hafner Publishing Company.
4. Sinha, P.C. (1998). *Marine Pollution*. New Delhi: Anmol Publications Pvt. Ltd.
5. Grant Gross, M. (1993) *Oceanography: A view of the earth*. New Jersey: Prentice - Hall Inc.
6. James W. Nybakker (2001). *Marine Biology*, San Francisco: Benjamin Cummings Publishing House.
7. Colin Munn, (2011). *Marine Microbiology*. (2nd). New York: Garland Science.

Semester - VI

Elective –IV (b) Organic Farming

Sub. Code: BC2065

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	3	60	100

- Objectives:** 1. Identify various sources of organic manures and their application.
2. To develop trainers at village level on organic management practices.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	understand the concept of organic farming and its importance.	PSO–1	U
CO – 2	apply the knowledge of organic nutrients and organic pest management in farming.	PSO–3	Ap
CO – 3	demonstrate the use of biocontrol agents, botanicals and other plant growthpromoting preparations in organic farming.	PSO–4	An
CO–4	learn the techniques of different concepts of composting methods.	PSO–1	U
CO–5	empower the employment opportunity of rural youth at village level in organic market as organic growers, stakeholders, and entrepreneurs.	PSO–7	Ap

UNIT I:

Introduction, concept and development of organic farming. principles of organic farming, objectives of organic farming, types of organic farming. benefits of organic farming. Social aspects of organic farming; market aspects of organic farming. Brief Account of Soil- Types of soil, Soil pH and Soil reclamation.

UNIT II:

Nutrient management: Organic Manure – uses of farm yard manure, rural compost, city compost, vermicompost, oil cakes, animal wastes—(cattle dung and urine, poultry wastes, slaughter wastes, piggery and fishery wastes), green manures, biofertilizers; recycling of organic wastes and residue management, brief account of nutrient deficiency symptoms.

UNIT III:

Preparation of fertilizer mixtures: preparation of bio-fertilizers-Rhizobium, mass production of VAM fungi, preparation of organic nutrient solutions- 'panchagavya', preparation of Neem Kernel Aqueous Extract (NKAE), chemical and physiological methods of increasing fertilizer use efficiency.

UNIT IV:

Pest management in organic farming: Role of Botanicals- Neem oil emulsion, Neem oil garlic emulsion (2%), Tobacco decoction, Bio-control agents – Entomopathogens (fungi, bacteria and virus), Preparation of Permitted Fungicides for Organic Farming (Bordeaux mixture (1%)). Integrated Pest Management (IPM).

UNIT V:

Organic Farming System: Systems of farming- wet land, garden land and dry land farming systems. Familiarization of farm equipments & implements, concept of different cropping systems in relation to organic farming—pure organic farming and integrated organic farming (cash crops, permaculture and polyculture).

Text Book:

1. Arun K Sharma(2005).*Handbook of Organic Farming*. Jodhpur: Agrobios.

Reference:

1. Charles.A. Francis.(2009). *Organic Farming – The ecological System*. U.S.A: Book and Multimedia Publishing Committee.
2. Lockeretz, W. (2007). *Organic Farming – An international History*. U.K.: Cornwell Press.
3. Dilip Nandwani.(2016) *Organic Farming for Sustainable Agriculture*. Switzerland: Springer International Publishing.

4. Mukesh Gupta. (2004). *Organic agriculture development in India*. Jaipur: ABD Publishers.
5. Ann Larkin Hansen. (2010). *The Organic Farming Manual: A Comprehensive Guide to Starting and Running a Certified Organic Farm*. Massachusetts: Storey Publishing.
6. Vayas, S.C, Vayas, S., Modi, H.A. (1998). *Bio-fertilizers and organic Farming*. Gujarat: AktaPrakashan.
7. Nair, G.M.(2015). *Chemical and biopesticides for crop protection: A handbook for technical officers*. Thiruvananthapuram: Department of Agriculture, Govt. of Kerala.

SEMESTER – VI

Major Elective IV (c) Ecotourism

Sub. Code: BC2066

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	3	60	100

- Objectives:**
1. To highlight the need for sustainable tourism.
 2. To appreciate and acknowledge the rich heritage of our country.
 3. To be aware about the role of various movements in the protection of nature and natural resources.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	recognize the values of natural heritage	PSO - 2	U
CO – 2	create environmental and cultural awareness to develop sustainable eco-tourism spots.	PSO - 4	C
CO – 3	understand the impact of ecotourism on economy, socio-economic and environment of a country.	PSO - 1	U
CO – 4	appreciate and admire the varieties of tourist centres.	PSO – 1	Ap
CO – 5	evaluate the role of local community in eco-tourism	PSO - 4	Ev

UNIT I:

Definition and scope of ecotourism. Classification of tourism: religion tourism, cultural tourism, heritage tourism, monumental tourism, adventure tourism, mass tourism, consumptive and non consumptive tourism.

UNIT II:

Interesting Eco-Tourism Places - global, national, regional (any five in each category). Identification of naturebased ecotourism. Maintenance of tourist centers.

UNIT III:

Ecotourism spots - dam sites, waterfalls, mangroves, bird sanctuaries, forest area, botanical garden, sacred groves, beaches, wildlife sanctuaries and national parks.

UNIT IV:

Impact of Ecotourism: Economical, Ecotourism-based/related employment socio-cultural and environmental impacts. Ecotourism and education. Ecotourism related organizations. Ecotourism research. Disasters and ecotourism. Coastal management activities related to ecotourism. Need for sustainable tourism.

UNIT V:

Infrastructural facilities for ecotourism. Funding agencies- government and private. Legislations to be followed, Ecotourism and local community. Strategies to maintain these areas in an ecological sustainable way.

Text Books:

1. Dasman, R.F. (1968) *Environmental Conservation*. New York: John Wiley and Sons.
2. Jadhav, H.V. and Bhosale, V.M. (1995). *Environmental Protection and Laws*. Bangalore: Himalaya publishing House.

Reference Books:

1. Mukherjee, N. (2008). *Ecotourism and sustainable Development*. New Delhi: Cybetech Publications.
2. Prabhas Chandra. (2003). *Global Ecotourism*. New Delhi: Kaniskha Publishers.

3. Sinha, P.C. (2003) *Encyclopedia of Ecotourism*. (Vol. I, II and III). New Delhi: Anmol Publications Pvt. Ltd.

4. Weaver, D.B. (2001) *The Encyclopedia of Ecotourism*. U.K.: CABI Publishing.

Major Practical - III

Taxonomy of Angiosperms and Economic Botany & Biochemistry and Biophysics

Sub. Code: BC20P3

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
2 + 2	2	30 + 30	100

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO-1	understand and identify the locally available common plants.	PSO -1	U
CO-2	identify the family and describe the plant parts and floral parts.	PSO -3	An
CO-3	record the economically important products from the prescribed families in the syllabus.	PSO -1	U
CO-4	prepare buffer solution for biological and biotechnological experiments.	PSO -1	Ap
CO-5	estimate and compare the biomolecules quantitatively.	PSO -3	Ev
CO-6	identify spotters (i.e., Photos/Models/Instruments) related to biochemistry and biophysics.	PSO -1	R
CO-7	do qualitative analysis of glucose, starch, protein and lipids.	PSO -3	Ev

Taxonomy of Angiosperms and Economic Botany

1. Technical description of plant parts, including floral parts (L.S. of flower, floral diagram and floral formula) with reference to the families prescribed in theory.

2. Identification of the plant specimens with reference to their families following the Bentham & Hooker's classification.
3. Survey of locally available plant species belonging to the families prescribed in the syllabus
4. Taxonomic field trip under supervision and submission of 5 herbarium sheets. Field note book to be submitted for external evaluation.
5. Study of different types of inflorescence, root, leaf, fruit and economically important part from the members of the families prescribed in the syllabus.

Submission - Record note book, Herbarium sheets and Field note book.

Biochemistry and Biophysics

A. Major Experiments:

1. Verification of Beer's law
2. Quantitative estimation of soluble starch by Colorimetry (Iodine-Test method)
3. Quantitative estimation of insoluble starch by gravimetric method
4. Quantitative estimation of sugar by Colorimetry (Phenol - Sulfuric Acid method)
5. Quantitative estimation of proteins in plant samples. (Lowry's method)
6. Titration of weak acid against strong base
7. Preparation of Buffers
8. Separation of dye mixture by circular paper chromatography

B. Spotters:

- a. Enzyme model - Lock and Key, Koshland's induced fit model
- b. Effect of pH on enzyme activity
- c. Effect of substrate concentration on enzyme action
- d. Fluorescence
- e. Phosphorescence

C. Demonstration only:

- a. Qualitative estimation of Glucose (Benedict's Test)
- b. Qualitative estimation of Starch (Iodine Test)
- c. Qualitative estimation of Protein (Biuret Test)
- d. Qualitative estimation of Lipid (Sudan III Test)

Major Practical -IV

Genetics, Biostatistics and Bioinformatics & Biotechnology and Molecular Biology

Sub Code: BC20P4

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
2 + 2	2	30 + 30	100

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO – 1	identify the different stages of mitosis from the root tip squash of Onion.	PSO –3	U
CO – 2	solve genetic problems related to monohybrid, dihybrid ratio and interaction of genes.	PSO – 3	An
CO – 3	interpret experimental data using biostatics.	PSO - 3	Ap
CO – 4	identify spotters (Photos/Models).	PSO - 1	R
CO – 5	be familiar with sterilization techniques.	PSO - 3	An
CO – 6	demonstrate Preparation of MS medium.	PSO - 1	U
CO – 7	AnalysePCRTechnique:Southern and Northern Blotting technique.	PSO - 3	Ap

Genetics, Biostatistics and Bioinformatics

1. To prepare root tip squash of onion and to identify the various stages of mitosis.
2. Solving genetic problems related to monohybrid, dihybrid ratio and interaction of genes (minimum of five problems in each category).
3. Calculation of mean and standard deviation for the given data.
4. Problems using Chi-square test.
5. Study of Photos/Models showing:
 - a. DNA-Structure (Watson and Crick Model)
 - b. Clover Leaf Model of tRNA
 - c. Giant chromosomes- Salivary gland chromosome
 - d. Lamp brush chromosomes
 - e. Crossing over

- f. Pectoral representation of data
- g. Central Processing Unit
- h. Pen drive
- i. Search Engine

Biotechnology and Molecular Biology

1. Preparation of MS medium.
2. Demonstration of *in vitro* sterilization of seeds and germination in MS media containing petriplates.
3. *In vitro* selection and inoculation methods using leaf and nodal explants.
4. Demonstration: DNA Isolation
5. Spotters: (Photos/models)
 - a. Anther culture, Pollen culture and protoplast fusion.
 - b. Vectors/Plasmids
 - c. Southern and Northern Blotting Technique
 - d. Methods of direct gene transfer – Microinjection and Short Gun Method
 - e. Transgenic plants – Bt-Cotton and Golden Rice

Major Practical -V

Microbiology and Plant Pathology & Plant Physiology and Metabolism

Sub Code: BC20P5

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
2 + 2	2	30 + 30	100

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO-1	apply sterilization technique and prepare sterile	PSO - 2	Ap

	bacterial culture media.		
CO-2	detect coliform bacteria in water samples.	PSO - 3	An
CO-3	identify the spotters.	PSO - 1	Ap
CO-4	know the importance of pasteurization through field visit.	PSO - 3	U
CO - 5	demonstrate and interpret the results to physiology experiments.	PSO - 3	R
CO- 6	able to analyse the relationship between absorption and transpiration.	PSO - 3	Ap

Microbiology and Plant Pathology

I. Demonstration/Spotters

1. Sterilization - autoclave, pressure cooker, laminar air flow, sprit lamp, inoculation needle.
2. Ultrastructure of Bacteria and Bacteriophage
3. Incubator
4. Plant pathology specimens
 - a. Citrus Canker
 - b. Angular Leaf Spot of Cotton
 - c. Bunchy Top of Banana
 - d. VeinClearing in Lady's Finger
 - e. Late Blight of Potato
 - f. Tikka Disease of Groundnut

II. Minor Experiment

- a) Bacterial culture(plate, slant).
- b) Gram's staining of bacteria.
Demonstration Only
- c) Analysis of milk – Dye reduction test.
- d) Detection of Coliform bacteria in water samples.

III. Visit to dairy farm

Plant Physiology and Metabolism

I. Major Physiology Experiments

1. Imbibition – by direct weighing method
2. Plasmolysis – Onion Peel
3. Determination of water potential by Chardakov’s method.
4. Determination of water absorption and transpiration ratio.
5. Rate of photosynthesis under varying concentration of CO₂
6. Effect of quality of light on evolution of O₂ during photosynthesis -colour filters.
7. Quantification of plant pigments by spectrophotometric method.
8. Respiration- R.Q using Ganong’s respirometer.

II. Demonstration only

1. Imbibition - Dialatometer
 2. Tissue tension
 3. Suction due to transpiration
 4. Ganong’s potometer
 5. Hydroponics
 6. Khune’s fermentation apparatus.
 7. Anaerobic respiration
 8. Growth – Arc auxanometer
- Phototropism

Semester - VI

PART -IV Skill Enhancement Course (SEC)

Global Environmental Issues

Sub. Code: SEC203

No. of hours per week	Credit	Total no. of hours	Marks
2	2	30	100

Objectives: 1. To understand the fundamental issues of environment.

2. To acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment.

3. To discuss social, psychological, economical and political issues surrounding each of the global environmental issues covered in the syllabus.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	analyse the causes and effects of pollution on various spheres of earth.	PSO –4	An
CO – 2	understand thecausesofclimate change and its effect on environment.	PSO – 4	U
CO – 3	examine the anthropogenic activities in soil desertification.	PSO –4	An
CO – 4	be aware of the importance of wet lands.	PSO – 4	U
CO – 5	explain the reasons for biodiversity loss.	PSO - 1	Ap

UNIT I:

Lithosphere: Geogenic and anthropogenic sources of environmental degradations, causes and their impacts, Soil degradation and desertification. Impact of quarrying.

UNIT II:

Hydrosphere: Importance of wetlands. Eutrophication; Point and non-point source of water pollution. Impact of water pollution in fresh water (lentic and lotic) and marine ecosystem.

UNIT III:

Atmosphere: Global warming, Acid rain, PC smog, Ozone depletion and its remedial measures. Types and sources of air pollutants; emission and air quality standards, PUC and air pollution control.

UNIT IV:

Noise Pollution: Sound and noise, Sources and impacts of Noise Pollution; management of noise pollution. Radiation Pollution: Sources, Biological impact of radiation, radioactive waste disposal.

UNIT V:

Biosphere: Biodiversity Loss, Invasive Species, Antibiotic Resistance, Infectious Disease and Pandemic, Deforestation, Revival of Mother Nature through education, awareness and training activities

Text Book:

1. Frances, H. (2012). *Global Environmental Issues*. (2nd ed.). New York: Willey-Blackwell and Sons.

Reference Books:

1. Mahesh Rangarajan, (2007). *Environmental Issues in India: A Reader*. New Delhi: Pearson-Longman Publishers.
3. Adger, N. Brown, K. and Conway, D. (2012). *Global Environmental Change: Understanding the Human Dimensions*. Washington DC: The National Academic Press.
4. Turekian. K. K. (1996). *Global Environmental Change-Past, Present, and Future*. New Jersey: Prentice-Hall

Employability / Entrepreneurship / Skill development

Holy Cross College (Autonomous)

**Nationally Re-Accredited with A+ by NAAC (CGPA 3.35 – IV Cycle),
Nagercoil, Kanyakumari District, Tamil Nadu, India**

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli



DEPARTMENT OF BOTANY



PG Syllabus

Semester I- IV

(With effect from the academic year 2020-2021)



DEPARTMENT OF BOTANY



Vision

Imbibing the spirit of the Holy Cross, the institution envisions a harmonious society by empowering women for global competency and ecological sustainability through holistic approach with innovative skills.

Mission

1. To provide quality education and to promote scholarly activities catering to global competencies.
2. To nurture participatory leadership to enhance social consciousness and social responsibility.
3. To uphold ethical values of honesty, personal accountability and transparency through professional commitment.
4. To create global professionals and entrepreneurs with innovative spirit and zeal.
5. To create empowered women of competence, commitment and compassion.
6. To instill in students the awareness of interconnectedness between man and nature

Programme Educational Objectives (PEOs)

PO No.	Upon completion of M.Sc. Degree Programme, the graduates will be able to :
PEO1	The graduates will apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.
PEO2	The graduates pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.
PEO3	The graduates will develop strong and competent knowledge with diversified professional skills in accordance with dynamic real – time challenges and career opportunities.

Programme Outcomes (POs)

PO No.	Upon completion of M.Sc. Degree Programme, the graduates will be able to :
PO – 1	carry out internship programmes and research projects to develop scientific skills and innovative ideas
PO – 2	analyse complex problems, think independently, formulate and perform quality research

PO – 3	become successful professionals and entrepreneurs
PO – 4	develop a multidisciplinary perspective and contribute to the knowledge capital of the globe
PO – 5	emerge as expressive, ethical and responsive citizens with proven expertise
PO – 6	utilize the obtained scientific knowledge to create eco- friendly environment

Programme Specific Outcomes (PSOs)

PSO No.	Upon completion of M.Sc. Degree Programme, the graduates of Botany will be able to:	PO Addressed
PSO – 1	apply fundamental mathematical tools and physical principles in analysing biological situations	PO – 2
PSO – 2	evaluate ecological interconnectedness of life on earth	PO – 4, 6
PSO - 3	experience in seeking external funds for their research from a diversity of resources	PO – 1, 2
PSO – 4	apply the acquired conceptual knowledge by connecting disciplinary and interdisciplinary aspects of Botany	PO – 4
PSO – 5	integrate the knowledge of botany for global sustainable development	PO – 3, 4
PSO – 6	understand the professional, ethical, legal and social issues related to gender	PO – 3, 5

Eligibility Norms for Admission

A pass in the B.Sc. or equivalent examination as per the norms of Manonmaniam Sundaranar University, Tirunelveli with Botany as major with the minimum of 50%. For SC/ST candidates, a pass in B.Sc. Botany is sufficient.

Duration of the Programme: 2 Years

Medium of Instruction: English

Passing Minimum

A minimum of 50% in the external examination and an aggregate of minimum 50% is required. There is no minimum pass mark for the continuous internal assessment.

Components of M.Sc. Botany Programme

Paper		Total Marks
Major Core Theory (3+3+2+3)	11 x 100	1100
Major Core Practical	4 x 100	400
Major Electives (Theory Papers)	4 x 100	400
Major Project	1 x 100	100

Total Marks	2000
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**Course Structure
Distribution of Hours and Credits**

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Total	
					Hours	Credits
Major Core - Theory	6 (5) +	6 (5) +	6 (5) +	6 (5) +	66	55
	6 (5) +	6 (5) +	6 (5)	6 (5) +		
	6 (5)	6 (5)		6 (5)		
Major Core -	2+2+2 (-)	2+2+2 (3+3)	3+3 (-)	2+2+2 (3+3)	24	12
Major Elective	6 (4)	6 (5)	6 (4)	6 (5)	24	18
Major Project	-	-	6 (5)	-	6	5
Total	30(19)	30(26)	30 (19)	30(26)	120	90
Non – Academic Courses						
Life Skill Training - I	-	(1)				1
Life Skill Training - II	-	-	-	(1)	-	1
Service Learning Programme (SLP) – Community Engagement Course	-	-	(2)	-	-	2
Summer Training Programme	-	-		(1)	-	1

Total number of Hours : 120

Mandatory Credits required: 90+5

- Non-Academic Courses are mandatory and conducted outside the regular working hours

- **SLP (Service-Learning Programme) - Community Engagement Course is conducted** outside the regular working hours on Saturdays and holidays (UBA) for all the students. No. of hours allotted for each of this programme is 30 and is supervised by the faculty in charge
- **STP (Summer Training Programme) (Mandatory Course - 30 hours) at the end of Semester II.**

Courses offered

Semester	Course Code	Title of the Course	Hours/Week	Credits
I	PB2011	Core I - Plant Diversity I – Algae, Fungi, Lichens and Bryophytes	6	5
	PB2012	Core II – Microbiology	6	5
	PB2013	Core III – Plant Anatomy & Embryology	6	5
	PB2014 PB2015	Elective I – (a) Marine Biology / (b) Organic Farming	6	4
	PB20P1	Practical I - Plant Diversity I – Algae, Fungi, Lichens and Bryophytes, Microbiology and Plant Anatomy & Embryology	6	-
	LST201	Life Skill Training (LST) – I	-	-
	II	PB2021	Core IV – Plant Diversity II - Pteridophyta, Gymnosperms and Palaeobotany	6
PB2022		Core V – Research Methodology	6	5
PB2023		Core VI – Cell Biology and Biomolecules	6	5
PB2024 PB2025		Elective II – (a) Herbalism / (b) Evolutionary Biology	6	4
PB20P1		Practical I - Plant Diversity I – Algae, Fungi, Lichens and Bryophytes, Microbiology and Plant Anatomy & Embryology	6	3
PB20P2		Practical II - Plant Diversity II- Pteridophyta, Gymnosperms and Palaeobotany, Research Methodology and Cell Biology and Biomolecules	6	3
LST201		Life Skill Training (LST) – I	-	1
SLP201		Service Learning Programme (SLP) -		-

		Community Engagement Course		
	STP201	Summer Training Programme	-	1

III	PB2031	Core VII - Taxonomy of Angiosperms	6	5
	PB2032	Core VIII – Genetics and Molecular Biology	6	5
	PB2033	Elective III – (a) Horticulture	6	4
	PB2034	(b) Forestry		
	PB20P3	Practical III - Taxonomy of Angiosperms & Genetics and Molecular Biology.	6	3
	PB20PR	Project	8	4
	LST202	Life Skill Training (LST) – II	-	-
	SLP201	Service Learning Programme (SLP) - Community Engagement Course	-	2
IV	PB2041	Core IX - Plant Physiology	6	5
	PB2042	Core X – Plant Ecology and Phytogeography	6	5
	PB2043	Core XI – Biotechnology & Bioinformatics	6	5
	PB2044	Elective IV – (a) Phytochemistry and Pharmacognosy	6	4
	PB2045	(b) Entrepreneurial Botany		
	PB20P3	Practical III - Taxonomy of Angiosperms & Genetics and Molecular Biology.	6	3
	PB20P4	Practical IV - Plant Physiology, Plant Ecology and Phytogeography and Biotechnology & Bioinformatics	6	3
	LST202	Life Skill Training (LST) – II	-	1
		TOTAL	120	90+5

Self Learning Courses – Extra Credit Course

Semester	Course Code	Title of the Course	Hours/ Week	Credits
III	PB20S1	Biology for Competitive Exam – I	-	2
IV	PB20S2	Biology for Competitive Exam – II	-	2
II - IV		Online Course MOOC – SWAYAM / NPTEL	-	2

Instruction for Course Transaction

Theory (Major Core / Elective) paper hours

Components	Sem. I	Sem. II	Sem. III	Sem. IV
Lecture hours	70	70	70	70
Continuous Internal Assessment	5	5	5	5
Internal Test (2)				
Quiz (2)	1	1	1	1
Class Test	2	2	2	2
Class Assignment / Group Discussion / Problem Solving / Open Book Test / Book or Article Review	2	2	2	2
Seminar	10	10	10	10
Total hours	90	90	90	90

Examination Pattern: Allotment of Marks for PG Programme

Ratio of Internal and External (Core/Elective): 40:60

Internal Components	Marks
Continuous Internal Assessment	20
Seminar	4
Class test(2)	4
Quiz (2)	4
Open book test/ Problem solving/ Book review/ Article review/ Group Discussion	4

Online home assignment	4
Total	40

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 4x1 (No Choice)	4	Part A 10x1 (No Choice)	10
Part B 3x4 (Internal Choice)	12	Part B 5x3 (Internal Choice)	15
Part C 3x8 (Internal Choice)	24	Part C 5x7 (Internal Choice)	35
Total	40	Total	60

(b) Practical Papers:

Internal – 40 marks (Model exam – 15, Performance – 10, Regularity – 5, Submission of Records –10)

External – 60 marks (Marks will be allotted as per the practical syllabus).

(c) **Project:** Internal – 40 marks; External – 60 marks

Life Skill Training- I (I Year)

Internal Component

Component	Marks
Album (20 pages)	40
Group Song, Mime, Skit(Group of 5 students)	20
Total	60

External Component

Course	Summative Examinations	Marks
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Life Skill Training- I	Written exam Part A 5x8 = 40 marks (Any 5 out of 7 questions)	40
	Total	40

Life Skill Training- II (II Year)

Internal Component

Component	Marks
Case Study (30 page)	60
Total	60

External Component

Course	Summative Examinations	Marks
Life Skill Training- II	Written exam Part A 5x8 = 40 marks (Any 5 out of 7 questions)	40
	Total	40

Community Engagement Programme

SLP Extension Activity (II & III Sem)

Courses / Programmes conducted outside the regular working hours on Saturdays and holidays. No. of hours allotted for each of these programmes is 30 and is supervised by the faculty incharge.

[Field work (15hrs); Class hours (15 hrs); Total 30 hrs]

Internal Component

Component	Marks
Assignment	10
Group Discussion	10

Attendance (Field Work)	30
Total	50

External Component

Course	Summative Examinations	Marks
Community Engagement Programme	Project Report / Case study (10 – 15 pages in print)	50
	Total	50

Self Learning Courses

Internal Test	Marks	External Exam	Marks
Part A 10x1 (Objective)	10		
		Part A 20x1 (Objective)	20
Part B 5x2 (Objective)	10		
		Part B 10x2 (Objective)	10
Part C 5x4 (High Order Thinking-Objective)	20		
		Part C 5x4 (High Order Thinking-Objective)	20
Total	40	Total	60

Semester I

Plant Diversity I - Algae, Fungi, Lichens and Bryophytes

Sub. Code: PB2011

No. of hours per week	Credit	Total no. of hours	Marks
6	5	90	100

Objectives:

1. To understand the diversity, life cycle patterns and major evolutionary trends of algae, fungi, lichens and bryophytes.
2. To comprehend the economic importance of the major groups.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	remember the basic concepts of plant diversity	PSO – 4	R
CO - 2	understand the morphological diversity of thallophytes	PSO – 3	U
CO - 3	evaluate the life history of different thallophytic members	PSO – 2	E
CO - 4	analyze the thallophytes found in water bodies	PSO – 2	An
CO - 5	create a protocol to assess the role of thallophytes with industrial applications	PSO – 3	C
CO - 6	apply the knowledge attained from evolutionary aspects of plant diversity towards research	PSO – 6	Ap

Unit I

General characters of algae including similarities and diversities; Classification of algae by Fritsch (1954); Thallus organization in algae; Life-cycle patterns and alternation of generations. Detailed study on occurrence, habitat, structure, reproduction and life history of Cyanophyceae and Chlorophyceae

Unit II

Detailed study on occurrence, habitat, structure, reproduction and life-history of Xanthophyceae, Bacillariophyceae, Phaeophyceae, Rhodophyceae, Fossil algae; Economic importance - Role of algae in soil fertility; Algal blooms; symbiotic associations; nitrogen fixation; Pollution indicators; SCP.

Unit III

General characters of fungi; Classification of fungi proposed by C.J Alexopoulos and C.W Mims (1979); Homothallism and Heterothallism in fungi; Parasexuality in fungi; An overview and life history of Zygomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes. Economic importance of fungi.

Unit IV

General account of Lichens; Classification by Miller (1984); Structure, nutrition and reproduction of the three major groups – Crustose, Foliose and Fruticose; Economic importance of Lichens.

Unit V

Classification, Distribution, Origin (including fossil evidence), Primitive and advanced features of Bryophytes; Evolution of gametophytes and sporophytes; Ecological adaptations; Economic importance. A comparative study of the morphological and anatomical features of Polytrichales, Bryales, Marchantiales, Jungermanniales and Anthocerotales.

Reference Books:

1. Bilgrami, K.S., & Sinha, L.B. (2004). *A Text Book of Algae*. New Delhi: CBS Publication and Distributors.
2. Cavers, F. (1988). *The Interrelationships of the Bryophyta*. New Delhi: Technico Publishing Pvt. Ltd.
3. Chapman, V.J., & Chapman, D.J. (1960). *The Algae*. London: Elbs and Macmillian Pvt. Ltd.
4. Chopra, R.N., & Kumar, P.K. (2004). *Biology of Bryophytes*. London: Wiley Eastern Ltd.
5. Fritsch, F.E. (1972). *The Structure and Reproduction of Algae*. Vol I and II, London: Cambridge University Press.
6. Kumar, H.D. (2004). *Introductory Phycology*. New Delhi: Affiliated East Press.
7. Peter George. (2010). *Hand Book of Bryophyta*. New Delhi: Rajat Publications.
8. Prem Puri, P. (1981). *Bryophytes*. New Delhi: Atma Ram and Sons Publishing Company.
9. Rashid, A. (1999). *An Introduction to Bryophyta*. New Delhi: Vikas Publishing House Pvt. Ltd.
10. Robert Edward Lee, T. (2008). *Phycology*. London: Cambridge University Press.
11. Sharma, O.P. (1986). *Text Book of Algae*. New Delhi: Tata McGraw Hill Publishing Co.
12. Vashishta, B.R., Sinha, A.K., & Singh, V.P. (1960). *Algae*. New Delhi: Chand and Company Ltd.

**Semester I
Microbiology
Sub. Code: PB2012**

No. of hours per week	Credit	Total no. of hours	Marks
6	5	90	100

Objectives:

1. To provide an understanding of microorganisms and the role they play in health and disease.
2. To understand the role of pathogens on selected economically important plants.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	understand the basic concepts of microbiology and immunology	PSO – 1	U
CO - 2	remember the classification and nomenclature of microorganisms and plant diseases	PSO – 4	R
CO - 3	apply modern techniques to detect antigen, antibodies, pathogens and its controlling measures	PSO – 5	Ap
CO - 4	evaluate the role of antimicrobial drugs and its resistance	PSO – 5	E
CO - 5	analyze the microbes present in milk, water, soil and plants	PSO – 4	An
CO - 6	create a protocol for identification of gram	PSO - 3	C

	positive and gram negative bacteria		
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Unit I

Scope and milestones of Microbiology: General properties of bacteria; Morphology and fine structure of Bacteria; Classification of bacteria as per Bergey's Manual of Systematic Bacteriology; Bacterial Nutrition; Bacterial Growth curve; Sterilization and disinfection; Culture media and its types; Methods of isolation - Pure culture; Identification of bacteria.

Unit II

General properties of viruses; Classification and nomenclature; Structure of virus; Cultivation of virus; Morphology of bacteriophages; life cycle – Lytic cycle and Lysogenic cycle; General properties of Actinomycetes and Mycoplasma; General characteristics of antimicrobial drugs; Antibacterial drugs – Sulfonamides, Penicillins; Drug resistance.

Unit III

Microbial flora of soil - Significance of soil microorganisms. Microbial flora of municipal water and its Purification; Bacteriological examination of drinking water; Microbial flora of milk - Pasteurization of milk - Phosphatase Tests for grading milk sample; Food spoilage by bacteria – *Clostridium botulinum*, *Salmonella sps*, *Shigella sps*, *Staphylococcus sps*.

Unit IV

Immunity – Definition and its types; Properties of Antigens; Antibodies – Basic structure and its types; Strength of Antigen - Antibody interactions; Agglutination reactions; Precipitation reactions; Cytokines - Properties and attributes; Monoclonal antibody production; Immunodiffusion; ELISA; Immune response during bacterial (Tuberculosis), parasitic (Malaria) and viral (HIV) infections.

Unit V

Classification of plant diseases - Symptoms - Infection process - Host parasite interaction - Defense mechanisms in plants; Disease control methods - Physical, chemical, Cultural and Biological - Integrated disease management. Detailed study of the plant diseases- Citrus canker, White rust disease, Blast of rice, Red rot of Sugarcane, Little leaf of Brinjal.

Reference Books:

1. Sharma, P.D. (2000). *Microbiology and Plant Pathology*. Meerut: Rastogi Company.
2. Singh, R.S. (1988). *Introduction to Principles of Plant Pathology*. New Delhi: Oxford IBH Publishing Company.
3. Dubey, R.C., & Maheswari, D.K. (2000). *A Text book of Microbiology*. New Delhi: S. Chand and Co. Ltd.
4. Prescott, P., Harley, H., & Klein, K., (2003). *Microbiology*. New York, NY: McGraw Hill Publishers.
5. Rangaswami, G. (1988). *Diseases of Crop Plants in India*. Delhi: Prentice Hall of India Pvt. Ltd.
6. Michael J. Pelczar, J.R., Chan, E.C.S., & Noel R. Krieg. (1998). *Microbiology*. New Delhi: Tata McGraw Hill Publishing Company.

- 7 Ananthanarayan, R., & Jayaram Paniker, C.K. (2005). *Textbook of Microbiology*. Hyderabad: Orient Longman Publication.
8. Gerard, J., Tortora, A., Berdell, R., Funke, M., & Christine Case, L. (2002). *Microbiology: An Introduction* (8th Ed.). New York, NY: Pearson Education, Inc.
9. Lansing, M., Prescott John, P., Harley, L., & Donald A Klein. (1999). *Microbiology* (4th ed.). New York, NY: McGraw Hill International Editions.

Semester I
Plant Anatomy & Embryology
Sub. Code: PB2013

No. of hours per week	Credit	Total no. of hours	Marks
6	5	90	100

Objectives:

1. To understand the characteristics of specialized cells and their components.
2. To impart an insight about the process of anomalous secondary growth of plants.
3. To imbibe knowledge regarding the secret of seed development.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	understand the characteristics of specialized cells and their components	PSO – 4	U
CO - 2	remember the knowledge of plant cells , tissues and functional theories	PSO – 5	R
CO - 3	analyze the structural differences among different taxa of vascular plants	PSO – 3	An
CO - 4	apply the knowledge of anatomical studies in different field	PSO – 1	Ap
CO - 5	evaluate the nature and secret of seed development	PSO – 2	E

Unit I

Introduction to Developmental Botany- Nuclear- Cytoplasmic interaction- Division- Differentiation- Polarity and Symmetry, organization of Shoot Apical Meristem (SAM) and Root Apical Meristem (RAM); vascular cambium- origin, structure and seasonal activity.

Unit II

Xylem, Phloem and their elements- primary and secondary structures, phylogenetic trends and specialization of xylem and phloem. Secondary growth- Periderm- structure- development of lenticels, Anomalous secondary growth- Bougainvillea, Bignonia, Achyranthes and Dracaena.

Unit III

Wood anatomy- physical, chemical and mechanical properties. Defects in wood- natural defects, knots and defects due to diseases. Reaction wood- Tension and Compression wood- Durability of wood.

Ontogeny of dicot and monocot leaves. Differentiation of epidermis with special reference to stomata and trichomes.

Unit IV

Microsporogenesis- Pollen morphology- pollen wall- pollen development- pollen dimorphism- pollen storage, pollen allergy. Microsporogenesis- Pollen- Pistil interaction- structure of style- stigma and significance. Megasporogenesis. Different types of embryo sac development- fertilization- barriers of fertilization- self- incompatibility- types, physiology and biochemistry, methods to overcome self-incompatibility.

Unit V

Fertilization- changes, physiological and biochemical changes during maturation. Seed- seed coat development and specialization. Endosperm- types- haustoria. Embryogenesis and organogenesis of dicot and monocot embryos- Apomixis- Polyembryony- parthenocarpy.

Reference Books:

1. Bhojwani, S.S., & Bhatnagar, S.P. (2000). *The Embryology of Angiosperms*. New Delhi: Vikas publishing House.
2. Davis, C.L., & John Willey. (1965). *Systematic embryology of Angiosperms*. New Delhi.
3. Erdtman, G. (1969). *Hand book of Palynology*. New York, NY: Hafuer Publication Co.
4. James, A.J. (1960). *Morphology of Angiosperms*. New York, NY: McGraw Hill Publishing Company Ltd.
5. Maheswari, A. (1950). *An Introduction to the Embryology of Angiosperm*. New York, NY: McGraw Hill Publishers.
6. Nair, P.K.K. (1970). *Pollen Morphology of Angiosperms*. Delhi: Scholar Publication, London and Vikas Publication.
7. Lars Hennig, A., & Claudia Kohler, K. (2011). *Plant Developmental Biology: Methods and Protocols*. London: Humana Press.
8. Paul, M., Wassarman., & Elsevier. (2016). *Essays on Developmental Biology*. New York, NY: McGraw Hill Publishing Company Ltd.

Semester I
Marine Biology (Elective I)
Sub. Code: PB2014

Objectives:	No. of hours per week	Credit	Total no. of hours	Marks
		6	4	90

1. To make the students realize the potentiality of marine environment.
2. To create an awareness among the students, about the usage of different marine products.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	understand the basic characteristics and biological processes of marine habitat	PSO – 4	U
CO – 2	remember the diversity of marine habitat	PSO – 2	R
CO – 3	create a protocol for producing useful products by cultivating marine organisms	PSO – 3	C

CO – 4	analyse the different types of pollution in marine environment	PSO – 2	An
CO – 5	apply different techniques to identify bioactive compounds	PSO – 4	Ap
CO – 6	evaluate the inter-relationships of mangroves, sea grasses, corals and salt marsh plants	PSO – 2	E

Unit I

Classification of marine habitat – pelagic – neritic and oceanic province, benthic – zonation – shore environment – muddy, rocky and sandy, waves and tides, deep sea bottom – pelagic deposits. Characteristics of marine habitat – physical parameters – temperature, illumination, specific gravity, pressure and buoyancy, ocean current. Chemical constituents – major and minor constituents, deep sea nodules. Plate tectonics – earthquakes and tsunami.

Unit II

Marine biodiversity – phytoplankton – characteristics, sampling and measuring. Marine bacteria, marine fungi, seaweeds and sea grasses; Energy relationship – primary production, grazing food chain, detritus chain and energy balance sheet. Green house effect, Carbon pump.

Unit III

Marine products – Production and uses of Agar-agar, Alginates, Carrageenan; Marine lipids; Marine pharmacology – Bioactive compounds from marine organisms; Sea grasses – structure, reproduction and ecological roles.

Unit IV

Culture of microalgae – Open pond method, Photobioreactors, Batch culture, Continuous culture; Maintenance of culture – Stock culture and Sub culture; Commercial cultivation of seaweeds; Marine pollution – thermal pollution, oil pollution, heavy metal pollution, radioactive pollution ; Eutrophication.

Unit V

Mangroves - Structure, Reproduction and ecological roles; Present status of mangroves with special reference to Pitchavaram; Salt marsh plants – Structure, Adaptations and ecological roles; Restoration of mangroves; Coral reefs – Formation, Types, Ecology, Species interaction and economic importance.

Reference Books:

1. Cliton J Dawes. (1981). *Marine Botany*. New York, NY: Wiley - Intersciences Publication John Wiley and sons.
2. Dring, M.J., & Edward Arnold, A. (1982). *The Biology of Marine Plants*. New York, NY: John Wiley and sons.
3. Kumudranjan Naskar, D., & Rathindrandath, A. (1999). *Ecology and Biodiversity of Indian Mangroves Vol. I & II*. Delhi: Daya Publishing House.
4. Michael, P. (1986). *Ecological Methods for Field and Laboratory Investigations*. New Delhi: Tata McGraw – Hill publishing company Ltd.
5. Raymond, P. (1980). *Plankton and Productivity*. Michigan: University Press.
6. Sinha, P.C. (1998). *Marine Pollution*. New Delhi: Anmol publications Pvt. Ltd.
7. Warren, W.B. (1971). *Biology and Water Pollution Control*. London: Toronto, Saunders Company, Philadelphia.

Semester I
Organic Farming (Elective I)
Sub. Code: PB2015

Objectives:	No. of hours per week	Credit	Total no. of hours	Marks
1. To maximize ecological productive efficiency.	6	4	90	100
2. To adopt cost effective farming to bring equity of food price and wage.				
3. To achieve an evergreen revolution in agriculture.				

CO No.	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	understand the role of micro and macro nutrients in plant growth and development	PSO – 4	U
CO – 2	remember the principles of organic and ecological approaches in agriculture	PSO – 5	R
CO – 3	analyse the soil types, agricultural waste and nature of pests in fields	PSO – 4	An
CO – 4	create organic farming and gardening methods that sustain profitable production, and environmental health.	PSO – 2	C

Unit I

Soil – Profile, formation, Types, Soil fertility- micronutrients and macronutrients – functions and deficiency symptoms.

Unit II

Green manuring Definition, types of green manure- Insitu, leaf manuring, Benefits, Green Manure crops- *Azadirachta*, *Tephrosia*, farming system- mulching, GM in Agroforestry

Unit III

Agricultural wastes Types – Crop residues, agro industrial waste- rice husk, baggasse, coir waste, Types of manures, Utilization of agro waste.

Unit IV

Composting - Definition, classification- Aerobic, anaerobic and vermicompost, Preparation of compost, importance of composting, factors affecting composting- oxygen, moisture, C:N ratio and temperature.

Unit V

Pest management - Physical and mechanical control, biological control, increasing the effectiveness of biological control, merits and demerits of biological control.

Reference Books:

1. Arun, K.S. (2007). *A Hand Book of Organic Farming*. Agrobios, India.
2. Trivedi, P.C. (2010). *Organic farming for sustainable agriculture*. Aavishkar, New Delhi
3. Bennett, H.H. (2004). *Soil Conservation for sustainable development*. Scientific Books suppliers. Delhi.
4. Palaniappan, S. P. (2010). *Organic farming theory and practice*. Scientific Books, New Delhi.
5. Singh, A. (2014). *Organic farming*. Pointed publishers, New Delhi.
6. Philip Stewart & Sabine Globig (2011). *Phytopathology in Plants*, Apple Academic Press

Semester I

Practical I

Sub. Code: PB20P1

(Practical I - Plant Diversity I – Algae, Fungi, Lichens and Bryophytes, Microbiology and Plant Anatomy & Embryology)

Number of hours per week	Credit	Total number of hours	Marks
6	3	90	100

CO No:	Expected Learning Outcomes Upon completion of this course, the students will be able to:	PSO Addressed	CL
CO - 1	understand the thallophytes by micropreparation	PSO – 4	U
CO - 2	analyze the cryptogams on the basis of morphological characters	PSO – 1	An
CO - 3	evaluate the methodology to differentiate gram positive and gram negative bacteria	PSO –2	E
CO - 5	apply the knowledge of anatomical studies in research	PSO –3	Ap
CO - 6	evaluate the nature and defects of wood	PSO – 2	E

Algae:

Collection and Microscopic Identification of fresh water algae

Gleocapsa, Anabaena, Oscillatoria, Microcystis, Chlorella, Cladophora, Oedogonium

Micropreparation and specimen identification:

Caulerpa – Rhizome, Ulva – Thallus,, Padina - Thallus, Chara – Sex organs, Cladophora – Sex organs, Codium – Thallus, Hypnea –Thallus, Gelidium – Morphology, Dictyota – Thallus, Vaucheria – Thallus and sex organs, Turbinaria – Receptacle.

Fungi:

Observation and study of fungi under natural habitat

Aspergillus, *Mucor*, *Penicillium*, *Peziza* - Apothecium, *Lichens* – Foliose thallus, *Fruticose*- *Usnea* – Thallus, Apothecium

Bryophytes:

Micropreparation and specimen identification:

Porella - Stem, *Anthoceros* - Thallus, *Plagiochasma*, *Sphagnum* –Stem, *Polytrichum* – Stem, Leaf, Sporophyte.

Microbiology

1. Sterilization of glasswares.
2. Streaking techniques.
3. Simple staining.
4. Gram's staining.
5. Indole production test.
6. Methyl red test.
7. Voges – Proskauer test.
8. Citrate utilization test.

Plant Anatomy & Embryology

1. Anatomy of epidermal hairs, trichomes, glandular hairs, tyloses, periderm, lenticels.
2. Anomalous secondary growth, root and stem of - *Bougainvillea*, *Bignonia*, *Achyranthes* and *Dracaena*
3. Leaf Anatomy – Dicot, Monocot (C4)
4. Stomatal type, stomatal index
5. Wood anatomy of some common Indian timbers such as *Mangifera indica*, *Azadirachta indica*.
6. Study on ovary, ovules and their modifications.
7. Organization of anthers and pollens, pollen wall patterns, pollen germination and pollen tube growth.

Semester II
Plant Diversity II - Pteridophyta, Gymnosperms and Palaeobotany
Sub. Code: PB2021

No. of hours per week	Credit	Total no. of hours	Marks
6	5	90	100

Objectives:

1. To understand the diversity, life cycle and major evolutionary trends of non-flowering plants.
2. To have a broad knowledge on fossils and methods of fossilization.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	understand the life cycle and major evolutionary trends of non – flowering plants	PSO - 1	U
CO - 2	remember, recognize and identify the non – flowering plants	PSO –2	R
CO - 3	analyze the inter - relationship between Pteridophytes and Gymnosperms	PSO – 2	An
CO - 4	evaluate and compare the evolution of gametophytes and sporophytes of Pteridophytes	PSO – 5	E
CO - 5	apply the knowledge attained from evolutionary aspects of plant diversity towards research	PSO – 3	Ap
CO - 6	create methods to extract, prepare, preserve and catalogue fossils	PSO – 3	C

Unit I

Origin and evolution of vascular plants; Stelar evolution; Telome theory; Apogamy and apospory; Economic importance of Pteridophytes. Classification of pteridophytes by G.M.Smith

Unit II

Range of thallus structure, reproduction and evolution of gametophytes and sporophytes of the following orders: *Psilotales*, *Lycopodiales*, *Selaginellales*, *Isoetales*, *Equisetales*.

Unit III

Ophioglossales, *Osmundales*, *Filicales* and *Salviniales*. Sporangial development - Eusporangiate and Leptosporangiate types, heterospory and origin of seed habit and soral evolution.

Unit IV

Affinities and evolution of gymnosperms; Classification of gymnosperms (K.R. Sporne, 1965); General characters - morphological, reproductive characters, phylogeny and interrelationship of the orders - *Cycadales*, *Ginkgoales*, *Coniferales* and *Gnetales*.

Unit V

Geological time scale; Methods of fossilization and determination of the geological age of fossils, carbon dating. A brief study of the following fossil Pteridophytes: *Rhynia*, *Lepidodendron*, *Sphenophyllum* and *Calamites*. A brief study of the following fossil Gymnosperms: *Lyginopteris*, *Cycadoidea*, *Pentaxylon* and *Cordaites*.

Reference Books:

1. Johri, R.M., Sneha Lata., & Kavita Tyagi. (2012). *Text Book of Gymnosperms*. New Delhi: Wisdom Press.
2. Ernest., Gifford., Foster. (1996). *Morphology and Evolution of Vascular Plants*. New York, NY: W.H. Freeman and Company.
3. Meyan, V. (1987). *Fundamentals of Palaeobotany*. London: Chapman and Hall.
4. Rashid, A. (1985). *An Introduction to Pteridophyta*. New Delhi: Vikas Publishing House Pvt. Ltd.
5. Shukla, A.C., & Misra, S.P. (1982). *Essentials of Palaeobotany*. New Delhi: Vikas Publishing House Pvt. Ltd.
6. Sundara Rajan, S. (2009). *Introduction to Pteridophyta*. New Delhi: New Age International Publishers.
7. Vashishta, B.R., Sinha, A.K., & Kumar. (2005). *Botany for Degree Students – Pteridophyta*. New Delhi: Chand and Co.
8. Vashishta, P.C., Sinha, A.K., & Anil Kumar. (2007). *Botany for Degree Students: Gymnosperms*. New Delhi: S. Chand and Co.

Semester - II
Research Methodology
Sub. Code: PB2022

No. of hours per week	Credit	Total no. of hours	Marks
6	5	90	100

Objectives:

1. To understand some basic concepts of research and its methodologies.
2. To select and define appropriate research problem and parameters.
3. To organize and conduct research in a more appropriate manner and write a research report and thesis.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	remember the basic concepts of research and its methodologies	PSO – 4	R
CO - 2	understand the principles and working mechanisms of various instruments	PSO – 5	U

CO - 3	apply computer skills in research	PSO – 3	Ap
CO - 4	analyze the biological data in solving biological problems	PSO –1	An
CO - 5	create skills in qualitative and quantitative data analysis and presentation	PSO – 3	C

Unit I

Research- Objectives of research, Types of research, Significance, Literature collection- Index card, reference card and Abstract card. Literature citation- Different systems of citing references- Name year system, Citation sequence system and Alphabet number system. Research report, components of a project report, tables, figures, foot note, thesis format, journal format- appendices, e- journal and e- book. Role of supervisors/ Guides in research.

Unit II

Microscopy – Principle, Instrumentation and uses of Light Microscope, Dark–Field Microscope, Phase contrast Microscope, Fluorescent Microscope, Electron Microscope – SEM and TEM, Confocal Microscope; Micrometry; Photomicrometry.

Unit III

Spectrophotometer - Principle, Instrumentation and uses of UV–Vis Spectrometry, Atomic Adsorption Spectrometry, Nuclear Magnetic Resonance Spectrometry, Flame Photometer. Chromatography – Affinity Chromatography, Ion exchange chromatography and High Performance Liquid Chromatography.

Unit IV

Centrifugation – Principles of sedimentation, Types of rotors, Differential centrifugation, Density gradient centrifugation, Ultracentrifuge. Electrophoresis – Agarose gel electrophoresis (AGE), Sodium Dodecyl Sulphate-Polyacrylamide Gel Electrophoresis (SDS-PAGE). PCR – Principle and technique. Cryobiology – Lyophilization and its application in Biology.

Unit V

Data collection and Analysis of data – Mean, Medium, Mode, Standard deviation, Standard error, Student ‘T’ test, Chi – square test, Correlation, Regression, ANOVA, SPSS.

Reference Books:

1. Jayaraman, J. (1972). *Techniques in Biology*. Madras: Higginbothams Pvt. Ltd.
2. Khan, I. A., & Khannum, A. (1994). *Fundamentals of Biostatistics*. Hyderabad: Vikas Publishing.
3. Khan. J.A. (2008). *Research Methodology*. New Delhi: A.P.H Publishing Corporation.
4. Kothari, C.R. (2004). *Methodology: Methods and Techniques*. Research New Age International Publishers Ltd.
5. Kothari, C. R. (1991). *Research Methodology: Methods and Techniques*. New Delhi: Wiley Eastern Ltd.
6. Michael T. Madigan., John M. Martinko., & Jack Parker. (2003). *Brock Biology of Microorganisms* (10th ed.). USA: Pearson Education International.
7. Ranjit Kumar, A. (2011). *Research Methodology: a step by step guide by beginners* (3rd ed.). London: SAGE Publications Ltd.
8. Sree Ramulu, V. S. (1988). *Thesis Writing*. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
9. Thomas, A. Scruggs., & Margo, A. (2006). *Mastropiere, Applications of Research Methodology*. London: Elsevier Ltd., JAI Press.

Cell Biology and Biomolecules
Sub. Code: PB2023

No. of hours per week	Credit	Total no. of hours	Marks
6	5	90	100

Objectives:

1. To enable the students to know about the different biomolecules and their functions.
2. To understand the basic principles and concepts of thermodynamics.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	understand the diversity of cells and the role of compartmentalization and cell signaling	PSO - 4	U
CO - 2	remember the role of inorganic and organic molecules to life	PSO –2	R
CO - 4	understand the structure and functions of different biomolecules	PSO –4	U
CO - 5	apply the basic principles and concepts of enzyme regulation	PSO – 5	Ap
CO - 6	analyze the modern techniques in cellular biology	PSO – 3	An

Unit I

Cell Type: History and origin. Prokaryotic and Eukaryotic cell. Difference between Prokaryotic and Eukaryotic cell; Plasma Membrane: History, Ultrastructure, and chemical composition of plasma membrane (Lamellar-models, micellar models and fluid mosaic model). Functions of plasma membrane; Mitochondria: History and structure of mitochondria, biogenesis and functions of mitochondria (Respiratory chain complex and Electron transport mechanism).

Unit II

Endoplasmic Reticulum, Ribosome, Golgi Bodies: History, structure, functions and importance. Lysosomes, Centrioles, Microtubules: History, structure, functions and Importance
Nucleus: History, structure, functions and importance; Chromosomes: History, types and functions of chromosomes. Giant chromosomes, Polytene chromosome and Lamp brush chromosome; Cell Division: Mitosis (cell cycle stages, cytokinesis) Meiosis (reproductive cycle stages, synoptonemal complex, recombination nodules). Comparison between meiosis and mitosis

Unit III

Carbohydrates - structure and properties of Monosaccharides - ring structure – Oligosaccharides - sucrose and maltose, Polysaccharides – starch and cellulose; structure, classification and properties of amino acids and proteins; Denaturation and renaturation of proteins ; purification of proteins.

Unit IV

Lipids- Classification- Structure and properties- Triglycerides, compound lipids- phospholipids- cholesterol. Structure- Biosynthesis of DNA and RNA. Secondary metabolites- Alkaloids, Glycosides, Steroids and Terpenoids. Vitamins.

Unit V

Enzyme - Nomenclature and classification - IUB system – properties - Active site - Mechanism of enzyme action (Fisher's Lock and Key model and Koshland's Induced fit model) - Activation energy.

Enzyme regulation - activators and inhibitors - coenzymes. Isoenzymes.

Reference Books:

- Gupta P.K. (1997) *Cytology, Genetics and Evolution*, Rastogi Publications, Meerut.
- Alberts, B. Bray D. Lewis J. Ralf, M. Roberts, K. and Watson, J.D., (1999). *Molecular Biology of the Cell*, Garland Publishing Inc., New York.
- C.J. Avers. (1986). *Molecular Cell Biology*, Addison Wesley Publishing Company, New York,
- De, D.N. (2000). *Plant Cell Vacuoles: An Introduction*, CSIRO Publication, Collingwood, Australia.
- Kleinmith, L.J. and Kish, V.M. (1995) *Principles of Cell and Molecular Biology*, 2nd Edition, Harper Collins College Publishes, New York, USA.
- Krishna Murthy, K.V. (2000) *Methods in Cell wall cytochemistry*, CPC Press, Boca Raton, Florida.
- Lodish, Berk A, Zipursky, S.L. Matsdaira P, Baltimore D and Darnell, J. (2000) *Molecular Cell Biology*, 4th Edition, W.H. Freeman and Co., New York, USA.
- Lehninger. (2008). *Principles of Biochemistry*. Delhi: CBS publishers and distributors.
- Conn and Stumpf. (2009). *Outlines of Biochemistry* (5th ed.). New York, NY: John Wiley & Sons.
- Pamela, C., Champe., Richard A. Harvey., Lippincott's Williams., & Wilkins. (1994). *Lippincott's Illustrated Reviews: Biochemistry* (2nd ed.). A Wolters Kluwer Company.
- Thomas M. Devlin., WILEY – LISS. (2002). *Text book of Biochemistry with Clinical Correlations* (5th ed.). John Wiley & Sons, Inc. Publications.
- Alexander, J., Ninfa and David P., Ballou. (1998). *Fundamental Laboratory Approaches for Biochemistry and Biotechnology*. Maryland: Fitzgerald Science Press, Inc. Bethesda.
- Jeremy, M., Berg., John L. Tymoczko., & Lubret Stryer. (2002). *Biochemistry* (5th ed.). New York, NY:Freeman and Compay.
- Albert B. Hoplkin, K., Johhson, A.D.,Morgan, D, Raff, M., Roberts, K & Walter, P. (2018) *Essential Cell Biology, 5th Edn., (Paper Back)*, W.W.Norton & Company p. 864.
- Karp G., Iwasa, J & Masall W. (2015) *Karp's Cell & Molecular Biology- Concepts & Experiments*. 8th Edn, John Wiley and Sons. p.832.
- Hardin J. and Bertoni G. (2017) *Becker's World of the Cell*. 9th Edn (Global Edition). Pearson Education Ltd., p. 923
- Urry L.A., Cain M.L., Wasserman S.A., Minorsky P.V., Jackson R.B. and Reece J.B. (2014) *Campbell Biology in Focus*. Pearson Education. p.1080

**Semester II
Herbalism (Elective II)
Sub. Code: PB2024**

No. of hours per week	Credit	Total no. of hours	Marks
6	4	90	100

Objectives:

- To impart knowledge about different medicinal systems.
- To learn about the extraction procedures for active principles.

CO No:	Upon completion of this course the students will be able to:	PSO Addressed	CL
CO - 1	remember the traditional systems of medicines in terms of Siddha, Ayurvedha, and Unani	PSO – 6	R
CO - 2	understand the conservation of medicinal plants – <i>in situ</i> and <i>ex situ</i>	PSO – 5	U

CO - 3	apply the methods that extract oil from <i>Eucalyptus</i> , <i>Cymbopogon</i> , Rose, and <i>Santalum</i>	PSO - 3	Ap
CO - 4	create the protocol for extracting withanolides, hyoscyamine and vinblastine.	PSO - 1	C
CO - 5	analyze crude drugs both qualitatively and quantitatively	PSO - 4	An

Unit I

Medicinal Botany – Definition – Aim and Scope – History – Importance – Present status and future prospects of medicinal crops; Traditional systems of medicine – Siddha, Ayurveda and Unani; Conservation of Medicinal plants – in situ and ex situ; Herbal gardens; IPR.

Unit II

Study the following plants with reference to their habitat, systematic position, morphology, useful parts, cultivation of *Aloe vera*, *Ocimum sanctum*, *Zingiber officinale*, *Catharanthus roseus*, *Phyllanthus amarus*, *Embllica officinalis* and *Azadirachta indica*.

Unit III

Methods of extraction of oil in the following plants – Eucalyptus, Cymbopogon, Rose and Santalum. Extraction procedures for active principles – Withanolides, Hyocycamine, Vinblastine.

Unit IV

Pharmacognosy – Definition, Classification of drugs – Morphological, Taxonomical, Pharmacological and Chemical; Collection and Processing of crude drugs – Antichemical, Phytochemical, Antimicrobial and Chemical.

Unit V

Screening and WHO standardization of crude drugs (WHO guidelines); Physicochemical (Ash and Extraction values); Fluorescence analysis – Qualitative and Quantitative analysis; Basic chromatographic and Spectroscopic analysis of crude drugs.

Reference Books:

1. Bhattacharjee, S.K. (2004). *Handbook on Medicinal Plants*. Jaipur: Pointer Publishers.
2. Faroqi, A. A., & Sreeramu, B.S. (2001). *Cultivation of Medicinal and Aromatic Crops*. Universities Press.
3. Joshi, S.G. (2000). *Medicinal plants*. New Delhi: Oxford and JBH Company Private Ltd.
4. Kokate, K., Purohit., & Gokhale. (1999). *Pharmacognosy*. Nirali Publications.
5. Sharma, P., & Etal, C. (2000). *Database on Medicinal Plants Used in Ayurveda*, Ministry of Health and Family Welfare.
6. Srivastava, A.K. (2006). *Medicinal Plants*. Dehradun: International Book Distributors.
7. Evans, W.C. (1997). *Pharmacognosy*. Harcourt Brace and Company Asios Pvt., Ltd.

Semester II
Evolutionary Biology (Elective II)
Sub. Code: PB2025

No. of hours per week	Credit	Total no. of hours	Marks
6	4	90	100

Objectives:

1. To provide a deeper insight into the evolutionary processes.
2. To teach students the basic methods of analysing the evolutionary relationships between species.

CO No:	Course Outcomes Upon completion of this course, students will be able to	PSO Addressed	CL
CO - 1	analyze the major genetic and ecological processes underlying evolution and selection	PSO – 2	An
CO - 2	remember the theory of evolution considering Darwinism and Modern Synthetic Theory	PSO – 4	R
CO - 3	understand the population genetic consequences of selection	PSO –5	U
CO - 4	create evolutionary hypotheses for a wide variety of biological phenomena	PSO - 1	C
CO - 5	apply evolutionary principles in research	PSO - 2	Ap

Unit I

Pre-Darwinian ideas – List of contributors influencing Darwin indicated as a timeline; Lamarckism – Merits and demerits; Darwinism – Merits and demerits; Post-Darwinian era – Modern synthetic theory; biomathematics and the theory of population genetics leading to Neo-Darwinism.

Unit II

Sources of evolution - Types of variations – Continuous and discontinuous; heritable and non-heritable. Causes, classification and contribution to evolution – Gene mutation; chromosomal aberrations; recombination and random assortment (basis of sexual reproduction); gene regulation . Concept of micro- and macro-evolution.

Unit III

Natural selection as a guiding force -attributes and action; Basic characteristics of natural selection; Colouration, camouflage and mimicry; Co-adaptation and co-evolution; Man-made causes of change – Industrial melanism, drug, pesticide, antibiotic and herbicide resistance in various organisms; Modes of selection, Polymorphism, Heterosis and Balanced lethal systems.

Unit IV

Population genetics – Gene pool; gene/allele frequency; genotypic frequency; phenotypic frequency (simple problems for calculation); Conservation of gene frequencies (when selection does not operate) ; Hardy-Weinberg's Law of Genetic Equilibrium; Alterations in gene frequency (when selection operates) ; Calculation based on Selection Coefficient and Fitness; Fluctuations in gene frequency ; Calculation based on standard deviation.

Unit V

Evolution of Plants - Origin of land plants – Terrestrial algae and Bryophytes; alternation of generations; Early vascular plants – Stelar evolution; Sporangium evolution; Phylogeny of Angiosperms ;

Phylogenetic evolution a) Fossil based – Phylogeny of horse as a model. b) Molecule based – Protein model (Cytochrome C); gene model (Globin gene family).

Reference Books:

- Hafner, M.S. (1994). *Evolution laboratory: Laboratory exercises and discussions in evolutionary biology*. Baton Rouge, LA: Louisiana State University.
- Hall, B. K. and Hallgrimson, B. (2008) Strickberger’s Evolution. IV Edn. Jones and Barlett
- Zimmer, C. and Emlen, D. J. (2013). *Evolution: Making Sense of Life*. Roberts & Co.
- Futuyma, D. (1998). *Evolutionary Biology*. III Edn. Sinauer Assoc. Inc.
- Barton, Briggs, Eisen, Goldstein and Patel. (2007) *Evolution*. Cold Spring Harbor Laboratory Press.
- Herron, J. C., and S. Freeman. (2014). *Evolutionary Analysis*, 5th edition. Pearson Education, Boston, USA.
- Kardong, K.V. (2005). *An Introduction to Biological Evolution*. 1st Edition. 322 pp. McGraw-Hill Publishers.
- Minkoff, E. C. (1983). *Evolutionary biology*. Reading, MA: Addison-Wesley Publishing Company.
- Hartl, D. L. (1988). *A primer of population genetics* (2nd edition). Sunderland, MA: Sinauer Associates.

Semester II

Practical II

Sub. Code: PB20P2

(Practical II - Plant Diversity II- Pteridophyta, Gymnosperms and Palaeobotany, Research Methodology and Cell Biology and Biomolecules)

Number of hours per week	Credit	Total number of hours	Marks
6	3	90	100

CO No:	Expected Learning Outcomes Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO - 1	understand vascular cryptogams by micropreparation	PSO –4	U
CO - 2	analyse Pteridophytes and Gymnosperms based on their anatomical features	PSO – 2	An
CO - 4	evaluate macromolecules in biological samples	PSO – 3	E
CO – 5	analyze different biological data using biostatistics	PSO –1	An

Pteridophyta

Micropreparation and specimen identification:

Psilotum - Synangium, *Lycopodium* – Cone, *Selaginella* – Cone, *Pteris* – rachis, sporophyll, *Pteridium* - rachis *Adiantum* – rachis, sporophyll,, *Gleichenia* - rachis, *Marsilea* –Sporocarp, *Azolla* – Habit, *Salvinia* –Habit, *Isoetes* – Root, Sporophyll,

Gymnosperms

Anatomy and wood structures of Gnetum – Leaf, Stem, Araucaria - Stem, Cone Cupressus – Cone, Podocarpus - Cone, Ovule, Cryptomeria – stem, cone

Research Methodology

1. Problems in Biostatistics
2. Thin Layer Chromatography
3. Microtome
4. Photomicrography
5. Gel moulding in Agarose gel electrophoresis.
6. Visiting different laboratories and report submission.

Cell Biology and Biomolecules

1. Make acetocarmine squash preparation of onion root tip and to identify different stages of Mitosis
2. Make squash preparation of flower buds of Rheo to identify different stages of Meiosis
3. Determination of pKa value of acetic acid
4. Determination of isoelectric point of amino acid
5. Estimation of protein
6. Estimation of free amino acid
7. Separation and determination of Rf value of amino acid.
8. Determination of saponification value of oil
9. Determination of Km value – Nitrate reductase

Examination at the end of II semester

Internal - 60 marks. External - 40 marks ($1\frac{1}{2}$ hrs test)

Internal Test (components)

Album – group of 4 students – 30 marks (marks for matter, organisation and originality not for decoration)

Song, skit, mime - group of 4 students – 30 marks

External Exam

Part A – (5 x 2) = 10 marks

Part B – (5 x 6) = 30 marks

Semester - III

Major Core VII - Taxonomy of Angiosperms

Course Code: PB2031

Hours / Week	Credits	Total Hours	Marks
6	5	90	100

Objectives

1. To be familiar in identifying the botanical name of plants.
2. To enable the students to get knowledge of modern trends in taxonomy of Angiosperms.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	differentiate between natural and artificial system of classification	PSO – 2	U
CO - 2	apply sketches to identify the flora	PSO – 5	Ap
CO - 3	collect and prepare herbaria for future use	PSO – 4	C
CO - 4	record the rules and regulations framed by ICBN	PSO – 2	R
CO - 5	interpreting biological knowledge in comparing and ranking plants	PSO – 3	An
CO - 6	evaluation of plants by using dichotomous keys	PSO – 5	E

Unit I

Aim and scope of plant taxonomy – Taxonomic Tools: Taxonomic literatures – floras, revisions, manuals, monographs and check lists; Identification and preparation of intended keys and bracketed keys; Herbarium techniques – Types and functions of herbarium; Digital Herbarium. Systems of angiosperm classification; Linnaeus, Bentham and Hooker and Engler and Prantle; APG Classification. Merits and demerits of these classifications.

Unit II

Botanical nomenclature – ICN, Principles and Role of ICN, Rules – principle of priority, rejection of names, limitations in the principle of priority, typification, author citation, effective and valid publications; Taxonomical Evidences - Numerical taxonomy, chemotaxonomy, cytotoxicity, and phytotoxicity; Molecular tools used in Taxonomy.

Unit III

Systematic position, diagnostic features, distribution, description and economic importance of Capparidaceae, Polygalaceae, Caryophyllaceae, Tiliaceae, Zygophyllaceae.

Unit IV

Systematic position, diagnostic features, distribution, description and economic importance of Rhamnaceae, Sapindaceae, Passifloraceae, Sapotaceae, Oleaceae, Boraginaceae, Scrophulariaceae, Bignoniaceae.

Unit V

Systematic position, diagnostic features, distribution, description and economic importance of Verbenaceae, Nyctaginaceae, Aristalochiaceae, Casuarinaceae, Orchidaceae, Commelinaceae, Araceae, Cyperaceae.

Reference Books

1. Davis, P.H. and V.M. Heywood. (1983). *Principles of Angiosperms Taxonomy*. London: Olive and Byod Publishers.
2. Gurcharan Singh. (2004). *Plant Systematics*. New Delhi: Oxford & IBH Publishing Company Ltd.
3. Nair, R. (2010). *Taxonomy of Angiosperms*. Hyderabad: A.P.H. Publishing Corporation.
4. Pandey, B.P. (2004). *Taxonomy of Angiosperms*. New Delhi: S. Chand and Company.
5. Sambamurty A. V. S. S. (2005). *Taxonomy of Angiosperms*. New Delhi: I.K. International Pvt. Ltd.
6. Sharma O.P. (1996). *Plant Taxonomy*. New Delhi: Tata McGraw Hill Publishing Company Limited.
7. Sivaraman V.V. (1996). *Introduction to the principles of Plant Taxonomy*. New Delhi: Oxford and IBH Publishing Company Limited.
8. Vahishta P.C. (1989). *Taxonomy of Angiosperms*, New Delhi: S.Chand and Co.

Semester - III

Major Core VIII – Genetics and Molecular Biology

Course Code: PB2032

Hours / Week	Credits	Total Hours	Marks
6	5	90	100

Objectives

1. To understand the organization and regulation of genes.
2. To acquire advanced training with opportunities to get employability in genetics and molecular biology laboratories.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	understand the organization of cell organelles and genes	PSO – 2	U
CO - 2	differentiate between mitochondrial DNA and chloroplast DNA	PSO – 6	U
CO - 3	evaluate the dissociation and re - association kinetics of DNA	PSO – 6	An
CO - 4	construct different types of plasmids and operons	PSO – 2	C
CO - 5	analyze Transcription and Translation of Prokaryotes and Eukaryotes	PSO – 5	An
CO - 6	evaluate the problems in genetics	PSO – 6	E

Unit I

Contribution of Gregor Johann Mendel, T.H. Morgan, Karl Landsteiner; Mendel's law of heredity – Monohybrid and Dihybrid cross; Gene interaction – Dominant epistasis (12: 3:1), Recessive epistasis (9:3:4), Duplicate recessive genes (9:7), Duplicate dominant genes (15:1); Sex determination in plants - theories of sex determination; Sex linked characters; Linkage and crossing over, construction of chromosome map, and three point cross.

Unit II

Mutation – Types of mutation, molecular mechanism of mutation. DNA- types (A, B, C & Z), Watson and Crick model of DNA, viral DNA, bacterial DNA, Mitochondrial and Chloroplast

DNA; T_m value and cot value; DNA replication of prokaryotes and eukaryotes; Genetic diseases – Sickle cell anaemia, Cystic fibrosis, Duchennes muscular dystrophy.

Unit III

DNA damage and repair mechanism – photo reactivation – excision repair – mismatch repair; Genetic recombination - generalised and site specific; Lysogenic and lytic cycle; Bacterial Transformation, Transduction and Conjugation. Super Vectors – Bacterial Artificial Chromosomes, Yeast Artificial Chromosome.

Unit -IV

RNA – types; Transcription - Initiation, elongation, termination, post transcriptional events; Genetic code, Wobble hypothesis; Translation – steps in translation, posttranslational modification events; Molecular tools for studying genes – northern blotting, southern blotting, western blotting, FISH.

Unit -V

Fine structure of the gene; Transposons – Tn3, Tn5; Gene regulations in Prokaryotes – lac operon, trp operon; gene regulation in Eukaryotes; Gene cloning – steps, Pros and Cons in gene cloning, Construction of genomic library; Construction of cDNA library; Gene silencing; Human Genome Project.

Reference Books

1. Benjamin Lewin. (2000). *Genes VII*. New York: Oxford University Press.
2. Bernard R. Glick and Jack J. Pasternack. (1996). *Molecular Biotechnology* (4th edition): *Principles and Manipulation of Recombinant DNA*, New Delhi: Panima Publishing Corporation.
3. Brown T.A. (2001). *Essential Molecular Biology Volume 2*. New York: Oxford University Press.
4. Brown, T.A. (2002). *Genomes* (Second Edition). New York: BIOS Scientific Publishers Ltd.
5. Edward I. Alcamo. (2001). *DNA Technology* (Second Edition). New York: Academic Press.
6. Freifelder. (1990). *Molecular Biology*. New Delhi: Narosa Publishing House.
7. Robert F. Weaver (2002). *Molecular Biology* (Second Edition). New York. McGraw Hill Higher Education.
8. Daniel L. Hartl and Elizabeth W. Jones. (2002). *Essential Genetics: A Genomics Perspective* (Third Edition). Sudbury: Jones and Bartlett Publishers.

Semester - III

Major Elective III a - Horticulture

Course Code: PB2033

Hours / Week	Credits	Total Hours	Marks
6	4	90	100

Objectives

1. To learn the techniques and applications of horticulture.
2. To motivate the students to get acquainted with nursery management.

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO Addressed	CL
CO - 1	categorize the propagation of horticultural crops	PSO – 2	An
CO - 2	describe orchard cultivation	PSO – 5	U
CO - 3	design a kitchen garden in growing vegetables and greens	PSO – 3	C
CO - 4	state the importance and principles of lawns, topiary and pergolas	PSO – 5	R
CO - 5	understand the methods involved in hybridization	PSO – 3	U
CO - 6	evaluate the molecular approaches for crop improvement	PSO – 2	E

Unit I

Horticulture: Concepts and Scope; Famous gardens in world and India. Tools & Implements; Plant growing structures – Green house, Glass house, Mist chamber, Shade net and Poly house. Arches, Pergolas, and Topiary. Lawns and Landscapes, Hydroponics and Aquaponics.

Unit II

Plant Propagation: Cutting, Layering, Grafting & Budding; Cultural practices – Thinning, Training, Trimming & Pruning; Fertilizers, Biofertilizers, Green manures, NPK, Compost, Vermicompost; Out-door horticulture – Vegetable garden, Medicinal plant garden, Roof garden, Fruit garden, Kitchen garden, Terrace garden; Bonsai.

Unit III

Plant Breeding & Plant Reproduction: Mode of reproduction and breeding; Mechanisms of Self-pollinations and Cross-pollinations; Floral Biology in relation to selfing and crossing techniques; Sexual reproduction – objectives, emasculation and pollination methods; raising

F1 hybrids; Asexual reproduction – Vegetative and Nonrecurrent apomixes; diplospory, apospory, parthenogenesis, Role of apomixes in plant breeding.

Unit IV

Hybridization: Objectives, choice of parents, purelines, failure of hybridization – problems & causes; Incompatibility and sterility. Methods of overcoming genetic consequences of hybridization; Methods of handling, segregating hybrids for isolation of superior strains – bulk & pedigree selection methods; Role of interspecific and intergeneric hybridization and plant improvement; Selection- principles, genetic basis and methods; Mass selection, pure line selection and clonal selection.

Unit V

Back-cross breeding: Theory & procedure for transferring various types of characters; Inbreeding depression; Hybrids & Heterosis theories – genetic and physiologic basis – Applications – steps in production of single cross, double cross, three way cross & synthetic cross; male sterility (cytoplasmic, genetic) in hybrid production.

Reference Books

1. Manibhusan Rao. (1991). *Text book of Horticulture*. New Delhi: Mac Millan India.
2. Sheela V. (2011). *Fundamentals of Horticulture*. Chennai: MJP Publications.
3. Shukla. R. S. Chandel. (1996). *Cytogenetics, Evolution and plant breeding*. New Delhi: Chand. S. c. Ltd.
4. Edmund Senn – Andrew – Halfacre. (1977). *Propagation of horticultural crops*. New Delhi:Tata McGraw – Hill.
5. Chopra. (2004). *Approaches for Incorporating Drought and Salinity Resistance in Crop Plants*. New Delhi: Salish Book Enterprise.
6. Kader, A.A. (2002). *Post-Harvest Technology of Horticultural Crops*. New Delhi: UCANR Publications.
7. Kumar, N. (2006). *Breeding of Horticultural Crops: Principles and Practices*. New Delhi: Publishing Agencies.
8. Singh, D and Manivannan, S. (2009). *Genetic Resources of Horticultural Crops*.Lucknow: IBDC Publishers.
9. Chahal G. S. and S. S. Gosal. (2002). *Principles and Procedures of plant breeding*. New Delhi: Narosa publishing House.
- 10.

Semester - III

Major Elective III b – Forestry

Course Code: PB2034

Hours / Week	Credits	Total Hours	Marks
6	4	90	100

Objectives

1. To enable the students to have broad knowledge about forest, its management and forest products.
2. To prepare the students to involve in tree plantings and to provide and improve wildlife habitat.

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO Addressed	CL
CO - 1	categorize the types of forests in Tamilnadu	PSO – 3	An
CO - 2	identify the reasons for degradation of forest	PSO – 2	R
CO - 3	summarize the methods in managing and conserving the forest	PSO – 5	AP
CO - 4	understand the objectives, advantages and disadvantages of agroforestry	PSO – 3	U
CO - 5	determine the role of botanical gardens, zoos, national parks, and sanctuaries	PSO – 6	U
CO - 6	evaluate the utilization of forest	PSO – 3	E

Unit I

Forest – definition, role of forest; forest as a balanced ecosystem; types and distribution of (Champion and Seth’s classification). Forest types in Tamilnadu – evergreen forest, deciduous and scrub jungle.

Unit II

Forest management and conservation; regeneration; tending operations; sustainable utilization of forest resources – forest organizations. Forest mensuration and remote sensing – methods of measuring diameter, girth, height, and volume of trees, geographic information systems for management (GIS).

Unit III

Forest utilization – harvesting, conservation, storage and disposal of wood in forest; major and minor forest products; forest based industries – paper and pulp industry, resin tapping and turpentine manufacture. Forest education in India.

Unit IV

Forest degradation – damage caused by fire, climatic factors and injuries by insects, plants, animals, and diseases, activities of man including encroachment and shifting cultivation; measures to protect the forest damage caused by various factors;

Unit V

Agroforestry – objectives, advantages and disadvantages, energy plantations; recreational forestry- role of botanical gardens, zoos, national parks and sanctuaries in recreation/conservation of wild life; Social forestry.

Reference Books

1. Kasturi Reddy. (2010). *Biodiversity and Land Conservation*. New Delhi: Pacific Publication N-187, ShivajiChowk. Sadatpur Extension.
2. RanaS.V.S . (2009). *Essential of Ecology and Environmental Science* (IV Edition). New Delhi: PHI learning Private Ltd.
3. Rao M.K. *Environemntal and Climate Change*. (2011).Delhi: Manglam Publications.
4. Shukla R.S.& Chandel P.S. (2006). *A Text Book of Plant Ecology*. Ram Nagar, New Delhi: S. Chand and Company Ltd.
5. Trivedi, P.R. Trivedi and Gurdeep Raj.(2002). *Environmental Ecology*. New Delhi: Akashdeep Publishing House.
6. Tyler Miller G. (2004). *Environmental Science*. Singapore: Thomson Brooks/cole,

Semester - III

Practical III – Taxonomy of Angiosperms, Genetics and Molecular Biology

Course Code: PB20P3

Hours / Week	Credits	Total Hours	Marks
6	3	90	100

Objectives

1. To learn the taxonomical terminology, morphology, structure and functions of various parts of plants.
2. To have broad knowledge on genetics problems and to carry out molecular biology experiments and interpret the results.

Course Outcome

CO	Expected Learning Outcomes	PSO Addressed	Cognitive level
CO - 1	isolate the DNA from plant materials	PSO – 4	Ap
CO - 2	separation of biomolecules using	PSO – 1	Ap

	spectrophotometry		
CO - 3	analyse the floral parts and relate to its corresponding family	PSO –5	An
CO - 4	solve genetics related problems	PSO – 1	E

Taxonomy of Angiosperms

1. Assigning plants to their respective families.
2. Technical description of floral parts with reference to families prescribed.
3. Identification of modification and economically important products from the members of the families prescribed in the syllabus (Botanical name, common name, morphology of the useful part-family and uses).
4. Preparing intended keys and bracketed keys for the locally available plants.
5. Field trip, Submission of field note book, with a report on the field trip.
6. Preparation of 5 herbaria of the locally available weed.

Genetics and Cell Molecular Biology

1. Genetics Problems – Monohybrid cross, Dihybrid cross.
2. Genetics Problems – Interaction of genes.
3. Isolation of DNA (Demo)
4. Agarose gel electrophoresis (Demo)
5. Estimation of DNA by UV- Spectrophotometric method.
6. PCR (Demo)

Semester III

Project

Course Code: PB20PR

Hours/ Week	Credits	Total Hours	Marks
6	5	90	100

Objectives

1. To enable students to design experiment, analyse data and interpret results.
2. To develop skills to identify subject related problems in the neighbourhood and report to the scientific community.

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	explore new areas of research in Botany and allied field of life science.	PSO - 1	Ap
CO - 2	analyze a research problem and construct tools for	PSO - 2	An

	data collection.		
CO - 3	write research reports and present results in the scientific community.	PSO - 3	Ap
CO - 4	develop skills to serve in Life science related industries and agencies.	PSO - 3	E
CO - 5	develop skills to publish articles in reputed journals.	PSO - 4	C

Guidelines

- All the students must undertake dissertation work at the final year (III semester).
- The students, with the consent of the Supervisor, HoD and the Principal can pursue their project in another institution, especially with MoU/ Collaboration for the successful completion of the project work.
- Evaluation

Evaluation	Marks	Month/ Date	Evaluator
Proposed title, review of literature and objectives.	-	3 rd Week of III Semester	-
I Review	10	July	Supervisor
II Review	10	August	Supervisor
Final- Internal	20	September/ October	Supervisor
External - Dissertation	40	October /November	Ext. examiner
*Viva-voce (individual & open)	20		
Total marks	100		

* Mode of presentation by Power Point

Dissertation framework

I. The dissertation format should be in:

- Font - Times New Roman
- Heading - Font size 14 (Bold) - Uppercase
- Sub headings - Font size 12 (Bold) – Lowercase; should be numbered.
(Eg: Introduction 1; Subheading 1.1; 1.2)
- Text, the content of the dissertation – Font size -12 (Normal).
- Citation - Any works of other researchers, if used either directly or indirectly should be indicated at appropriate places in the text.

The citation may assume any one of the following forms:

- i) A paper, a monograph or a book with single author may be designated by the name of the first author followed by the year of publication, placed inside brackets at the appropriate places in the text.
- ii) A paper, a monograph or a book with two authors may be designated by the name of the first and second author followed by the year of publication, placed inside brackets at the appropriate places in the text.
- iii) A paper, a monograph or a book with more than two authors may be designated by the name of the first author followed by et al, and the year of publication, placed inside brackets at the appropriate places in the text.

- Line space - 1.5
- Margin - 2” on the left and 1” on the right, Gutter -0.5.
- Page Numbering – Bottom middle alignment; excluding initial pages and reference
- Total number of pages - Minimum 30 - Maximum 50 (excluding initial pages and reference).
- The Tables and Figures should be included subsequently after referring them in the text of the Thesis.
- The thesis from Chapters should be printed on both sides.

II. Dissertation must be completed within the stipulated time.

III. Submission of Dissertation:

- one soft copy (PDF format in CD)
- three hard copies (soft binding) duly signed and endorsed by the Supervisor and the Head.

The report - dissertation will have three main parts:

I. Initial Pages - in the following sequence

- i. Title Page
- ii. Certificate from the Supervisor

- iii. Declaration by the candidate endorsed by the Supervisor and HOD.
- iv. Acknowledgement (within one page - signed by the candidate).
- v. Table of Contents
- vi. List of abbreviations
- vii. Abstract

II. Main body of the dissertation

- i) Introduction with Literature review and Objectives
- ii) Methodology
- iii) Results
- iv) Discussion
- v) Summary
- vi) References (DOI number of the journals can be included)

The guidelines for reference

Journal Article : with Single Author

Waldron, S 2008, "Generalized Welch bound equality sequences are tight frames", IEEE Transactions on Information Theory, vol. 49, no. 9, pp. 2307-2309.

Journal Article : with Two Authors

Conley, TG & Galeson, DW 1998, "Nativity and wealth in mid-nineteenth century cities", Journal of Economic History, vol. 58, no. 2, pp. 468-493.

Journal Article : with more than two Authors

Alishahi, K, Marvasti, F, Aref, VA & Pad, P 2009, „Bounds on the sum capacity of synchronous binary CDMA channels“, Journal of Chemical Education, vol. 55, no. 8, pp. 3577-3593.

Books

Holt, DH 1997, Management Principles and Practices, Prentice-Hall, Sydney. Centre for Research, M S University - Ph.D. Revised Guidelines Page | 39 / 41

E-book

Aghion, P & Durlauf, S (eds.) 2005, Handbook of Economic Growth, Elsevier, Amsterdam. Available from: Elsevier books. [4 November 2004].

Conference Proceeding Paper with editors

Riley, D 1992, „Industrial relations in Australian education“, in Contemporary Australasian industrial relations: proceedings of the sixth AIRAANZ conference, ed. D. Blackmur, AIRAANZ, Sydney, pp. 124-140.

Conference Proceeding Paper without editors

Fan, W, Gordon, MD & Pathak, R 2000, "Personalization of search engine services for effective retrieval and knowledge management", Proceedings of the twenty-first international conference on information systems, pp. 20-34.

Website

Australian Securities Exchange 2009, Market Information. Available from: . [5 July 2009].

Thesis

Unpublished Hos, JP 2005, Mechano chemically synthesized nano materials for intermediate temperature solid oxide fuel cell membranes. Ph.D. thesis, University of Western Australia.

Newspaper Print Ionesco, J 2001, 'Federal election: new Chip in politics', The Advertiser 23 October, p. 10.

Semester III Self-Learning Course – Biology for Competitive Exam I Course Code: PB20S1

No. of credits	Marks
2	100

Objectives

1. To understand the structure and organization of plant cells.
2. To know about the control of gene expression.

Course outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	understand the organization of cell organelles	PSO – 2	U
CO - 2	know the molecular and metabolic mechanisms of plants	PSO – 6	U
CO - 3	evaluate gene interactions	PSO – 6	E
CO - 4	analyze Transcription and Translation of Prokaryotes and Eukaryotes	PSO – 5	An
CO - 5	classify the plant diseases	PSO – 4	U

Unit I

Structure and functions of plant cell - cell wall, nucleus, mitochondria, golgi bodies, endoplasmic reticulum, chloroplast; Cell division - mitosis and meiosis; Apoptosis.

Unit II

Glycolysis, Krebs's cycle, Electron transport chain, responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Unit III

Law of dominance, segregation, independent assortment; Allele, multiple alleles, pseudoallele; Codominance, incomplete dominance, gene interactions, linkage and crossing over, sex linkage; Structural and numerical alterations of chromosomes - deletion, duplication, inversion, translocation.

Unit IV

DNA replication – conservative, semi conservative and dispersive; homologous and site-specific recombination; Structure and function of different types of RNA, Protein synthesis and processing; Control of gene expression at transcription and translation level prokaryotic and eukaryotic genes.

Unit V

Biological nomenclature - Concepts of species and hierarchical taxa; classical & quantitative methods of taxonomy of plants; Classification of plants; Common parasites and pathogens of crops; Rare and endangered species. Conservation strategies.

Reference Books

1. Experiments in plant Tissue Culture, Dodds, J.H. and L.W. Roberts, Cambridge University Press, London, 1995.
2. Molecular Biology, Freifelder, D. Narosa publishing house, New Delhi, 1990.
3. Plant Molecular Biology, II Edn. Grierson and S.N. Covery, Blackie, New York, 1988.
4. Molecular Biotechnology : Principles and Manipulation of Recombinant DNA, 4th edition, Bernard R. Glick and Jack J. Pasternack, Panima Publishing Corporation, New Delhi, 1996.
5. Plant Cell and Tissue Culture, Narayanaswamy, S. Tata McGraw – Hill publishing Co. New Delhi, 1994.
6. Plant Biotechnology, Comprehensive Biotechnology series, Murray Moo Young. Pergamon press, 1992.
7. Protein Targets for structure based Drug Design, Walklndahaw, Ned, Res. Rev P.317-372, 1992.

Semester - IV

Major Core IX – Plant Physiology

Course Code: PB2041

Hours / Week	Credits	Total Hours	Marks
6	5	90	100

Objectives

1. To facilitate the study of integrated activities in plants.
2. To evaluate the stress related mechanism of plants.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	relate the physical and chemical process occurring in plants	PSO – 2	R
CO - 2	understand the molecular and metabolic mechanisms of plants	PSO – 1	U
CO - 3	generalize a minor research using their theory knowledge	PSO – 5	Ap
CO - 4	examine, compare and conclude the stressed and stress free plants	PSO – 3	An
CO - 5	measure the biological mechanisms that takes place inside the plants	PSO – 2	E
CO - 6	design a protocol for plant regeneration under aseptic condition.	PSO – 4	C

Unit I

Physico-chemical properties of water - water potential; Mechanism of absorption of water - active and passive transport - Apoplast and symplast concept. Transpiration - Stomatal mechanism. Antitranspirants. Ascent of sap – SPAC; Mineral nutrition - criteria for essentiality. Macro and micro nutrients, their role and deficiency symptoms. Absorption of solutes - passive, active diffusion and facilitated diffusion. Hydroponics – Nutrient Film Technique (NFT).

Unit II

Properties of light - Interaction between radiant energy and phosphorescence; Photosynthetic apparatus and thylakoid organization; Two pigment systems - Light harvesting systems. Reaction center, P680, P700, water oxidation complex, electron transport system - cyclic - non cyclic - photophosphorylation; photosynthetic carbon reduction pathways in C3, C4 and CAM plants. Photorespiration and its significance.

Unit III

Respiration - Glycolysis – Anaerobic (Fermentation) and Aerobic (Kreb’s cycle); Electron transport system and oxidative phosphorylation - mechanism - Energetics - Respiratory inhibitors - Cyanide resistant respiration; Integration of metabolic pathways.

Nitrogen Metabolism – Sources of nitrogen. Biological nitrogen fixation – symbiotic and asymbiotic; Nitrate and Ammonia assimilation (GS-GOGAT pathway).

Unit IV

Plant growth regulators and elicitors: Physiological effect and mechanism of action of auxin, gibberellins, cytokinins, ethylene, abscissic acid, morphactins, brassinosteroids.

Photomorphogenesis – phytochrome mediated photoresponses. Physiology of flowering; Fruit ripening.

Unit V

Physiology of senescence and abscission; Biological clock; Stress physiology – biotic and abiotic stress- salinity stress, drought stress, water stress, freezing stress, radiation stress, and heavy metal stress. Stress proteins in plants – stress resistance mechanism.

Reference Books

1. Bidwell, R.G.S.(1974). *Plant physiology*. New York: Macmillan Publishing Company.
2. Devlin, R.M. and F.H. Witham.(1983). *Plant Physiology*.U.S.A: Willard Grant Press.
3. Hall, D.O and Rao. K.K. (1994). *Photosynthesis* (Fifth Edition).U.K: Cambridge University Press.
4. Hess, D. (1981).*Plant Physiology*.New Delhi: Narosa Publishing House.
5. Jain, V.K. (2004). *Fundamentals of Plant Physiology*.New Delhi:S. Chand and Company Ltd.
6. Noggle, G.R. and Fritz G.J.(2002).*Introductory Plant Physiology*. New Delhi: Prentice Hall India.
7. Salisbury, F.B. and Ross. C. (1991).*Plant Physiology*. Belmont: Wadsworth Publishing Company.

Semester - IV

Major Core X – Plant Ecology and Phytogeography

Course Code: PB2042

Hours / Week	Credits	Total Hours	Marks
6	5	90	100

Objectives

1. To impart basic knowledge about the environment and its allied problems.
2. To acquire skills to help the concerned individuals in identifying and solving environmental problems.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	understand the scope and importance of ecosystem	PSO – 3	U
CO - 2	distinguish the difference between hydrosere and xerosere	PSO – 2	An
CO - 3	list out the various food chains in ecosystem	PSO – 1	R
CO - 4	implement the mode of studying vegetation	PSO – 4	Ap
CO - 5	understand the importance of conservation strategies	PSO – 5	U

Unit I

Habitat Ecology - Freshwater and Marine water ecosystems; Wetlands and their Characteristics – Classification of Wetlands and Examples; Succession - Causes of succession, Types of succession; Process of succession; Concept of Climatic Climax; Hydrosere; Xerosere.

Unit II

Structure of Ecosystem; Productivity of ecosystem; Food chains in ecosystem; Ecological Pyramids; Energy flow in ecosystem; Biogeochemical cycle – Water cycle, Carbon cycle, Oxygen cycle, Nitrogen cycle, Sedimentary cycle; Ecological Genetics of Population – Ecads, Ecotypes, Ecoclines, Ecospecies; Population Ecology - Characteristics of a population; Population Structure – Population Dispersal and interactions among population;

Unit III

Phytogeography: Definition and Principles of Phytogeography; Distribution – Wides, Endemics and Discontinuous species; Theories of Discontinuous distribution; Factors affecting

distribution of species; Climate of India; Vegetation of India; Global environment changes – Global warming and Ozone depletion; Bioremediation, Biofueling, Biofilm and Biocorrosion, Carbon sequestration method, Carbon trading.

Unit IV

Current practices in conservation: Habitat or Ecosystem Approaches - Species-based Approaches - Social Approaches: Chipko Movement – In-situ conservation: Afforestation, Social Forestry, Agroforestry, Botanical gardens, Zoos, Biosphere Reserves, National Parks, Sanctuaries, Protected Area Network, Sacred Groves and Sthalavrikshas – Ex-situ conservation: Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperm Banks, DNA Banks.

Unit V

Status and protection of species in National and International levels – Role of CITES and IUCN – Convention on Biological Diversity (CBD) – Nagoya Protocol – Man and Biosphere Programme (MAB) – Policies implemented by MoEF for biodiversity conservation – Salient features of Biological Diversity Act 2002 – Ecosystem restoration.

Reference Books

1. Ambasht R.S. (1974). *A Text Book of Plant Ecology* (3rd Edn). Varanasi, India: Students' Friends & Co.
2. Chapman, J.L. and Reiss, M.J. (1999). *Ecology: Principles and Applications* (2nd Ed). New York: Cambridge University Press.
3. Chawla, S. (2011). *A text book of Environment & Ecology*. New Delhi: Tata McGraw-Hill.
4. Good, R. (1974). *The Geography of Flowering Plants*. London: Longman's Publication.
5. Odum E.P. Gray, W. Barrelet Thomas. (2004). *Fundamentals of Ecology* (5th Edition). Asia Pvt. Ltd.
6. Sharma, P.D. (2005). *Ecology and Environment*. New Delhi: Rastogi Publications.
7. Rana, S.V.S. (2008). *Energy, Ecology and Environment*. I.K. International Publishing House Pvt. Ltd.
8. Yadav.P.R, Shubhrata R. Mishara. (2004). *Environmental Biology*. New Delhi: Discovery Publishing House.
9. Subrahmanyam N.S. and Sambamurty A.V.S.S. (2011). *Ecology* (2nd Edition). New Delhi: Narosa Publishing House.
10. Shukla. R.S and Chandel P., S. (2012). *A Textbook of Plant Ecology including Ethnobotany and Soil Science*. New Delhi: Chand and Company Pvt. Ltd.
11. Verma. P.S and Agarwal. V.K. (2008). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. New Delhi: Chand and Company Pvt. Ltd.

Semester - IV

Major Core XI – Biotechnology and Bioinformatics

Course Code: PB2043

Hours / Week	Credits	Total Hours	Marks
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6	5	90	100
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Objectives

1. To apply the knowledge of biotechnology in different fields to produce high value products.
2. To develop skill and get employment in biotechnology and bioinformatics laboratories and industries.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	understand the importance of biotechnology and design a plant tissue culture laboratory	PSO – 3	U
CO - 2	differentiate batch, continuous and fed batch culture	PSO – 4	An
CO - 3	evaluate the pros and cons of Transgenic plants	PSO – 6	E
CO - 4	recall the different aspects of pharmaceuticals	PSO – 5	R
CO - 5	apply different databases in biological sciences	PSO – 1	Ap

Unit I

rDNA Technology: Restriction enzymes - Nomenclature, classification and properties; Types of cloning vectors - Plasmids, Cosmids, ssDNA phages, Ti plasmid; Yeast vectors - YIP, YEP, YRP and YAC ; shuttle vectors; Construction of genomic library; Construction of cDNA library.

Unit II

Plant tissue culture – laboratory organization; sterilization of explants; composition and preparation of MS media; Meristem culture; suspension culture; protoplast culture and somatic hybridization; production of haploid plants; somatic embryogenesis; synthetic seed production; Transgenic plants – Bt cotton, Golden rice.

Unit III

Industrial Biotechnology – Fermentor design; Immobilization of enzymes; Production of ethanol, acetic acid, citric acid and Penicillin; Biosafety – possible dangers of GEOs; biosafety guidelines; physical and biological containments; Process of patenting application.

Unit IV

Pharmaceutical Biotechnology: Edible vaccines, Plantibodies; Gene therapy – types of gene therapy, production of monoclonal antibodies and its application; Production of DNA vaccine; Production of subunit vaccine; Nanotechnology – nanomaterials, Synthesis of nanodrugs.

Unit V

Bioinformatics: The internet, World Wide Web, search engines Primary nucleotide sequence databases - Genbank, DDBJ; Primary protein sequence databases - NCBI, PIR, EMBL; Sequence Analysis - Pair-wise alignment; BLAST & FASTA types; Multiple sequence alignment; CADD.

Reference Books

1. Olsen R.C and Chrishtopher. (1992). *Computer assisted Drug Design*. Washington D.C: Americal Chemical Society.
2. Dodds, J.H. and L.W. Roberts. (1995). *Experiments in plant Tissue Culture*. London: Cambridge University Press.
3. Freifelder.(1990).*Molecular Biology*. New Delhi:Narosa Publishing house.
4. Grierson and Covery, S.N. (1988).*Plant Molecular Biology* (II Edn).New York: Blackie Publishing Pvt. Ltd.
5. Bernard R.Glick and Jack.J.Pasteunack. (1996). *Molecular Biotechnology: Principles and Manipulation of Recombinant DNA* (4th edition). New Delhi: Panima Publishing Corporation.
6. Narayanaswamy. (1994). *Plant Cell and Tissue Culture*. New Delhi:Tata McGraw Hill Publishing Company.
7. Murray Moo Young. (1992). *Plant Biotechnology, Comprehensive Biotechnology series*. Pergamon Press.
8. Peter F. Stanbury, Allan Whittaker, Stephen J Hall, Elsevier. (1984). *Principles of Fermentation Technology*. United States.

Semester - IV

Major Elective IV a – Phytochemistry and Pharmacognosy

Course Code: PB2044

Hours / Week	Credits	Total Hours	Marks
6	4	90	100

Objectives

1. To learn about the extraction procedures for active compounds.
2. To impart knowledge about different medicinal systems.

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO Addressed	CL
CO - 1	classify and understand secondary metabolites in plants	PSO – 5	U
CO - 2	remember the traditional systems of medicines in terms of Siddha, Ayurvedha, and Unani	PSO – 6	R
CO - 3	apply phytochemistry in different industries	PSO – 3	Ap
CO - 4	create the protocol for healing procedures in ethnobotany	PSO – 1	C
CO - 5	analyze crude drugs both qualitatively and quantitatively	PSO – 4	An

Unit I

Phytochemistry - Definition, history, principles; Secondary metabolites - definitions, classification, occurrence and distribution in plants, their functions, chemical constituents. Alkaloids, Terpenoids, Flavonoids, Steroids, and Coumarins.

Unit II

Techniques for isolation of medicinally important Biomolecules - solvent extraction, steam distillation, soxhlet extraction; Purification, concentration, determination and quantification of compounds (TLC, Column, HPLC). Characterization of phytochemicals by spectroscopic methods.

Unit III

Biosynthetic pathways and Application of phytochemicals: Biosynthetic pathways of secondary compounds: Shikimic Acid pathway; Mevalonic Acid Pathway; Pathways for

commercially important phytochemicals: Forskololn, Taxol and Vinca alkaloids. Applications of phytochemicals in medicine, pharmaceuticals, food, flavour and cosmetic industries.

Unit IV

Herbalism and Ethnobotany: Herbs and healing; Historical perspectives local, national and global level; Herbal cultures: origin and development of human civilizations; Ethnomedicine - Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

Unit V:

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). Medicinal plant banks micro propagation of important species (*Wihania somnifera*, *Azadirachta indica* and *Ocimum sanctum* - Herbal foods-future of pharmacognosy)

Reference Books

1. Bannerman, R. H., J. Burton and C. Wen Chen (eds). 1983. Traditional medicine and health care coverage. WHO, Geneva.
2. Harborne, JB. 1984. Phytochemical Methods (2nd Ed.). Chapman &Hall, London.
3. Agarwal, P. K. and R. S. Thakur, C. M Bansal. 1989. Carbon-13 NMR of Flavonoids. Elsevier Science Publishers, Amsterdam.
4. AlerGingauz. 2001.Medicinal Chemistry. Oxford University Press & Wiley Publications.
5. Braithwaite, A. and F. J. Smith. 1996. Chromatographic Methods (5th Edition) Blackie Academic & Professional London.
6. Mann J. Davidson, R. S and J. B. Hobbs, D. V. Banthorpe, J. B. Harborne. 1994. Natural Products. Longman Scientific and Technical Essex.
7. Schwedt, G. 1997. The Essential Guide to Analytical Chemistry. John Wiley & Sons, New York.
8. Wilson, K. and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4thEdition) Cambridge University Press, Cambridge.
9. Cotton, CM. 1996. Ethnobotany:Principles& Applications. John Wiley & Sons, New York.
10. Gopalan, C., B. V. Ramasastry and S. C. Balasubramanian. 1985. Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad.

Semester - IV

Major Elective IV b – Entrepreneurial Botany

Course Code: PB2045

Hours / Week	Credits	Total Hours	Marks
6	4	90	100

Objectives

1. To enable the students to become self-employable.
2. To introduce the students about the funding agencies.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	create protocol for the production of mushroom	PSO – 1	C
CO - 2	understand the nutritive value of SCP	PSO – 4	U
CO - 3	justify the impact of organic fertilizers over synthetic fertilizers	PSO – 5	E
CO - 4	summarize the aesthetic sense of gardening	PSO – 6	U
CO - 5	know the different funding agencies	PSO – 3	R

Unit I

Mushroom Cultivation - Introduction to mushroom fungi, nutritional value, edible and poisonous type, medicinal value of mushrooms, Spawn Production; Cultivation techniques; problems in cultivation – disease and pest management strategies; harvesting, packing and storage.

Unit II

Single Cell Protein Production – Introduction, Importance, nutritive value, production process, properties, microbes employed in the production of SCP. Biomass production of SCP from *Spirulina*. Advantages of SCP.

Unit III

Organic Farming – Introduction, advantages and importance of organic farming, biofertilizers – production of biofertilizers – *Azolla*; large scale production and applications of humic acid and panchagavya.

Unit IV

Gardening – Indoor – Green House, Hydroponics, Terrarium, Bonsai, Hanging pots, Miniature Rockery Orchidarium and water garden.

Outdoor – Kitchen Garden and roof top garden.

Unit V

Entrepreneurship – Role of funding agencies (NABARD), Rural Banking, FAO, STEP (Science & Technology Entrepreneurship Programme) - Govt and NGO's, Yojana Schemes. Entrepreneurship Development Programme (EDP).

Reference Books

1. Don Ellison, 2002. Garden Plants of the world. New Holland Publishers. V.K.
2. Lakshman, H.C and Channabasava, A. (2014)*Biofertilizers and Biopesticides*. Jaipur: Pointer Publishers.
3. Peter Mc Hoy., Barbara Segall and Stephanie Donaldson. 1997. Practical Small Gardening.
4. Pratibha Trivedi. 1996. Home Gardening ICAR, New Delhi. 9. Jane Fearnley 1995. Gardening Made Fast, Wedenfeld London.
5. Vijaya Ramesh, K. 2007. Food Microbiology, MJP Publisher, Chennai.
6. Suresh Gopalani, 2011. Fundamentals of Applied Nutrition.
7. Dubey, H.C. and Maheswari D.K. (2000). *A Text Book of Microbiology*. New Delhi: S. Chand & Co Ltd.

Semester - III

Practical III – Taxonomy of Angiosperms, Genetics and Molecular Biology

Course Code: PB20P3

Hours / Week	Credits	Total Hours	Marks
6	3	90	100

Objectives

1. To learn the taxonomical terminology, morphology, structure and functions of various parts of plants.
2. To have broad knowledge on genetics problems and to carry out molecular biology experiments and interpret the results.

Course Outcome

CO	Expected Learning Outcomes Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO - 1	isolate the DNA from plant materials	PSO – 4	Ap
CO - 2	separation of biomolecules using	PSO – 1	Ap

	spectrophotometry		
CO - 3	analyse the floral parts and relate to its corresponding family	PSO –5	An
CO - 4	to solve genetics related problems	PSO – 1	E

Taxonomy of Angiosperms

7. Assigning plants to their respective families.
8. Technical description of floral parts with reference to families prescribed.
9. Identification of modification and economically important products from the members of the families prescribed in the syllabus (Botanical name, common name, morphology of the useful part-family and uses).
10. Preparing intended keys and bracketed keys for the locally available plants.
11. Field trip, Submission of field note book, with a report on the field trip.
12. Preparation of 5 herbaria of the locally available weed.

Genetics and Cell Molecular Biology

7. Genetics Problems – Monohybrid cross, Dihybrid cross.
8. Genetics Problems – Interaction of genes.
9. Isolation of DNA (Demo)
10. Agarose gel electrophoresis (Demo)
11. Estimation of DNA by UV- Spectrophotometric method.
12. PCR (Demo)

Semester - IV

Practical IV – Plant Physiology, Plant Ecology & Phytogeography and Biotechnology & Bioinformatics

Course Code: PB20P4

Hours / Week	Credits	Total Hours	Marks
6	3	90	100

Objectives

1. To understand the methodology involved in environment and conservation biology.
2. To learn the physiochemical analysis of plant materials in the context of plant physiology.
3. To achieve skills in practical aspects regarding plant tissue culture.

Course Outcome

CO	Expected Learning Outcomes Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO - 1	analyze DO, BOD and COD of water	PSO – 2	An
CO - 2	prepare tissue culture media, initiate callus culture, anther culture, pollen culture, etc	PSO – 4	Ap
CO - 3	identification of phytoplanktons in water bodies	PSO – 5	U
CO - 4	evaluate the metabolic reactions in plants	PSO – 4	E
CO - 5	report on common environmental problems, their consequences and possible solutions	PSO – 2	E

Plant Physiology

1. Hill reaction – Ferricyanide / DCPIP by isolated chloroplast with reference to light and time.
2. Determination of osmotic potential by plasmolytic methods.
3. Estimation of Carotenoids
4. Determination of stomatal index and stomatal frequency by cellulose acetate film method.
5. Estimation of Proline (stress and unstressed plants)
6. Membrane permeability based on temperature, detergent and pH
7. Effect of age (C3 and C4 plants)

Plant Ecology and Phytogeography

1. Determination of Dissolved oxygen
2. Determination of Total Dissolved solids.
3. Determination of Chemical Oxygen Demand
4. Determination of Salinity
5. Preparation of activated carbon from waste materials
6. Identification of Planktons in the water.
7. Students should be aware of the common environmental problems, their consequences and possible solutions (Submit a report).

Biotechnology and Bioinformatics

1. Preparation of media and Sterilization
2. Callus culture
3. Immobilization of yeast cells
4. Anther culture
5. Synthetic Seed preparation
6. Fermentor (Demo)
7. Isolation of amylase producing microorganism from soil sample
8. Isolation of lactic acid producing bacteria from milk
9. Wine preparation

Semester - IV

Self-Learning Course – Biology for Competitive Exam – II

Course Code: PB20S2

No. of credits	Marks
2	100

Objectives

1. To have a brief knowledge on biotechnology and biostatistics.
2. To motivate the students to write competitive examinations.

Course outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	analyze the relationship between different ecological groups	PSO – 2	An
CO - 2	understand the importance of biotechnology and in various fields	PSO – 4	U
CO - 3	evaluate the origin and development of different meristems	PSO – 5	E
CO - 4	apply the conceptual knowledge to operate biotechnological equipments	PSO – 6	Ap
CO - 5	formulate and perform statistical problems	PSO – 1	E

Unit I

Biotic and abiotic interactions; Concept of habitat and niche; population growth curves; structure and function of some Indian ecosystems- terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Environmental pollution; global environmental changes.

Unit II

DNA replication, enzymes involved, replication origin and replication fork, fidelity of replication, extra chromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination of DNA.

Unit III

Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis.

Unit IV

Isolation and purification of RNA, DNA and proteins; Analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis; Generation of genomic and cDNA libraries; plasmid, phage, cosmid, BAC and YAC vectors. RFLP, RAPD and AFLP techniques.

Unit V

Measures of central tendency and dispersal; probability distributions, Regression and Correlation; t-test; Analysis of variance; Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells.

Reference Books

1. Bernard R. Glick and Jack J. Pasteunack. (1996). *Molecular Biotechnology : Principles and Manipulation of Recombinant DNA* (4th Edition). New Delhi Panima Publishing Corporation.
2. Bernard Rosner. (2006). *Fundamental of Biostatistics* (7th Edtn). Cengage Learning Inc.
3. Freifelder. (1990). *Molecular Biology*. New Delhi: Narosa publishing house.
4. Hall, D.O and K.K. Rao. (1994). *Photosynthesis* (Fifth Edition). U.K: Cambridge University Press.
5. Jain, V.K. (2004). *Fundamentals of Plant Physiology*. New Delhi: S. Chand and Co. Ltd.
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7. Sharma A.K. (2005). *Text Book of Biostatistics*. New Delhi: Discovery Publishing House.