

DEPARTMENT OF BOTANY

With effect from the academic year 2017-2020

B.Sc. Programme Outcome (PO)

PO No.	Upon completion of B.Sc. Degree Programme, the graduates will be able to :
PO - 1	apply the acquired scientific knowledge to face day to day needs.
PO - 2	create innovative ideas through laboratory experiments.
PO - 3	carry out field works and projects independently and in collaboration with other institutions and industries
PO - 4	reflect upon green initiatives and take responsible steps to build a sustainable environment.
PO - 5	face challenging competitive examinations that offer rewarding careers in science and education.
PO - 6	impart communicative skills and ethical values.
PO - 7	equip students with hands on training through various courses to enhance entrepreneurship skills.

Aim

To impart an education that promises an integrated growth of knowledge, skills and values and enables the students to have confidence and positive outlook.

Objectives

1. To develop an in-depth knowledge in the subject.
2. To enable the students to pursue higher studies.
3. To create an awareness on environment.
4. To seek employment after graduation in fields that reflect their area of training

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 the Manonmaniam Sundaranar University, Tirunelveli.

Duration of the Programme : 3 years

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
	Practicals (Core applied) (4x50) + (3x100)	500
	Elective - Theory papers (4 x 100)	400
	Major -Total marks	1900

Allied (I & II)

Theory	(4x100)	400
Practicals	(2x100)	200
	Allied - Total marks	600

Part III - Total marks **2500**

All theory papers and Allied Practicals carry 100 marks each.

Major Practicals during I and II year carry 50 marks each.

Major Practicals during III year carry 100 marks each.

Practical examinations for I year and II year major will be conducted at the end of each semester. Project Viva will be conducted at the end of even semesters.

Course Structure

Distribution of Hours and Credits

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI	Total	
							Hours	Credit
Language	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
English	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
Major Core – Theory	4(4)	4(4)	4(4)	4(4)	(6+6+5 (5+5+4))	(6+6+5 (5+5+5))	50	45
Major Core - Practical	2	2(4)	2	2(4)	2+2+2	6(6)	20	14
Elective	-	-	4(4)	4(4)	5(5)	5(4)	18	17
Allied -Theory	4(4)	4(4)	4(4)	4(4)	-	-	16	16
Allied Practical	2	2(2)	2	2(2)	-	-	8	4
AECC	2 (2)	2 (2)	-	-	-	-	4	4
SBC	-	-	2 (2)	2 (2)	2 (2)	2 (2)	8	8
NMEC	4 (2)	4 (2)	-	-	-	-	8	4
*FC –I(Values for Life)	-	(1)	-	-	-	-	-	1
*FC– II(Personality Development)	-	-	-	(1)	-	-	-	1
*FC –III (HRE)	-	-	-	-	(1)	-	-	1
*FC –IV (WS)	-	-	-	-	-	(1)	-	1
* SDP-Certificate Course	-	(1)	-	-	-	-	-	1
*SLP-Extension activity (RUN)	-	-	(1)	-	-	-	-	1
*STP – Clubs & Committees / NSS	-	-	-	(1)	-	-	-	1
Total	30 (18)	30 (26)	30 (21)	30 (28)	30 (22)	30 (28)	180	140+3

Total number of hours = 180

Total number of Credits = 140+3

*** Courses / Programmes conducted outside the regular working hours**

Instruction for Course Transaction

Theory (Major Core) paper hours

Components	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI
Lecture hours	50	50	50	50	60 / 75	60 / 75
Assignment / Group discussion	5	5	5	5	5	5
CIA (Test, Quiz)	5	5	5	5	5	5
Seminar	-	-	-	-	5	5
Total Hours / semester	60	60	60	60	75 / 90	75 / 90

Theory (Elective/ Allied) paper hours

Components	Elective				Allied	
	Sem. III	Sem. IV	Sem. V	Sem. VI	Sem. I/III	Sem. II / IV
Lecture hours	50	50	65	65	50	50
Assignment/ Group discussion	5	5	5	5	5	5
CIA (Test, Quiz)	5	5	5	5	5	5
Total Hours	60	60	75	75	60	60

Practical Hours

Major	Semester	Hours per week	Total hours / semester
	I / II / III / IV	2	30
V / VI	2+2+2 = 6	90	
Allied	I / II / III / IV	2	30

Value Added Courses

S. No.	Name of the Course	Total hours	Credit
I	Mushroom Culture Technology	30	1

II	Hydroponics	30	1
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Courses Offered

Sem ester	Course	Subject code	Paper	Hours/ week	Credit
I	Part I	TL1711/FL 1711	Language: Tamil / French	6	3
	Part II	GE1711 / GE1712	General English (A Stream / B Stream)	6	3
	Part III	BC1711	Major Core I – Algae, Fungi and Lichens	4	4
		BC17P1	Major Practical I - Algae, Fungi and Lichens	2	-
		BA1711	Allied I – Theory: Cell Biology and Plant Anatomy	4	4
		BA17P1	Allied I – Practical - Cell Biology and Plant Anatomy	2	-
	Part IV	AEC171	Ability Enhancement Compulsory Course (AECC): English Communication	2	2
		BNM171	Non Major Elective Course (NMEC) – Food and Nutrition	4	2
		VEC172	Foundation Course I – Values for Life	-	-
	Part V	SDP172	Skill Development Programme (SDP) – Certificate Course	-	-
		STP174	Student Training Programme (STP) - Clubs & Committees/NSS	-	-
II	Part I	TL1721/FL 1721	Language: Tamil / French	6	3
	Part II	GE1721/ GE1722	General English (A Stream / B Stream)	6	3
	Part III	BC1721	Major Core II – Plant Anatomy and Embryology	4	4
		BC17P1	Major Practical I - Algae, Fungi and Lichens	-	2
		BC17P2	Major Practical II - Plant Anatomy & Embryology	2	2
		BA1721	Allied I – Theory: Taxonomy of Angiosperms and Plant Physiology	4	4
BA17P1		Allied I – Practical - Cell Biology, Plant Anatomy, Taxonomy of Angiosperms and Plant Physiology	2	2	

	Part IV	AEC172	Ability Enhancement Compulsory Course (AECC): Environmental Studies	2	2
		BNM172	Non Major Elective Course (NMEC)- Eco friendly Technology	4	2
		VEC172	Foundation Course – II –Personality Development	-	1
	Part V	SDP172	Skill Development Programme (SDP) – Certificate Course	-	1
		STP174	Student Training Programme (STP) - Clubs & Committees/NSS	-	-
III	Part I	TL1731/FL 1731	Language: Tamil / French	6	3
	Part II	GE1731 / GE1732	General English (A Stream / B Stream)	6	3
	Part III	BC1731	Major Core III – Archegoniate	4	4
		BC1732 BC1733 BC1734	Major – Elective I (a) Herbal Botany (b) Nursery and Gardening (c) Agricultural Botany	4	4
		BC17P3	Major Practical III - Archegoniate	2	-
		BA1731	Allied II – Theory: Taxonomy of Angiosperms and Plant Physiology	4	4
		BA17P2	Allied II – Practical - Taxonomy of Angiosperms and Plant Physiology	2	-
		Part IV	SBC173/ SBC174	Skill Based Course (SBC) – Yoga / Computer Literacy	2
		VEC174	Foundation Course II – Personality Development	-	-
	Part V	STP174	Student Training Programme (STP): Clubs & Committees/NSS	-	-
		SLP173	Service Learning Programme (SLP): Extension Activity (RUN)	-	1
IV	Part I	TL1741/FL 1741	Language : Tamil / French	6	3
	Part II	GE1741/ GE1742	General English (A Stream / B Stream)	6	3
	Part III	BC1741	Major Core IV – Plant Ecology and Phytogeography	4	4
		BC1742 BC1743 BC1744	Major – Elective II (a) Biological Resources (b) Food Science (c) Biodiversity and Human Welfare	4	4
		BC17P3	Major Practical III - Archegoniate	-	2
		BC17P4	Major Practical IV - Plant Ecology and	2	2

			Phytogeography		
		BA1741	Allied II – Theory: Cell Biology and Plant Anatomy	4	4
		BA17P2	Allied II – Practical: Taxonomy, Anatomy, Plant Physiology, Cell Biology and Plant Anatomy	2	2
	Part IV	SBC173/ SBC174	Skill Based Course (SBC) – Yoga / Computer Education	2	2
		VEC174	Foundation Course II – Personality Development	-	1
	Part V	STP174	Student Training Programme (STP) - Clubs & Committees/NSS	-	1
V	Part III	BC1751	Major Core V - Taxonomy and Economic Botany	6	5
		BC1752	Major Core VI - Biochemistry and Biophysics	6	5
		BC1753	Major Core VII - Microbiology and Plant Pathology	5	4
		BC1754 BC1755 BC1756	Major – Elective III (a) Horticulture and Plant Breeding (b) Forestry (c) Biological Techniques	5	5
		BC17P5	Major Practical V - Taxonomy and Economic Botany & Biochemistry and Biophysics	4	-
		BC17P6	Major Practical VI - Microbiology and Plant Pathology	2	-
	Part IV	BSK175	Skill Based Course (*SBC) – Floriculture	2	2
		HRE175	Foundation Course III - Human Rights Education (HRE)	-	1
VI	Part III	BC1761	Major Core VIII - Genetics, Biostatistics and Bioinformatics	6	5
		BC1762	Major Core IX - Biotechnology and Molecular biology	6	5
		BC1763	Major Core X - Plant Physiology and Metabolism	5	5
		BC1764 BC1765 BC1766	Major – Elective IV (a) Marine Botany (b) Organic Farming (c) Ecotourism	5	4
		BC17P5	Major Practical V – Taxonomy and Economic Botany & Biochemistry	-	2

			and Biophysics		
		BC17P6	Major Practical VI - Genetics, Biostatistics and Bioinformatics & Biotechnology and Molecular Biology	4	2
		BC17P7	Major Practical VII - Microbiology and Plant Pathology & Plant Physiology and Metabolism	2	2
	Part IV	BSK176	Skill Based Course (*SBC) – Project	2	2
		WSC176	Foundation Course IV - Women's Studies (WS)	-	1
			TOTAL	180	140+3

***SBC for the V & VI semesters is offered by the departments for their students**

Self Learning– Extra Credit Course

Semester	Subject code	Title of the paper	Hours/week	Credit
III/ V	BC17S1	Plant Resource Utilization	-	2
IV/VI	BC17S2	Algal Biotechnology	-	2
		On line Course (MOOC)	-	2

Programme Specific Outcomes (PSO)

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	PO - 1
PSO - 2	apply the contextual knowledge in Botany to improve the supply of medicines, food, fibers and other plant products to the society.	PO - 7
PSO - 3	understand the basic professional skills through various laboratory technical training, to analyze the relevant biological situations	PO - 2
PSO - 4	create green environment to protect nature for future sustenance	PO - 4
PSO - 5	seek entrepreneurship through skill based, value added and related courses	PO – 7
PSO - 6	communicate appropriately and effectively in science and also interact productively with people from diverse background	PO – 5
PSO - 7	utilize the scientific explanation for the unity and diversity of life on earth	PO – 4
PSO - 8	understand the professional, ethical, legal and social issues related to gender	PO – 6
PSO - 9	integrate the related topics from other branches of science to carry out projects to have a successful career.	PO – 3

Semester - I
Algae, Fungi and Lichens
Sub. Code: BC1711

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

Objectives: 1. To understand the importance of different groups of plants and their diversity.

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 important contrast characters of Algae, Fungi and Lichens	PSO - 1	R
CO - 2	describe ways in which lichens are beneficial to the environment	PSO - 4	U
CO - 3	interpret the general characteristics of lichens	PSO - 1	Ap
CO - 4	categorize the algal organisms according to Fritsch (1945)	PSO - 7	An
CO - 5	correlate the study of life form, structure, reproduction and life cycle of different classes of Algae	PSO - 1	E
CO - 6	recall the salient features of the different fungi	PSO - 1	U

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 (Development aspect not included)

Cyanophyceae- *Nostoc*

Chlorophyceae- *Volvox*, *Caulerpa*

Unit II

Phaeophyceae- *Sargassum*

Rhodophyceae- *Gracilaria*

Unit III

Morphology and life cycle of the following

Xanthophyceae – *Vaucheria*

Bacillariophyceae – *Diatoms*

Economic and Ecological importance of Algae

Unit IV

Fungi: Classification of fungi according to Alexopoulos and Mims (1962). General characters, Salient features of the classes, occurrence, structure, reproduction and life cycle of the following (Development aspect not included)

Oomycetes - *Albugo*

Ascomycetes - *Aspergillus, Peziza*

Basidiomycetes - *Puccinia*

Economic importance of Fungi

Unit V

Lichens:

General characters of Lichens, Classification of Lichens

Ascolichens- *Usnea*

Economic importance of Lichens

Text Books:

1. Sharma, O.P. (1997). *Text book of Algae*. New Delhi: Tata McGraw- Hill Publications.

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. Kumar, H.D., & Singh, N.A. (1982). *A text book of Algae*, East West Press Pvt. Ltd New Delhi.
4. Pandey, S.N., & Trivedi, P.S. (1977). *Text book of Botany Vol I*. New Delhi. Vikas publishing house Pvt. Ltd.
5. Fritsch, F.E. (1972). *The Structure and Reproduction of Algae Vol. I & II*. London: Cambridge University Press.
6. Dubey, H.C. (1993). *Introduction to Fungi*. New Delhi: Vikas Publishing House.

Semester - I

Cell Biology and Plant Anatomy (Allied)

Sub. Code:BA1711

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

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

2. To know the internal structure of higher plants.

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 - 7	R
CO - 2	differentiate Prokaryotes from Eukaryotes	PSO - 1	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 - 7	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

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

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

Unit III

Tissues – Meristems – Classification (origin, position and function); Permanent – structure and functions of simple tissues – parenchyma, collenchyma, sclerenchyma. structure and functions of complex tissues – xylem and phloem.

Unit IV

Primary structure of dicot stem and root.

Primary structure of monocot stem and root.

Unit V

Study of the internal structure of dicot and monocot leaf.

Normal secondary thickening of dicot stem

Text Books:

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

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*. Saunders College Philadelphia.
3. Gupta, P.K. (1997). *Cytology, Genetics and Evolution*. Meerut: Rastogi Publications.
4. Esau, K. (1953). *Plant Anatomy*. New York, NY: Wiley Publication Co.
4. Pandey, B.P. (1982). *Plant Anatomy*. New Delhi: S. Chand and Company Ltd.
5. Arthur J Eames.,& Laurence H Macdaniels. (2005). *An Introduction to Plant Anatomy*. New Delhi: Tata McGraw-Hill.

Semester - I
Food and Nutrition (NMEC)
Sub. Code: BNM171

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

Objectives: 1.To study the sources and nutritive value of food.

2. To be aware of food adulteration and ill effects of junk food.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	understand the natural sources and nutritive value of food	PSO - 2	U
CO - 2	discuss the role of balanced diet	PSO - 2	U
CO - 3	know the pathogenic organisms which occur very often in food and dishes	PSO - 4	An
CO - 4	recall the methods of food preservation	PSO - 9	R
CO - 5	test for detection of food adulteration	PSO - 3	E
CO - 6	collaborate with food industries and FAO of government to develop healthy food products from indigenous food ingredients	PSO - 9	C

Unit I

Energy value of food, major classes of food- carbohydrates, proteins, fats and oils, Vitamins, minerals – sources and requirements. Probiotics – a general account. Balanced diet - functions and deficiency symptoms - causes and prevention. Food colourants - Natural and artificial.

Unit II

Nutritive value of rice and wheat

Cereals - Rice, processing and products; Wheat- processing, bread manufacturing and other value added products of wheat.

Beverages: Non-alcoholic- Coffee, tea and cocoa-processing.

Alcoholic- Beer, wine and distilled liquors

Unit III

Food preservation: Importance of preservation. Methods of preservation - low and high temperature, use of oil and spices, salt and sugar.

Preparation of jam, jelly, pickles and squashes.

Nutritive value of meat, fish and egg

Meat and meat products; sea foods- storage and processing of fish and fish products

Egg- egg products

Unit IV

Food additives: Definition and types. Milk and milk products, ice cream and related products; cheese, reduced fat dairy products. Food adulteration- harmful effects, simple physical tests for detection of food adulterants.

Unit V

Food borne infection and their prevention- Botulism, Salmonellosis and Shigellosis. Food intoxication- bacterial toxins and fungal toxins.

Text Book:

1. Sumathi R Madamti & Rajagopal, M.V. (1984). *Fundamentals of Food and Nutrition*. New Delhi: New Age Publishers.

Reference Books:

1. Swaminathan, M. (1996). *Food Science Chemistry and Experimental Food*. Bangalore Print and Publishing Company.
2. Shakunthal O Manny. (1999). *Food: Facts & Principles*. New Delhi: New Age Publishers.
3. Sivasankar ,B. (2014). *Food Processing and Preservation*. New Delhi: PHI Learning Private Limited.
4. Girdhari Lal, G.S. Siddappa., & Tandon, G.L. (1999). *Preservation of Fruits and Vegetables*. Indian Council of Agricultural Research, New Delhi: Publications and Information Division.
5. Martin R. Adams., & Maurice O Moss. (2008). *Food Microbiology*. 3rd ed., Cambridge, RSC Publishing.

Semester - II
Plant Anatomy and Embryology
Sub. Code:BC1721

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, stomata, simple and complex tissues	PSO - 2	R
CO - 2	differentiate between primary and secondary structures	PSO - 1	U
CO - 3	understand the epidermal cells and its modification	PSO - 7	U
CO - 4	interpret the different types of endosperm	PSO - 6	U
CO - 5	examine the nodal anatomy types	PSO - 3	An
CO - 6	compare the development of male and female gametophyte	PSO - 7	Ev

Unit I

Meristems – Classification (origin, position and function); Apical organization of shoot and root.

Tissues – Structure and function of simple tissue (parenchyma, collenchyma and sclerenchyma) and complex tissue (xylem and phloem). Primary structure of dicot and monocot stem, root and leaf.

Unit II

Secondary growth in stem and root – Formation of cambial ring, activity of cambial ring, secondary vascular tissue, formation of periderm, lenticels, annual ring, Wood (heartwood and sapwood). Anomalous secondary thickening in dicot stem (*Boerhaavia*) and monocot stem (*Dracaena*).

Unit III

Epidermal tissue system, trichomes, glandular hairs, cuticle, stomata and its types; Nodal anatomy types - unilacunar (*Justicea*), trilacunar (*Azadirachta*) and multilacunar (*Aralia*), Hydathodes and laticifers.

Unit IV

Embryology – Structure of anther; Structure of microsporoangium, 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. Fertilization, endosperm - types- nuclear, cellular and helobial, ruminant endosperm, perisperm. Development of embryo in dicot (*Capsella*) and monocot (*Luzula*).

Text Books:

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

Reference Books:

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

Semester - II
Major Practical – II
Plant Anatomy and Embryology
Sub. Code: BC17P2

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

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	observe and identify different types of tissues and stomata	PSO - 3	U
CO - 2	prepare plant material for microscopic observation	PSO - 9	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 - 7	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

Plant Anatomy and Embryology

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. Dissection of *Tridax* embryo (Globular or Cordate stage).

Semester - II
Taxonomy of Angiosperms and Plant Physiology (Allied)
Sub. Code: BA1721

No. of hours per week	Credit	Total no. of hours	Marks
4	4	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 study the functions of plants.

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 – 9	Ap
CO - 4	analyze the various processes involving in water uptake and transport in plants.	PSO - 7	An
CO - 5	classify the different plants by the natural, artificial and phylogenetic classification	PSO - 1	An
CO - 6	interpret the role of growth hormones in plants	PSO–2	Cr

Unit I

Brief account of morphology: Root, stem, leaf, inflorescence and fruits. Classification – artificial, natural (Bentham & Hooker’s) and phylogenetic, Binomial nomenclature

Unit II

Study of the following families and their economic importance - Annonaceae, 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 - passive and active mechanisms, ascent of sap, transpiration – types and brief note on stomatal movement.

Unit IV

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

Unit V

Respiration: Types - aerobic (glycolysis, Kreb's cycle and oxidative phosphorylation) anaerobic (fermentation) –Brief account on oxidative phosphorylation. Factors affecting respiration.

Plant growth - Growth hormones – physiological role of auxins and gibberellins.

Text Books:

1. Pandey, B.P. (1997). *Taxonomy of Angiosperms*. New Delhi: S. Chand & Co.
2. Pandey, K.K., & Sinha, B.K. (1988). *Plant Physiology*. New Delhi: Vikas Publications.

Reference Books:

1. Singh., & Jain. (1997). *Taxonomy of Angiosperms*. Meerut: Rastogi Publications.
2. Noggle., & Fritz. (2002). *Introductory Plant Physiology*. New Delhi: Prentice Hall of India, Pvt. Ltd.
3. Lawrence, G.H.M. (1951). *Taxonomy of Vascular Plants*. New York. NY: Mac Milan Company.

Semester - II
Allied Practical - I
Taxonomy of Angiosperms and Plant Physiology
Sub. Code: BA17P1

No. of hours per week	Credit	Total no. of hours	Marks
4	2	60	100

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	identify the electron micrographs of the cell organelles, non living inclusions and tissues	PSO - 1	U
CO - 2	preparation of plant material for microscopic observation	PSO - 9	C
CO - 3	draw appropriate anatomical diagrams from the sectioned plant material using microscope	PSO - 3	An
CO - 4	dissect and display the floral parts of the families studied and draw floral parts and write floral formula	PSO - 7	An
CO - 5	assign the plant provided to the respective families	PSO - 7	E
CO - 6	demonstrate plant physiology experiments	PSO - 3	Ap

Taxonomy of Angiosperms and Plant Physiology (To be conducted in Semester – II)

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. Demonstration only
 - a. Transpiration pull
 - b. Oxygen evolved during photosynthesis
 - c. Light- screen experiment
 - d. Khune's apparatus

Semester - II
Eco - Friendly Technology (NMEC)
Sub. Code: BNM172

No. of hours per week	Credit	Total no. of hours	Marks
4	3	60	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	know the nutritive value of mushroom and learnt the techniques of mushroom cultivation	PSO - 2	U
CO - 2	design novel mechanisms for the sustainable utilization of natural resources	PSO - 4	Ap
CO - 3	understand the role of microbes in fermentation	PSO - 9	An
CO - 4	transform waste plant products into biofuels	PSO - 5	C
CO - 5	make valuable craft articles utilizing the fibers of banana, <i>Cyperus</i> and palm	PSO - 5	C
CO - 6	become an entrepreneur	PSO - 5	Ap

Unit I

Mushroom: Nutritional value of Mushrooms; Cultivation, processing and marketing of *Plerotus* and *Agaricus*.

Unit II

Vermicomposting: Conditioning of sludge, disinfection of sludge, dewatering, heat drying and disposal of sludge; advantages of vermicompost.

Unit III

Fermentation: Definition – Role of microorganisms in fermentation process - wine and vinegar preparation.

Unit IV

Biogas technology: Anaerobic digestion- Biogas production by KVIC model. Solar energy: Solar cooker, solar lamp and solar water heater.

Unit V

Banana fibre processing: Cutting and slitting, fibre separation and drying, uses of banana fibre. Craft Articles from natural fibres of Palm, Bamboo and Cyperus.

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 Biotechnolgy*. New Delhi: S. Chand and Company.
2. Adrian Slater., Nigel Scott., & Mark Fowler. (2003). *Plant Biotechnology*. New York, NY: Oxford University Press.
3. Satyanarayana, U. (2008). *Biotechnology*. Kolkata: Books and Allied (P) Ltd.
4. Rajni Gupta., & 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 (P) Ltd.

Semester - III

Major Core III - Archegoniate

Sub. Code: BC1731

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

Gender

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. hgmghhhhhSharma, O.P. (2006). *Text Book of Pteridophyta*. New Delhi: Macmillan PublishersIndia Ltd.
1. Chamberlain, C.J. (2000). *Gymnosperms*. New Delhi: CBS Publishers and Distributors.
2. Pandey, S.N., Misra, S.P.& Trivedi, P.A. (1998). *Text book of Botany*. Vol. II. New Delhi: Vikas Publishing Pvt Ltd.
3. Mishra, S.R. (2010). *Text book of Paleobotany*. New Delhi: Discovery publishing Pvt. Ltd.

Semester – III
Major Elective – I (a) Herbal Botany
Sub. Code: BC1732

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 important 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*, *Rauvolfia* and *Cannabis*.

UNIT IV

Evaluation and standardization of herbal drugs. Physico-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.
1. Kanny Lal Dey and Raj Bahadur (1984). *The indigenous drugs of India*. Dehradun: International Book Distributors.
2. Sivarajan, V.V. Balachandran and Indra. (1994). *Ayurvedic drugs and their plant source*. New Delhi: Oxford IBH publishing Co.
4. 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.
5. [Vasant Balaji Athavale](#) (2009). *Basic Principles of Ayurveda*. New Delhi: Chaukhamba Sanskrit Pratishthan Publishers.
6. Wendy Applequist, (2006). *The Identification of Medicinal Plants*. Austin: American Botanical Council.

Semester - III

Major Elective – I (b)Nursery and Gardening

Sub. Code: BC1733

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 ownseed 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, Pepperand 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 andCo-operation, National Seed Corporation Ltd.
5. Sheela, V.L. (2011). *Horticulture*. Chennai: MJP Publishers.

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

Sub. Code: BC1734

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.

Self Learning Course (III /IV)

Plant Resource Utilization

Sub. Code: BC17S1

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.

Semester - IV

Major Core – IV Plant Ecology and Phytogeography

Sub. Code: BC1741

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: BC1742

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

UNIT IV

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: BC1743

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, Flavourimprovers. 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*. (3rd ed.) 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: BC1744

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 - IV

Major Practical Paper - IV

Plant Ecology and Phytogeography

Sub Code: BC17P4

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 addressed	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 - V
Major - Elective - III (a) Horticulture and Plant Breeding

Sub. Code: BC1754

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
5	5	75	100

- Objectives:**
1. To learn the different techniques of vegetative propagation through hands-on training
 2. To understand different branches of horticulture, horticultural management and their application.
 3. To familiarize plant breeding techniques and crop improvements

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	understand the scope of horticulture	PSO - 1	U
CO - 2	develop creative skills for establishment of an orchard	PSO - 5	C
CO - 3	explain the propagation methods by seeds, cuttings, grafting, budding and layering	PSO - 5	U
CO - 4	apply the knowledge of horticultural techniques to develop ornamental gardens	PSO - 5	Ap
CO - 5	recall the special techniques in plant breeding	PSO - 3	R
CO - 6	analyze the employability skills in the field of horticulture	PSO - 5	An

UNIT I

Scope of Horticulture. Propagation methods: Vegetative - advantages and disadvantages.

Cuttage- root, stem and leaf

Layerage - simple, compound and air layering

Graftage - approach, tongue and cleft.

Budding- T-budding and patch budding.

Vegetative propagules - tubers, suckers, bulbs and corm.

UNIT II

Propagation by seeds - Advantages and disadvantages, raising nurseries, aftercare and transplantation.

Pomology - establishment of an orchard – planning, layout, planting and cultivation of Banana and Mango.

Special techniques – ringing, notching, smudging, de-blossoming, thinning and pruning.

UNIT III

Olericulture - importance and objectives of vegetable culture. Kitchen garden - site, layout and choice of plants.

Vegetable cultivation - Brinjal and Tomato.

Plantation crops - Tea, Cardamom, Pepper and Cloves.

UNIT IV

Floriculture: Principles and components of ornamental garden - Layout of lawns, topiary, pergolas and hedges. Rockery, bonsai, water garden and indoor hanging basket. Commercial floriculture with reference to Jasmine and Rose.

UNIT V

Plant breeding: definition, scope and objectives. Introduction, Methods of selection – pure line, mass and back cross methods. Hybridization techniques - F₁ seeds. Role of polyploids in crop improvement.

Text Books:

1. Kumar, N. (1997). *Introduction to Horticulture*. Nagercoil: Rajalakshmi Pub.
2. Sharma, J.R. (1994). *Principles and Practice of Plant Breeding*. New Delhi: Tata McGraw-Hill Publishing Company Ltd.

Reference Books:

1. Michael J. McGroarty. (2007). *Easy Plant Propagation*. U.K.: Author House.
2. Manibhushan Rao, K. (2003). *Text book of Horticulture*. New Delhi: Macmillan India Ltd.
3. Chadha, K.L. (2003). *Hand book of Horticulture*. New Delhi: ICAR publication.
4. Sheela, V.L. (2011). *Horticulture*. Chennai: M.J Publishers.
5. Robert. W. Allard (1999). *Principles of Plant Breeding*. New York: Wiley & Sons Inc.
6. Singh B.D. (1994). *Plant Breeding*. New Delhi: Kalyani Publishers.

Semester - V
Major - Elective - III (b) Forestry
Sub. Code: BC1755

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
5	5	75	100

- Objectives:** 1. To enable the students to have a broad knowledge about the forest and forest products.
2. To impart the role of agroforestry in forest protection and management.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	list the different agroforestry technologies and identify ways to classify them into relevant groups	PSO - 4	R
CO - 2	review the types and distribution of forest with reference to India	PSO - 4	U
CO - 3	apply forest management principles and practice them in land management	PSO - 4	Ap
CO - 4	analyze recreational forestry including Botanical gardens, Zoos, National Parks and Sanctuaries in recreation/conservation of wildlife	PSO - 5	An
CO - 5	recognize the valuable forest products and the methods of conservation	PSO - 4	U
CO - 6	report the possible man - made calamities of the forest	PSO - 8	U

UNIT I

Importance of forest– utility and values of forests: Commercial benefits, ecological benefits and aesthetic benefits. Forest as a balanced ecosystem; Types and distribution of forest with reference to India and Tamilnadu (Champion and Seth’s classification).

UNIT II

Forest management and conservation - Regeneration - Tending operations - Sustainable utilization of forest resources - Forest organizations. Role of remote sensing in forest management. Eco tourism.

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.

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. Social forestry.

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.

Text Book:

1. Anandan Kumaravelan, R (2005). *Environmental Science and Engineering*. Chennai: Seitech publication (India) Pvt. Ltd.

Reference Books:

1. Kasturi Reddy(2010). *Biodiversity and Land Conservation*. New Delhi: Pacific publication.
2. Rana, S.V.S. (2009). *Essential of Ecology and Environmental Science*. (4th ed.). New Delhi: PHI learning Pvt. Ltd.
3. Rao, M. K. (2011). *Environmental and Climate Change*, NewDelhi: Manglam publications.
4. Shukla, R.S. and Chandel, P.S. (2006). *A Text Book of Plant Ecology*. New Delhi: S. Chand and Co.
5. Trivedi, P.R. and.Gurdeep Raj. (2002). *Environmental Ecology*, New Delhi: Akashdeep Publishing House.

Skill Based Course

Floriculture

Sub. Code: BSK175

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

- Objectives:** 1. Learn the different types of floriculture.
2. Develop flower garden around the home and office to reduce of stress related depression of the livelihood

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	Understand the importance of the features of garden	PSO - 4	R
CO - 2	apply the acquired knowledge and practical skill in developing ornamental garden	PSO - 5	Ap
CO - 3	understand the process of plant growth	PSO - 1	R
CO - 4	recall the methods of harvesting, packing and marketing of cut flowers	PSO - 5	R
CO - 5	create aesthetic arrangement of dry flower decoration	PSO - 5	C
CO - 6	prepare the students for a job in plant nursery or commercial grower or floral whole sale	PSO - 5	C

UNIT I

Introduction: Importance and scope of floriculture - pluck flowers – cultivation of *Chrysanthemum*, *Polyanthus*, Jasmine, Rose and *Gomphrena*.

UNIT II

Soil sterilization: Seed sowing – Pricking - Planting and transplanting - Shading - Stopping or pinching – Defoliation – Wintering- Mulching - Topiary.

UNIT III

Cultivation of plants in pots; Indoor gardening- Bonsai. Cultivation of *Anthurium* and Orchids.

UNIT IV

Features of a garden: Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden.

UNIT V

Flower arrangement: General Principles of flower arrangement - Western and Japanese style- Dry flower decorations.

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.J. Publishers.
5. Hartman H.T and Kester. D.E. (1976). *Plant Propagation Principles and Practices*. New Delhi: Prentice Hall of India.

Semester - VI

Major Core VIII - Genetics, Biostatistics and Bioinformatics

Sub. Code: BC1761

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

- Objectives:** 1. To inculcate the genetic inheritance patterns using Mendelian principles .
2. To generate logical interpretations and conclusions from graphs, models, and data of scientific research

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	apply Mendelian principle and predict genetic inheritance patterns	PSO - 6	U
CO - 2	analyze the scientific evidence for the origin of life	PSO - 7	Ap
CO - 3	get an insight of chromosome abnormalities and related human syndromes	PSO - 3	U
CO - 4	generate biological interpretations and conclusions from data of scientific research	PSO - 9	C
CO - 5	develop skills to become employable as professionals in Biochemical Industries	PSO - 5	C

UNIT I

Mendel's laws of heredity with reference to monohybrid and dihybrid crosses. Gene interactions - complementary genes (flower colour in sweet Pea). Supplementary genes – inheritance (Comb shapes in fowls), Epistasis – Dominant Epistasis (12:3:1), Recessive Epistasis (9:3:4), Lethal genes (Dominant Coat colour in Mice, Recessive – Chlorophyll content in Maize). Incomplete dominance (*Mirabilis jalapa*), and Codominance (Coat colour in cattle).

UNIT II

Sex Linkage inheritance (eye colour in *Drosophila*) Polygenic inheritance with reference to (ear length in maize), Multiple alleles with reference to (ABO blood group in man), Rh factor. Non Mendelian inheritance cytoplasmic, shell coiling in snails. Morgon's views on linkage, crossing over – types, mechanism of crossing over and its significance, Holiday model.

UNIT III

Cell division (mitosis and meiosis), DNA as the genetic material, double helical DNA structure, semi conservative method of replication of DNA. Mutation types - Chromosomal aberrations- addition, deletion, translocation, inversion, polyploidy. Types of point mutations, mutagenic agents - physical and chemical. Chromosomal abnormality- Down Syndrome and Klinefelter Syndrome.

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: KalailatheerAchagam.

Reference:

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 edition
India: John Wiley & sons.
3. Snustad, D.P. and Simmons, M.J.(2010). *Principles of Genetics*. (5th ed).
India: John Wiley & Sons Inc.
4. Klug, W.S. Cummings, M.R., Spencer, C.A. (2009). *Concepts of Genetics*. (9th ed.).U.S.A: Benjamin Cummings Publishers
5. 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.
6. Gurumani, N. (2005). *An Introduction to Biostatistics*. (2nd ed.). Chennai: MJP Publishers.
7. Prasad S. (1990). *Elements of Biostatistics*. Meerut: Rastogi Publications.

Semester - VI

Major Core IX - Biotechnology and Molecular Biology

Sub. Code: BC1762

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

- Objectives:** 1. To learn and apply the general principles of biotechnology and ensure adequate training in modern biotechnology.
2. To evaluate and use biological information effectively, ethically, and legally.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	acquaint with the fundamental principles of biotechnology	PSO - 1	U
CO - 2	familiarize with the laboratory requirements for plant tissue culture	PSO - 3	Ap
CO - 3	<i>understand</i> the impact of technology upon society and <i>utilizing</i> with social conscience	PSO - 8	U
CO - 4	explain the mechanisms of genetic information	PSO - 8	An
CO - 5	apply the skill of Biotechnological concepts, to solve problems related to Biotechnology	PSO - 2	Ap
CO - 6	become employable in Biotech laboratories	PSO - 5	C

UNIT I

Definition and scope of biotechnology. Introduction to genetic engineering-Principles of recombinant DNA technology, gene cloning, cloning vectors-plasmids, cosmids, binary and shuttle vectors, restriction enzymes –exonucleases, endonucleases: type I, II and III. and Ligases. Gene transfer methods- Fragmentation, Microinjection, Shot Gun Method.

UNIT II

Scope and importance, laboratory requirements for plant tissue culture, Sterilization techniques
Culture media preparation (M.S. Medium). Concept of totipotency – differentiation, de-
differentiation and redifferentiation. Explants- culture of explants, callus induction and
maintenance, callus sub culture on a fresh nutrient medium, Organogenesis

UNIT III

Protoplast culture-Isolation and purification, culture and regeneration, uses of cultured
protoplasts. Somatic hybridization- methods, production of Hybrids and Cybrids.

Production of haploid plants – Anther culture and Pollen culture. Production of somatic
embryos.

GM crops (Bt – Cotton and Golden rice)

Transgenic plants- merits and demerits; Cryopreservation, Brief knowledge on IPR

UNIT IV

DNA Replication in prokaryotes and transcription in prokaryotes, Protein Synthesis- Translation,
post translation processing, inhibitors of protein synthesis

UNIT V

Characteristic of Genetic Code, Codons, anticodons. Degeneracy of codons, Wobble hypothesis.
Gene regulation in Prokaryotes- Lac Operon. Gene Mutation- Molecular mechanism, Mutagens,
DNA Repair mechanisms.

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.

Semester - VI

Elective –IV (a) Marine Botany

Sub. Code: BC1764

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
5	4	75	100

Objectives: 1. Understand the different adaptations (morphological, physical, conduct) of living beings in the marine environment.

2. Recognize the marine pollution and conservation methods

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	describe the relationship between organisms and environment	PSO - 4	U
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 - 1	E
CO - 4	create a broad knowledge about the economic importance marine biodiversity	PSO - 7	C
CO - 5	recognize the marine pollution and conservation methods	PSO - 9	U
CO - 6	describe the classification of marine habitat	PSO - 6	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. Oceanography: Marine environment - physical and chemical properties of sea water.

UNIT II

Marine biodiversity – phytoplankton, Zooplankton, marine bacteria, marine fungi, seaweeds and sea grasses. Threats and conservation of seaweeds and sea grasses.

UNIT III

Marine products: traditional uses - human food and agriculture. Marine colloids and hydrocolloids – Agar–agar, algin, alginates, carrageenan, diatomite. Marine bioactive compounds from mangroves, seaweeds and seagrasses.

UNIT IV

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

UNIT V

Mangroves – present status and 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:

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

Semester - VI

Elective –IV (b) Organic Farming

Sub. Code: BC1765

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
5	4	60	100

- Objectives:** 1.To sensitize the need and generating knowledge and skill on various organic farming practices
2. To carry out organic agricultural farming and retailing it.

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	understand the legacy of organic farming	PSO - 8	U
CO – 2	apply the knowledge on organic pest management	PSO - 1	Ap
CO – 3	analyze different sources of organic manures	PSO - 3	An
CO - 4	recall different types of farming and its benefits	PSO - 5	R
CO - 5	evaluate the land for organic farming	PSO - 5	E
CO - 6	create an awareness on organic farming and its certification	PSO - 2	C

UNIT I

Organic Farming- Introduction, A legacy of damaged soils. Retail chemicals farming made cheap and easy. Contamination of food products by pesticides and chemicals. Threat to biodiversity. Present status of organic farming in India

UNIT II

Soil: Assessment of soil, Fertility of soil, Importance of organic matter, Water retentivity and aeration of soil, Soil pH, Soil reclamation.

UNIT III

Balanced Nutrient Supply- Sources of nutrients for organic farming. FYM, Rural Compost, City Compost, Oil cakes, Animal waste, Bio-fertilizer and Vermicompost.

Nutrient content of the above source (data chart).

Green manure, Liquid manure (Panchagavya)

UNIT IV

Plants: Choosing the right crop for the environment, Best management practices for organic farming

Types of farming – Definition, Concepts and benefits – Pure Organic Farming, Integrated Organic system (Combination of organic and inorganic) and mixed farming

UNIT V

Pest management – Integrated pest and disease management. Organic pesticides, Bio-pesticides, Feasibility of complete dependence of organic sources.

Required management practices for organic farming certification

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.: CornwellPress
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

SEMESTER – VI

Major Elective I

Elective –IV (c) Ecotourism

Sub. Code: BC1766

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
5	4	75	100

- Objectives:**
1. To highlight the need for sustainable tourism
 2. 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 that tourism has on naturally beautiful environments	PSO – 4	R
CO - 2	explain that tourism does not exploit the natural environment or local communities.	PSO – 4	U
CO - 3	create environmental and cultural awareness and respect	PSO – 7	C
CO - 4	understand the type of tourism	PSO – 1	U
CO - 5	apply the environment as well as cultural matters in eco tourism	PSO – 3	Ap
CO - 6	evaluate research in tourism environment related areas	PSO – 4	E

UNIT I

Definition, introduction and scope. 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). Eco circuit of Western Ghats. Identification of nature based ecotourism. Maintenance of ecological centers.

UNIT III

Ecotourism opportunities - dam sites, waterfalls, mangroves, bird sanctuaries, pilgrim tourism, forest area, parks, sacred groves, beaches, wildlife sanctuaries and national parks.

UNIT IV

Impact of Ecotourism: Economical, 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

Infra structural facilities for ecotourism. Funding agencies- government and private. Legislations to be followed, 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*, Kaniskha Publishers, New Delhi.
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.

Environment Sustainability

Human Values

Professional Ethics

Indian Knowledge System

CBCS for PG Courses

Study Components	No. of Courses	Credit per Course	Total
Core Papers/ Project	13-18	4-5	67
Elective Papers	4	5	20
* Life Skill Training	2	1	2
* Summer Training Programme	1	1	1
Total			90

* Courses/ programmes conducted outside the regular working hours.

Note : Each P.G student has to undergo Summer Training Programme for a period of 60 hours during Summer Vacation.

DEPARTMENT OF BOTANY
With effect from the academic year 2017 – 2018

Aim

The course aims at providing knowledge about the basic concepts concerning various areas associated with the field of Botany with specialization in important applied areas.

Objectives

- 1 To enable the students to have a thorough understanding of the different branches of plant science and to grasp a comprehensive knowledge of Botany.
- 2 To develop the ability of students to think analytically and solve biological problems.
- 3 To help the students of Botany to apply the skills and knowledge gained through the subject to face competitive examinations with confidence.
- 4 To impart research and entrepreneurial skills to students.

Eligibility for Admission

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.

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 Major Programme

Paper	No. of Papers	Max. Marks / Paper	Total Marks
Core Theory (3+3+2+3)	11	100	1100
Core Practicals	4	100	400
Electives (Theory Papers)	4	100	400
Project	1	100	100
Total Marks			2000

Course Structure
Distribution of Hours and Credit

Course	Sem. I	Sem. II	Summer vacation	Sem. III	Sem. IV	Total	
						Hours	Credit
Core - Theory	6 (4) + 6 (4) + 6 (4)	6 (4) + 6 (4) + 6 (4)	-	6 (4) + 6 (4)	6 (4) + 6 (4) + 6 (4)	66	44
Core - Practical	6	6 (5+5)	-	4	6 (4+5)	22	19
Elective	6 (5)	6 (5)	-	6 (5)	6 (5)	24	20
Project	-	-	-	8 (4)	-	8	4
*Life Skill Training - I	-	(1)	-	-	-	-	1
*Life Skill Training - II	-	-	-	-	(1)	-	1
*Summer Training Programme	-	-	(1)	-	-	-	1
TOTAL	30 (17)	30 (28)	(1)	30 (17)	30 (27)	120	90

* Courses / Programmes conducted outside the regular working hours

Courses offered

Semester	Subject code	Title of the paper	Hours/week	Credit
I	PB1711	Core I - Plant Diversity I – Algae, Fungi, Lichens and Bryophytes	6	4
	PB1712	Core II – Microbiology, Immunology and Plant Pathology	6	4
	PB1713	Core III – Developmental Botany	6	4
	PB1714	Elective I – (a) Marine Biology / (b) Cell Biology	6	5
	PB17P1	Practical I - Plant Diversity I – Algae, Fungi, Lichens and Bryophytes, Microbiology, Immunology and Plant Pathology and Developmental Botany	6	-
II	PB1721	Core IV –Plant Diversity II - Pteridophyta, Gymnosperms and Palaeobotany	6	4
	PB1722	Core V – Research Methodology	6	4
	PB1723	Core VI – Biochemistry and Biophysics	6	4
	PB1724	Elective II – (a) Medicinal Botany and Pharmacognosy / (b) Medicinal Plants and Ethnobotany	6	5
	PB17P1	Practical I - Plant Diversity I – Algae, Fungi, Lichens and Bryophytes, Microbiology, Immunology and Plant Pathology and Developmental Botany	-	5
	PB17P2	Practical II - Plant Diversity II- Pteridophyta, Gymnosperms and Palaeobotany, Research Methodology and Biochemistry and Biophysics	6	5
	LST172	Life Skill Training (LST) – I	-	1
III	PB1731	Core VII - Taxonomy of Angiosperms and Economic Botany	6	4
	PB1732	Core VIII – Genetics and Molecular Biology	6	4
	PB1733	Elective III – (a) Forestry / (b) Horticulture and Plant Breeding	6	5
	PB17P3	Practical III - Taxonomy of Angiosperms and Economic Botany, Genetics and Molecular Biology.	4	-

	PB17PR	Project	8	4
IV	PB1741	Core IX - Plant Physiology and Metabolism	6	4
	PB1742	Core X – Environment and Conservation Biology	6	4
	PB1743	Core XI – Applied Biotechnology	6	4
	PB1744	Elective IV – (a) Industrial Microbiology (b) Biostatistics and Bioinformatics	6	5
	PB17P3	Practical III - Taxonomy of Angiosperms and Economic Botany, Genetics and Molecular Biology.	-	4
	PB17P4	Practical IV - Plant Physiology and Metabolism, Environment and Conservation Biology and Applied Biotechnology	6	5
	LST174	Life Skill Training (LST) – II	-	1
	STP171	Summer Training Programme	-	1
		TOTAL	120	90

Practical examination and Project Viva will be conducted only in even semesters.

Self Learning – Extra Credit Course

Semester	Subject code	Title of the paper	Hours/ week	Credit
III	PB17S1	Biology for Competitive Exam - I	-	2
IV	PB17S2	Biology for Competitive Exam - II	-	2

Guidelines for Project

The objective of the project is to motivate the students for doing research and to inculcate in them self confidence, team spirit and creativity. The project will be done by a group of two students and if needed 3 students in case of odd number.

Project:

Report : 80 (Internal – 40 marks & External – 40 marks)

Viva : 20 (External only)

Instruction for Course Transaction

Theory (Major Core / Elective) paper hours

Components	Sem. I	Sem. II	Sem. III	Sem. IV
Lecture hours	75	75	75	75
Group Discussion /	5	5	5	5

Tutorial				
CIA (Test, Quiz)	5	5	5	5
Seminar	5	5	5	5
Total hours / semester	90	90	90	90

Examination Pattern

Ratio of Internal & External – 30 : 70

Internal Components and distribution of marks

Test	- 20 marks
Seminar	- 5 marks
Assignment	- 2.5 marks
Quiz	- 2.5 marks

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 6x1 (No Choice)	6	Part A 10x1 (No Choice)	10
Part B 2x4 (Internal Choice)	8	Part B 5x4 (Internal Choice)	20
Part C 2x8 (Internal Choice)	16	Part C 5x8 (Internal Choice)	40
Total	30	Total	70

(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).

Semester I
Plant Diversity I - Algae, Fungi, Lichens and Bryophytes
Sub. Code: PB1711

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

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, Phaeophyta, 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, Immunology and Plant Pathology
Sub. Code: PB1712

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

Unit I

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 cancer, White rust disease, Blast of rice, Red rot of Sugercane, 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
Developmental Botany
Sub. Code: PB1713

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

Objectives:

1. To understand basic concepts of modern developmental biology.
2. To know the importance of Apomixes and Plant breeding.
3. To imbibe knowledge regarding the secret of seed development.

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-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: PB1714

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

Objectives:

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.

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 micro algae – 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
Cell Biology (Elective I)
Sub. Code: PB1714

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

Objectives:

1. To enable the students to have a broad knowledge on cell biology.
2. To understand the working principle of modern equipments.

Unit 1

Introduction - The cell theory, Origin and development of cell biology as a separate branch; Structure and organization of prokaryotic and eukaryotic cells; Specialized cell types; Plasma membrane - Structure, models and functions of plasma membrane, ATPases, Receptors, Carriers, Channels and Pumps; Vacuole structure and function, Vacuolar ATPases, Transporters.

Unit II

Cytoskeleton - Microtubules and Microfilaments, their role in cell division and motility ; Intermediate filaments- role in providing strength; Chemical foundation - Macromolecules - Structure, shape and information, Noncovalent interactions in relation to function of nucleic acids and proteins; Biochemical energetic - Types of energy- thermal, electrical and radiant energy; Interconvertability of energy; Laws of thermodynamics as applicable to biological systems.

Unit III

Chloroplast and Mitochondria - Structure and function, genome organization; Nucleocytoplasmic interactions; RNA editing; Other organelles - Structure and functions of endoplasmic reticulum, golgi apparatus, lysosomes, functions of microbodies and peroxisomes.

Unit IV

Cell wall - Structure and functions, Cell wall architecture, Biogenesis and Growth; Plasmodesmata structure and function; Plasmodesmata in comparison with gap junctions of animal cells.

Unit V

Tools in cell Biology - Microscopy: Working principles of Light microscopy, Scanning electron microscopy, Transmission electron microscopy; Preparation of specimens for Microscopy: Freeze fracture and Freeze etching techniques; Subcellular fractionation - Principles of centrifugation. Spectroscopic techniques - principles and applications of UV-visible, ESR, Nuclear magnetic resonance, Spectrofluorimetry, Circular dichroism (CD).

Reference Books:

1. Alberts, B., Bray, D., Lewis, J., Ralf Roberts, K., & Watson, J.D. (1999). *Molecular Biology of the Cell*. New York, NY: Garland Publishing Inc.
2. Avers, C.J. (1986). *Molecular Cell Biology*. New York, NY: Addison Wesley Publishing Company.
3. De, D.N. (2000). *Plant Cell Vacuoles: An Introduction*. Australia: CSIR Publication, Collingwood.
4. Kleinmith, L.J., & Kish, V.M. (1995). *Principles of Cell and Molecular Biology* (2nd ed.). New York, NY: Harper Collins College Publishes.
5. Krishna Murthy, K.V. (2000). *Methods in Cell Wall Cytochemistry*. Florida: CPC Press, Boca Raton.
6. Lodish., Berk, A., Zipursky, S.L., Matsdaira, P., Baltimore, D., & Darnell, J., (2000). *Molecular Cell Biology* (4th ed.). New York, NY: W.H. Freeman and Co.

Semester II
Plant Diversity II - Pteridophyta, Gymnosperms and Paleobotany
Sub. Code: PB1721

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

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
Biochemistry and Biophysics
Sub. Code: PB1723

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

Unit I

Introduction - Biological processes – Carbohydrates - structure and properties of Monosaccharides - ring structure – Oligosaccharides - sucrose and maltose, Polysaccharides - starch, cellulose, pectin and agar - Glycosidic linkage formation.

Unit II

Structure and properties of amino acids and proteins - classification - Peptide bond formation - Biologically important peptides - Denaturation and renaturation of proteins - purification of proteins.

Unit III

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 IV

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

Unit V

Properties of light - Different components of Electromagnetic radiation. Emission – Excitation - Fluorescence and Phosphorescence – Action and absorption spectrum- Bioluminescence. Laws of Thermodynamics, Concept of free energy, Redox potential, Coupling of chemical reactions. High energy compounds in biology - significance.

Reference Books:

1. Lehninger. (2008). *Principles of Biochemistry*. Delhi: CBS publishers and distributors.
2. Conn and Stumpf . (2009). *Outlines of Biochemistry* (5th ed.). New York, NY: John Wiley & Sons.
3. Pamela, C., Champe., Richard A. Harvey., Lippincott's Williams., & Wilkins. (1994). *Lippincott's Illustrated Reviews: Biochemistry* (2nd ed.). A Wolters Kluwer Company.
4. Thomas M. Devlin., WILEY – LISS. (2002). *Text book of Biochemistry with Clinical Correlations* (5th ed.). John Wiley & Sons, Inc. Publications.
5. Alexander, J., Ninfa and David P., Ballou. (1998). *Fundamental Laboratory Approaches for Biochemistry and Biotechnology*. Maryland: Fitzgerald Science Press, Inc. Bethesda.
6. Jeremy, M., Berg., John L. Tymoczko., & Lubret Stryer. (2002). *Biochemistry* (5th ed.). New York, NY:Freeman and Compay.
7. Robert K. Murray., Daryl K. Granner., Peter A. Mayes., & Victor W. Rodwell. (2003). *Harper's Illustrated Biochemistry* (26th ed.). New Delhi: McGraw Hill.
8. Mahesh., S. (2003). *Biotechnology, Molecular Biology and Biophysics*. New Delhi: New Age International publishers.
9. Jain., Sunjay Jain., & Nitin Jain. (2012). *Fundamentals of Biochemistry*, New Delhi: S. Chand and Company Pvt Ltd.
10. David Rawn, N. (1989). *Biochemistry*. The University of Michigan: Patterson Publishers.

Semester II
Medicinal Botany and Pharmacognosy (Elective II)
Sub. Code: PB1724

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

Objectives:

1. To study different medicinal systems.
2. To learn the important medicinal plants.

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*, *Zingiber*, *Catharanthus roseus*, *Phyllanthus amarus*, *Embllica* and *Azadirachta*.

Unit III

Methods of extraction of oil in the following plants – Eucalyptus, Cymbopogan, Rose and Santalum. Extraction procedures for active principles – Withaonalides, Hyocyamine, 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
Medicinal Plants and Ethnobotany (Elective II)
Sub. Code: PB1724

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

Objectives:

1. To learn the different systems of indigenous medicines.
2. To know about Phytopharmaceuticals, and patenting principles.

Unit 1

Ethnobotany - Introduction, concept, scope and objectives; Ethnic groups and Ethnobotany; Major and minor ethnic groups of Kanyakumari and their life styles; Forest Vs. Ethnic groups; Methodology of Ethnobotanical studies - (a) Field work (b) Herbarium (c) Ancient Literature (d) Archaeological findings (e) Temples and sacred places (f) Protocols.

Unit II

Plants and Tribal medicine: Significance of the following plants in Ethno-medical practices (along with a brief note on their habitat and morphology) - (a) *Curculigo orchoides* (b) *Costus speciosus* (c) *Gloriosa superba* (d) *Butea monosperma* (e) *Wrightia tinctoria* (f) *Pongamia pinnata*; Medico-ethnobotanical research in Kanyakumari District.

Unit III

Different systems of indigenous medicine (Traditional medicine, Ayurveda, Siddha, Unani), Homeopathy and Allopathy, Role of Phytomedicine in modern systems of medicine; Classification of drugs; analytical methods – drug adulteration, drug evaluation, anatomical and phytochemical analysis of crude drugs.

Unit IV

Phytopharmaceuticals - Drugs of alkaloids, coumarins, volatile oils, tannins, resins and gums; Natural pesticides, antibiotics, allergens and poisonous plants; Economic potential of phytomedicine; potential drug yielding plants and their marketing avenues.

Unit V

Preliminary screening, fractionation and separation of different groups of biodynamic compounds and biological evaluation; IPR and patenting of active principles.

Reference Books:

1. Cotton, C.M. (1997). *Ethnobotany, Principles and Applications*. New Delhi: John Wiley and sons.
2. Faulks, P.J. (1958). *An introduction to Ethnobotany*. London: Moredale Pub. Ltd.
3. Jain, S.K. (1990). *Contributions of Indian Ethnobotany*. Jodhpur: Scientific publishers.
4. Jain, S.K. (1981). *Glimpses of Indian Ethnobotany*. New Delhi: Oxford and I B.H. Jain, S.K. (1995). *Manual of Ethnobotany*. Jodhpur: Scientific Publishers.
5. Jain, S.K. (1989). *Methods and Approaches in Ethnobotany*. India: Society of Ethnobotanists, Lucknow.
6. Kokate, C.K., Purohit, A.P., & Gokhale, S.P. (2000). *Pharmacognosy*. Chennai: Nirali Prakasan Publishing Company.
7. Martin, G.J. (1996). *Ethnobotany, A Methods Manual*. London: Chapman and Hall.
8. Rama Rao, N., & Henry, A.N. (1996). *The Ethnobotany of Eastern Ghats in Andhra Pradesh*, India: Howrah, Botanical Survey of India.
9. Trease, G.E., & Evans, W.C. (2005). *Pharmacognosy*. New York, NY: Saunders Publishing Pvt. Ltd.
- 10.

Semester I
Practical I
Sub. Code: PB17P1
(Plant Diversity I – Algae, Fungi and Bryophytes;
Microbiology, Immunology and Plant Pathology; Developmental Botany)
(To be conducted during Semester – II)

Number of hours per week	Credit	Total number of hours	Marks
6	5	90	100

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

Aspergillss, 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.

Developmental Botany

1. Study on ovary, ovules and their modifications.
2. Organization of anthers and pollens, pollen wall patterns, pollen germination and pollen tube growth.

Semester II
Practical II
Sub. Code: PB17P2
(Plant Diversity – II - Pteridophyta, Gymnosperms and Paleobotany; Research
Methodology and Biochemistry and Biophysics)

Number of hours per week	Credit	Total number of hours	Marks
6	5	90	100

Pteridophyta:

Micro preparation 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. Microtome
3. Photomicrography
4. Gel moulding in Agarose gel electrophoresis.
5. Visiting different laboratories and report submission.

Biochemistry and Biophysics

1. Determination of pKa value of acetic acid
2. Determination of isoelectric point of amino acid
3. Estimation of protein
4. Estimation of free amino acid
5. Separation and determination of Rf value of amino acid.
6. Separation of photosynthetic pigments
7. Determination of saponification value of oil
8. Determination of Km value – Nitrate reductase
9. Qualitative analysis of secondary metabolites
10. Estimation of iodine value in any two vegetable oils

Semester - III
Core VII - Taxonomy of Angiosperms and Economic Botany
Sub. Code: PB1731

Number of hours per week	Number of credits	Total number of hours	Marks
6	4	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.

Unit I

Aim and scope of plant taxonomy – Systems of angiosperm classification; Linnaeus, Bentham and Hooker and Engler and Prantle; Merits and demerits of these classification; 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.

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; Numerical taxonomy – principles, character coding, measurement of resemblance-cluster analysis, current trends in biosystematics; Cladistics – phylogenetic approach of classification, species concept; Molecular markers as taxonomic tools – RAPD, RFLP, AFLP, ISSR.

Unit III

Objectives and importance of systematic botany; Systematic position, salient features, distribution, description and economic importance of Capparidaceae, Polygalaceae, Caryophyllaceae, Tiliaceae, Zygophyllaceae.

Unit IV

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

Unit V

Systematic position, salient 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. Sivarajan 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
Core VIII – Genetics and Molecular Biology
Sub. Code: PB1732

Number of hours per week	Number of credits	Total number of hours	Marks
6	4	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.

UNIT I

Contribution of Johann Gregor 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; Mutation – Types of mutation, Detection of mutation.

UNIT II

DNA- types (A, B, C & Z), Watson and Crick model of DNA, viral DNA, bacterial DNA, Mitochondrial and Chloroplast DNA; Dissociation and re-association kinetics of DNA; cot value and its significance; DNA replication of prokaryotes and eukaryotes; Genetic diseases – Sickle cell anemia, Cystic fibrosis, Duchennes muscular dystrophy.

UNIT III

Damage and DNA repair mechanism – photo reactivation – excision repair - mismatch repair; Genetic recombination - generalised and site specific; Lysogenic and lytic cycle; Bacterial Transformation ,Transduction and Conjugation; Cloning vectors- plasmids, cosmids, phages, plasmids – characters of plasmids, types, copy number; pBR322, pUC9, MI3, BAC,YAC, shuttle vectors, advantages of cloning vectors.

UNIT -IV

RNA – types; Transcription - Initiation, elongation, termination, post transcriptional events; Genetic code, Wobble hypothesis; Translation – steps in translation; Molecular tools for studying genes – Autoradiography, Liquid Scintillation counting, Phosphorimaging.

UNIT -V

Fine structure of the gene; Transposons – Tn3, Tn5; Operon concept – lac operon, trp operon, Steps in gene cloning; 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. Pastan. (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
Forestry (Elective III)
Sub. Code: PB1733

Number of hours per week	Number of credits	Total number of hours	Marks
6	5	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.

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
Horticulture and Plant Breeding (Elective III)
Sub. Code: PB1733

Number of hours per week	Number of credits	Total number of hours	Marks
6	5	90	100

Objectives

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

Unit I

Introduction – divisions of horticulture – propagation of horticultural crops- seed propagation. Seed storage – germination – characteristics of good seeds – pure seeds and seed treatment. Asexual propagation – advantages and disadvantages. Methods – cuttings, layering, grafting, and tissue culture.

Unit II

Fruit culture: Orchard cultivation – establishment of orchard – location and site selection planning – layout – planting methods – clean culture, cover crops, intercrops. Cropping and fruit set – unfruitfulness – causes and prevention – harvest – marketing and storage of fruits. Special techniques – ringing, notching, smudging, deblossoming, thinning, trimming and pruning. Vegetable culture – growing of vegetables and greens. Kitchen garden – site, layout and choice of plants.

Unit III

Importance and principles of ornamental garden making – layout and components of ornamental gardening. Lawns, topiary and pergolas. Indoor gardening and care of indoor plants. Floriculture, cultivation of commercial and cut flowers (Rose, Gerbera, Gladiolus, Anthurium, Carnation)

Unit IV

Plant breeding – objectives, methods of crop improvement, simple and honored methods of selection, hybridization, gene recombination, success and failure, methods of hybridization (pedigree and back cross); genetic basis of heterosis and production of hybrid seeds. plant Introduction and acclimatization; mutation breeding – types and mode of mutagens, mutagen treatment and selection of mutants, introduction of mutation through tissue culture, significance of induced mutation in breeding, breeding for resistance to disease and insect pest.

Unit V

Plant breeders' rights – methods of multiplication of seed, seed certification, labeling, legislation intellectual property right in relation to crop plants (both agricultural and horticultural plants). Molecular approaches to crop improvement – gene cloning, molecular markers, application of markers in breeding. Breeding on rice, cotton, and sugar cane.

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.

Semester - IV
Plant Physiology and Metabolism
Sub. Code: PB1741

Number of hours per week	Number of credits	Total number of hours	Marks
6	4	90	100

Objectives

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

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
Environment and Conservation Biology
Sub. Code: PB1742

Number of hours per week	Number of credits	Total number of hours	Marks
6	4	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.

Unit I

Habitat Ecology - Freshwater and Marine water ecology (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; Applications of ecology.

UNIT II

Structure of Ecosystem; Productivity of ecosystem; Food chains in ecosystem; Ecological Pyramids; Energy flow in ecosystem; Biogeochemical cycle – Water cycle, Gaseous 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
Applied Biotechnology
Sub. Code: PB1743

Number of hours per week	Number of credits	Total number of hours	Marks
6	4	90	100

Objectives

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

Unit I

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; MS media composition and preparation of 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; Batch culture; Continuous culture; Fed batch culture; Immobilization of enzymes; Production of ethanol, acetic acid, citric acid, Penicillin and Vitamin B₁₂.

Unit IV

Biosensors – Principle, types and applications; Biochips; Biosafety – possible dangers of GEOs; biosafety guidelines; physical and biological containments; Intellectual property rights; Process of patenting application; Farmer’s Rights and plant breeder’s Rights.

Unit V

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.

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
Industrial Microbiology (Elective IV)
Sub. Code: PB1744

Number of hours per week	Number of credits	Total number of hours	Marks
6	5	90	100

Objectives

1. To know the relevance of microorganisms in the production of some useful human products.
2. To enhance the ability of students to culture and genetically manipulate microorganisms of industrial importance.

Unit I

Screening and Production medium – Introduction, history and development of industrial microbiology, scope of industrial microbiology; Screening techniques – Primary screening and Secondary screening; Strain development; Preservation of microorganisms; Characteristics of an ideal production medium; Raw materials used in fermentation medium.

Unit II

Fermentation Process – Basic structure of a fermentor; Batch culture; Continuous culture; Semi continuous culture; Fed batch culture; Growth kinetics of microorganisms; Classification of fermentation process; Sterilization of equipment, media and air.

Unit III

Types of fermentor – Bubble column reactor, Airlift fermentor, Fluidized bed reactor, Tower fermentor; Immobilization – Methods of immobilization, Different types of immobilized enzyme reactors; Solid – Liquid separation methods; Liquid – liquid extraction; Physical, Chemical and enzymatic methods of cell disruption.

Unit IV

Microbial production of food – Production of single cell protein (SCP); Production of Bakers yeast; Production of bread, Production of wine; Production of beer; Production of whisky, Production of sauerkraut; Preparation of cheese.

Unit V

Production of useful products – Antibiotics – Penicillin, Streptomycin; Organic acids - Citric acid, Acetic acid; Enzyme - Amylase enzyme; Solvents - Ethyl alcohol; Amino acid - Glutamic acid; Vitamin – Vitamin B₁₂.

Reference Books:

1. Patel, A.H. (1999). *Industrial Microbiology*. New Delhi: Macmillan India Ltd.
2. Pelczar, M.H. and Cahn, E.C.S. (1993). *Microbiology*. New Delhi :Tata-McGraw Hill Publishing Co. Ltd.
3. Power and Dagainawala (1994). *General Microbiology*. New Delhi :Himalayan Publishing House.
4. Ringo, J. (2004). *Fundamental Genetics*.United Kingdom : Cambridge University Press.
5. Salle, A.J. (1974). *Fundamental Principles of Bacteriology*. New Delhi :Tata-McGraw Hill Publishing Co. Ltd.
6. Schlegel, H.G. (1993). *General Microbiology (7th Edition)*.United Kingdom: Cambridge University Press.
7. Starr, M.P. (1981). *The Prokaryotes: A Handbook on Habitat, Isolation and Identification of Bacteria, Vols. I & II*. Berlin : Springer Verlag.
8. Trevan, M.D. (1987). *Biotechnology: The Biological Principles* New Delhi :Tata-McGraw Hill Publishing Co. Ltd.
9. Trevan, K. (1991). *Biotechnology*.New Delhi: Wiley Eastern Ltd.

Semester - III
Practical III
Sub. Code: PB17P3

(Taxonomy of Angiosperms and Economic Botany, Genetics and Molecular Biology)

Number of hours per week	Number of credits	Total number of hours	Marks
4	4	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.

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 - IV
Practical IV
Sub. Code: PB17P4
(Plant Physiology and Metabolism, Environment and Conservation Biology and Applied Biotechnology)

Number of hours per week	Number of credits	Total number of hours	Marks
6	5	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.

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)

Environment and Conservation Biology:

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).

Applied Biotechnology:

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
Sub. Code: PB17S2
Biology for competitive exam – II

Objectives

1. To have a brief knowledge on different areas of botany.
2. To motivate the students to write competitive examinations.

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.
6. Noggle, G.R and Fritz G.J. (2002). *Introductory Plant Physiology*. New Delhi: Prentice Hall India.
7. Sharma A.K. (2005). *Text Book of Biostatistics*. New Delhi: Discovery Publishing House.

Value Added Courses

S. No	Name of the course	Total hours	Credit
I	Mushroom Culture Technology	30	1
II	Hydroponics	30	1

1. Value added course I (Mushroom Culture Technology)

This course will help the students to empower with entrepreneurial skills through the production and sale of mushroom.

2. Value added course II (Hydroponics)

Hydroponics is a method of growing plants without soil, using mineral nutrient solutions in a water solvent. This course will provide exposure to the latest technological developments.

Value Added Course Mushroom Culture Technology

Credit	Hours
1	30

Objectives

1. To learn the techniques of mushroom culture.
2. To provide self-employment opportunity.

Unit I

Introduction, history, morphology, types and life cycle of mushrooms. Identification of edible mushroom. Nutritional and medicinal value of edible mushrooms.

Unit II

Cultivation of mushroom – Oyster mushroom (*Pleurotus* sp.) Button mushroom (*Agaricus bisporus*) Paddy Straw Mushroom (*Volvariella* sp.). Isolation, Spawn Production, Substrate for mushroom cultivation. Spawn running and harvesting.

Unit III

Post harvest technology of mushroom, protection of mushroom from insect pest, nematodes, mites, viruses, fungal competitors and other diseases

Unit IV

Spawn Production technique – Microbiological technique, mother spawn and commercial spawn.

Unit V

Few recipes, value added Products, packing techniques, marketing in India and abroad, Commercial production – model unit, Banking, Government, Help-Line.

Text book:

Tewari Pankaj, Kapoor, S.C. (1988). *Mushroom Cultivation*. Delhi: Mittal Publications.

Reference Books:

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R. (1991). *Oyster Mushrooms*. Coimbatore: Tamil Nadu Agricultural University.
2. Bappco, Swaminathan, M.(1990). *Food and Nutrition*, Bangalore: The Bangalore Printing and Publishing Co. Ltd.
3. Nita Bahl,(1984-1988). *Hand book of Mushrooms*. II Edition. Vol. I & II. New Delhi:Oxford and IBH Pub. Co.

Value added courses Hydroponics

Credit	Hours
1	30

Objectives

1. To educate the student about hydroponics and its types.
2. To implement hands on training about hydroponic techniques and to give a thorough knowledge about the business opportunities in hydroponic gardening.

Unit I

The merging of nature and technology. Plants – A basic overview. Introduction to Hydroponics/Soil-less Cultivation: History of Hydroponics, Hydroponic system. Basic needs of hydroponics.

Unit II

Hydroponic poly house- location factors, basic structure and design, flooring, glazing material, heating and cooling, air movement, plant support system, supplemental lighting, CO₂ enrichment, climatic condition, backup systems and sanitation, Basic hydroponic structure and components.

Unit III

Garden practices: Kinds of substrates and its preparation, Water analysis, nutrient solution analysis, Selection of plant. Planting of seeds and germination characteristics, transplanting of saplings into larger grow beds, spacing characteristics between plants, Mixing of nutrients, organic nutrients.

Unit IV

Parameters to be maintained: Environmental Factors: Light (quality, energy, photoperiodism & systems), Temperature (heating & cooling) and carbon dioxide, Consulting parameters (EC & pH), Pest and pest control, Cutting and clones, pruning and training, Harvesting

Unit V

Startup costs for an indoor hydroponic farm, Yield and commercial hydroponic farming and Profits, Vocational and Business opportunities in Hydroponics.

Text Book:

Jeffrey Winterborne. (2005). *Hydroponics: Indoor Gardening*. (4th ed.). U.K: Pukka Press Ltd

Reference Books:

1. Keith Roberto. (2003). *How to Hydroponics*. New York: The Future Garden Press.
2. Benton Jones Jr. (2005). *Hydroponics- A Practical Guide for the soilless grower*. (2nd ed.). U.S.A.: CRC Press.
3. Les Bridgewood. (2002). *Hydroponics- Soilless gardening explained*. U.K.: Crowood Publishers.
4. Adam. J. Savage. (1996). *Planning a Profitable Hydroponic- Greenhouse Business*. London: Sovereign University Publishing House.

Environment Sustainability

Human Values

Professional Ethics

Indian Knowledge System