

2020

B.Sc BOTANY
Course Structure and Syllabus

(For the candidates admitted from the academic year 2020-2021
onwards)

CHOICE BASED CREDIT SYSTEM (CBCS)

THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)

(Approved by NAAC, Affiliated to Bharathidasan University) ELAMBALUR,

PERAMBALUR - 621 220



DEPARTMENT OF BOTANY

Programme Outcomes (POs)

Undergraduate Programme

Upon completion of the programme, the undergraduate will be able to

1. Acquire knowledge, understand concepts and apply new ideas which enable them to be employable or self employed
2. Demonstrate motivation in advancing to higher learning programmes
3. Engage in socially responsible behaviour and have value-added education
4. Have exposure to technical proficiency, analytical capability, soft skills and life skills development
5. Develop broad understanding in the basic concepts of Languages/Commerce/Management Studies/ Physical Sciences Computing Sciences Biological Sciences/Life Sciences

Programme Specific Outcomes (PSOs):

Undergraduate Programme

1. Inculcate strong fundamentals on modern and classical aspects of Botany
2. Acquired knowledge of Botany for the society.
3. Build life skill through value added and skill based elective courses.
4. Create platform for higher studies in Botany.
5. Facilitate students to take-up successful career in Botany.

Thanthai Hans Roever College (Autonomous), Elambalur, Perambalur - 621 220
Bachelor of Botany - UG Course Structure under CBCS

(For the candidates admitted from the academic year 2020-2021 onwards)

Semester	Part	Subject Code	Course Title	Ins. Hours/ Weeks	Credits	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)
1	I	20UT1	Tamil-I (Ilakiyam-kavithai, Sirukathai, Urainadai, Ilakkia Varalaru)	6	3	3	25	75	100
1	II	20UE1	English -I (Communicative English)	6	3	3	25	75	100
1	III	20UBO1CC1	Plant diversity-I Bacteria, Viruses, Algae, Fungi and Lichens	5	4	3	25	75	100
1	III	20UBO1CP1	Plant diversity-I Bacteria, Viruses, Algae, Fungi and Lichens (P)	3	3	3	40	60	100
1	III	20UZO1AC1	Zoology-I (Biology of Invertebrates and Chordates)	3	3	3	25	75	100
1	III	20UZO1AP1	Allied Zoology-I (P)	3	-	-	-	-	-
1	III	20UBO1PE1	Stream -B Professional English for Life science-I	2	2	3	25	75	100
1	IV	20UVE	Value Education	2	2	3	25	75	100
Total				30	20				700
2	I	20UT2	Tamil-II (Idaikkala Illakiyam, Nadagam, Puthinam, Ilakkiya varalaru)	6	3	3	25	75	100
2	II	20UE2	English -II (Communicative English)	6	3	3	25	75	100
2	III	20UBO2CC2	Plant Pathology and Plant Protection	5	4	3	25	75	100
2	III	20UBO2CP2	Plant Pathology and Plant Protection (P)	3	3	3	40	60	100
2	III	20UZO2AC2	Allied Zoology-II (Economic Zoology)	3	3	3	25	75	100
2	III	20UZO1AP1	Allied Zoology-I & II (P)	3	3	3	40	60	100
2	III	20UBO2PE2	Stream -B Professional English for Life science-	2	2	3	25	75	100

			II						
2	IV	20UES	Environmental studies	2	2	3	25	75	100
Total				30	23				800
3	I	20UT3	Tamil-III (Kappiya Ilakkiyam, Nadagam, Ilakkiya varalaru)	6	3	3	25	75	100
3	II	20UE3	English -III (Communicative English)	6	3	3	25	75	100
3	III	20UBO3CC3	Plant Diversity-II, Bryophytes, Pteridophytes, Gymnosperms and Paleobotany	6	6	3	25	75	100
3	III	20UBO3CP3	Plant Diversity -II Bryophytes, Pteridophytes, Gymnosperms and Paleobotany (P)	3	3	3	40	60	100
3	III	20UCH3AC3	Chemistry-III	4	3	3	25	75	100
3	III	20UCH3AP2	Chemistry-I(P)	3	-	-	-	-	-
3	IV	NME1	Non Major Elective1	2	2	3	25	75	100
Total				30	20				600
4	I	20UT4	Tamil- IV (Palan Ilakkiyam, Ilakkiya varalaru, Podhu Katturai)	6	3	3	25	75	100
4	II	20UE4	English -IV (Communicative English)	6	3	3	25	75	100
4	III	20UBO4CC4	Plant Anatomy and Embryology	4	4	3	25	75	100
4	III	20UBO4CP4	Anatomy and Embryology (P)	3	3	3	40	60	100
4	III	20UCH4AC4	Chemistry-IV	4	3	3	25	75	100
4	III	20UCH3AP3	Chemistry-I & II(P)	3	3	3	40	60	100
4	IV	NME2	Non Major Elective 2	2	2	3	25	75	100
4	IV	20UBO4SBE1:1 20UBO4SBE1:2 20UBO4SBE1:3	Mushroom Culture Technology Seaweed Technology Agri Based Microenterprises	2	2	3	25	75	100
Total				30	23				800
5	III	20UBO5CC5	Cell Biology and Genetics	5	5	3	25	75	100
5	III	20UBO5CC6	Plant Ecology and Phytogeography	5	5	3	25	75	100

5	III	20UBO5CC7	Morphology, Taxonomy and Economic Botany	5	5	3	25	75	100
5	III	20UBO5CP5	Cell Biology and Genetics & Plant Ecology and Phytogeography Morphology, Taxonomy of Angiosperms and Economic Botany (P)	4	3	3	40	60	100
5	IV	20UBO5MBE1:1 20UBO5MBE1:2 20UBO5MBE1:3	Herbal Botany Ethno Botany Industrial Botany	5	4	3	25	75	100
5	IV	20UBO5SBE2:1 20UBO5SBE2:2 20UBO5SBE2:3	Plant tissue culture and Molecular techniques Techniques in Biology Phytochemistry	2	2	3	25	75	100
5	IV	20UBO5SBE3:1 20UBO5SBE3:2 20UBO5SBE3:3	Organic Farming Greenhouse Technology Biodiversity and Climate Change	2	2	3	25	75	100
5	IV	20USSD	Soft Skills Development	2	2	3	25	75	100
Total				30	28				800
6	III	20UBO6CC8	Plant Physiology and Biochemistry	6	6	3	25	75	100
6	III	20UBO6CC9	Evolution, Biostatistics and Biophysics	6	6	3	25	75	100
6	III	20UBO6CP6	Plant Physiology, Biochemistry & Evolution, Biostatistics and Biophysics (P)	5	4	3	40	60	100
6	IV	20UBO6MBE2:1 20UBO6MBE2:2 20UBO6MBE2:3	Plant Breeding, Horticulture and Landscaping Seed Science and Technology Silviculture	6	4	3	25	75	100
6	IV	20UBO6MBE3:1 20UBO6MBE3:2 20UBO6MBE3:3	Plant Biotechnology and Bioinformatics Wood science and Technology Environmental Impact Assessment	6	4	3	25	75	100
6	V	Extension activities	Extension activities	-	1	--	--	--	-
6	IV	20UGS	Gender Studies	1	1	3	25	75	100
Total				30	26				600
Grant Total				180	140				4300

List of Allied Courses

Group - I

Zoology

Group - II

Chemistry

Language Part - I	-	4
English Part -II	-	4
Core Paper	-	9
Core Practical	-	6
Allied Paper	-	4
Allied Practical	-	2
Non-Major Elective	-	2
Skill Based Elective	-	3
Major Based Elective	-	3
Environmental Studies	-	1
Value Education	-	1
Soft Skill Development	-	1
Professional English for life science	-	2
Gender Studies	-	1
Extension Activities	-	1 (Creditonly)

* for those who studied Tamil upto 10th +2 (Regular Stream)

+ Syllabus for other Languages should be on par with Tamil at degree level those who studied Tamil upto 10th +2 but opt for other languages in degree level under Part I should study special Tamil in Part IV

** Extension Activities shall be outside instruction hours

Non Major Elective I & II - for those who studied Tamil under Part I

a) Basic Tamil I & II for other language students

b) Special Tamil I & II for those who studied Tamil upto 10th or +2 but opt for other languages in degree programme

Note:

	Internal Marks	External Marks
1. Theory	25	75
2. Practical	40	60
3. Separate passing minimum is prescribed for Internal and External marks		

NME course offered to Other Department

20UBO3NME1-Bio fertilizers and Bio pesticides

20UBO4NME2-Horticulture

FOR THEORY

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]

The passing minimum for University Examinations shall be 40% out of 75 marks

[i.e. 30 marks]

FOR PRACTICAL

The passing minimum for CIA shall be 40% out of 40 marks [i.e. 16 marks]

The passing minimum for University Examinations shall be 40% out of 60 marks [i.e. 24 marks]

Note :

1. As a part of Botany Degree Course every student shall undertake a tour and Field study of Vegetation under the guidance of the staff for not less than (FIVE DAYS within the state) in the 1st year and submit a minimum number of 25 Herbarium sheets. Students shall submit duly certified record of their practical Work for all the practical examinations and those who do not submit the record shall not be permitted to the concerned practical examination.
2. The IA components for the practicals are skill - 10 marks, Test 2 x 10 = 20 Marks, Observation - 10 Marks [for Taxonomy practicals Herbarium marks to be included in the IA component in the place of skill Marks]

List of Skill Based Elective Course

Skill Based Elective	Course code	Title of the course
Skill Based Elective-1	20UBO4SBE1:1 20UBO4SBE1:2 20UBO4SBE1:3	Mushroom Culture Technology Seaweed Technology Agri Based Microenterprises
Skill Based Elective-2	20UBO5SBE2:1 20UBO5SBE2:2 20UBO5SBE2:3	Plant tissue culture and Molecular techniques Techniques in Biology Phytochemistry
Skill Based Elective-3	20UBO5SBE3:1 20UBO5SBE3:2 20UBO5SBE3:3	Organic Farming Greenhouse Technology Biodiversity and Climate Change

List of Major Based Elective Course

Major Based Elective	Course code	Title of the course
Major Based Elective-1	20UBO5MBE1:1	Herbal Botany
	20UBO5MBE1:2	Ethnobotany
	20UBO5MBE1:3	Industrial Botany
Major Based Elective-2	20UBO6MBE2:1	Plant Breeding, Horticulture And Landscaping
	20UBO6MBE2:2	Seed Science and Technology
	20UBO6MBE2:3	Silviculture
Major Based Elective-3	20UBO6MBE3:1	Plant Biotechnology and Bioinformatics
	20UBO6MBE3:2	Wood science and Technology
	20UBO6MBE3:3	Environmental Impact Assessment

SEMESTER - I

Course code: 20UBO1CC1

Instruction: Hours: 5

Credit: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE - I PLANT DIVERSITY-I

(BACTERIA, VIRUSES, ALGAE, FUNGI AND LICHENS)

Course Outcomes:

On successful completion of the course, the students will be able to:

- Examine the general characteristics of bacteria and their cell reproduction/recombination
- Viruses based on their characteristics and structures
- Discuss about importance of morphological structure, classification, reproduction and economic importance of Algae.
- Study and impart knowledge about the general Characteristics, structure, reproduction, life history and economic importance of fungi.
- Understand the features of Lichens

Unit I: Bacteria

The scope of microbiology - history of microbiology - classification of microorganisms- Whittaker's Five Kingdom concept- Outline of bacterial classification-Bergey's manual of determinative bacteriology - Ultrastructure Gram positive - and gram negative bacteria- flagellation- nutrition - cell division-reproduction - Endospore and genetic recombination- Transformation- transduction - and conjugation.

Unit II: Viruses

History - morphology shape- size - structure - helical viruses (naked and enveloped viruses)- icosahedral (naked and enveloped) viruses - complex viruses - General characteristics of plant - and animal viruses - Classification of viruses - Viral multiplications (Lytic cycle - Lysogenic cycle).

Unit III: Algae

classification (Silva, 1982) - criteria for classification - algal distribution - thallus organization -(unicellular *Chlamydomonas*, - *Diatoms*- colonial *Volvox*- filamentous *Anabaena*- *Oedogonium*- siphonous *Caulerpa*- parenchymatous *Ulva*- *Sargassum* - *Gracilaria*)- reproduction Vegetative asexual sexual reproduction - and life cycles (haplontic *Chlamydomonas*- *Oedogonium* - and *Chara*- diplontic *Diatoms*- and *Sargassum*- diplohaplontic *Ulva* - and diplobiontic *Gracilaria*) -Economic importance of algae - Algae as food and feed- Agaragar - Alginic acid and Carrageenan - Diatomite.

Unit IV: Fungi

classification (Alexopoulos) - criteria for classification - Characteristic features- structure-reproduction - and lifehistory of classes - each with one suitable example: Zygomycotina (*Mucor*) - Ascomycotina (*Peziza*) - Basidiomycotina (*Agaricus*) - and Deuteromycotina (*Cercospora*) -Economic importance of Fungi: Medicine - food- biopesticides- biofertilizers and industrial uses such as alcohol - acids and enzymes - Harmful effects of Fungi

Unit V: Lichens

Structure- types- distribution - reproduction - and ecological significance of lichens with special reference to - *Usnea* - Economic importance of lichens.

REFERENCE BOOKS:

1. Pelczar, Michel J. JR., E.C.S. Chan and Noel R. Krieg (Eds.) Text book of Microbiology. Tata McGraw Hill. Co. New Delhi.
2. Atlas, R.M. 1989 Microbiology-Fundamentals and applications. McMillan Publishing Company, New York.
3. Anantharayan, R. and C.K.J. Paniker 2000 Text book of Microbiology, 6th Edition. Orient Longman.
4. South G.R. and A. Whittick 1987 Introduction to Phycology. Blackwell Scientific Publications, Oxford.
5. Vashista, Sinha B.R., Singh, V.P., 2002, Botany for Degree students, Algae 9th revised edition, S.Chand & Company Ltd., New Delhi.
6. Pandey B.P., 2000 Revised edition, Text Book of Botany Algae, S.Chand & Company, New Delhi.
7. Sharma O.P., 1992, Text Book of Algae, Tata McGraw Hill Publication Company Ltd., New Delhi.
8. Pandey, B.P. (2001). College Botany Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd., New Delhi.
9. Alexopolous, C.J. and C.W. Misra 1972 Introductory mycology. John Wiley and Sons, New York.
10. Vashista B.R. , 1982, Botany for Degree Students - Fungi- S.Chand & Co New Delhi.
11. Chopra G.L., A Text book of Fungi, S.Nagin & Co. Meerut, India
12. Pandey B.P., 1997 College Botany Vol. I Fungi & Pathology.
13. Dube, H., 1978, A textbook of Fungi, Bacteria and Virus. Vikas Publishers.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
I	20UBO1CC1	Plant diversity-I Bacteria, Viruses, Algae, Fungi and Lichens	5	4						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓		✓	✓	✓	✓	
CO2	✓	✓	✓	✓		✓	✓	✓		✓
CO3	✓	✓	✓	✓		✓	✓	✓	✓	
CO4	✓	✓	✓	✓			✓	✓	✓	✓
CO5	✓	✓	✓	✓		✓	✓		✓	✓
Number of Matches(✓) = 40 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
77	0	0	0	77

SEMESTER - I

Course code: 20UBO1CP1

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE PRACTICAL - I PLANT DIVERSITY-I (BACTERIA, VIRUSES, ALGAE, FUNGI AND LICHENS) (P)

Course Outcomes:

On successful completion of the course, the students will be able to:

- Learn the microscopic technique, familiarize with the external and internal structure of lower and higher group organisms.
- Develop the skill for micro slide preparation and understand the internal structure of algae.
- Understand the internal structure of fungi.
- Study of Lichens and its types.
- Students get knowledge in fossil and fossilization.

1. Preparation of culture media for bacteria sterilization procedures
2. Isolation of pure culture from soil by serial dilution techniques.
3. Gram staining procedure.
4. EMs/Models of viruses TPhage and TMVLine drawing/Photograph of Lytic and Lysogenic Cycle.
5. Study of vegetative and reproductive structures of *Chlamydomonas-Volvox-Oedogonium-* and *Chara* (electron micrographs)- *Oedogonium- Caulepra- Diatoms-Sargassum - and Gracilari* through temporary preparations and permanent slides.
6. *Rhizopus - and Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides
7. Micropreparation of *Usnea* to study vegetative and reproductive structures

Field visit

Conduct field visit for direct observation of algae, fungi and other specimen

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
I	20UBO1CP1	Plant diversity-I Bacteria, Viruses, Algae, Fungi and Lichens (P)	3	3						
Course Outcomes (COs)	Programme Outcomes(Pos)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓	✓		✓
CO2	✓		✓	✓	✓	✓	✓		✓	✓
CO3	✓	✓	✓	✓		✓	✓	✓	✓	
CO4	✓	✓	✓		✓	✓	✓	✓		✓
CO5	✓	✓	✓		✓	✓		✓	✓	✓
Number of Matches(✓) = 40 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
16	11	2	1	2

SEMESTER - II

Course code: 20UBO2CC2

Instruction: Hours: 5

Credit: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE II - PLANT PATHOLOGY AND PLANT PROTECTION

Course Outcomes:

On successful completion of the course, the students will be able to:

- Understand the history and importance of plant pathology.
- Inculcate the importance of plant disease management.
- Identify the causative organism, symptoms and control measure of plant disease.
- Acquire knowledge on plant protection
- Understand the methods of plant protection.

Unit I Plant Pathology

Plant Pathology: Scope- History- importance of study of Plant pathology- Classification of plant diseases based on (a) Major causal agents biotic- and abiotic-(b) General Symptoms- Process of infection and pathogenesis- (a) Penetration and entry of pathogen into host tissue- mechanical- physiological- and enzymatic- (b) Host parasite interaction- enzymes- and toxins in pathogenesis.

Unit II Plant Disease Management

Chemical means of disease control Fungicides: Definition- classification- characters of an ideal fungicide- antibiotics- and nematicides- Biological Control of Plant Diseases: Definition- Importance of plant disease.

Unit III Common Plant Diseases

Study of plant diseases with respect to symptoms- causal organism- disease cycle -and their management- (a) Cereals: Rice blast disease- (b) Vegetables: Brinjal Little leaf- (c) Fruits: Banana bacterial leaf blight- Citrus bacterial canker- (d) Oil seeds: Groundnut Tikka disease- (e) Sugar yielding: Sugarcane- red rot disease.

Unit IV Plant Protection

Scope- Importance- and equipments used in plant protection -Types of Sprayers - dusters - soil injector - seed dressing drum- Seed treatment- objectives of seed treatment- Traditional and modern methods of seed treatment- Soil sterilization-Traditional and modern methods of soil sterilization techniques. - Role of soil sterilization in Polyhouse farming- and their importance.

Unit V Methods of Plant Protection

- a) Cultural: Tillage- sowing- and planting dates- crop hygiene- crop rotation- trap crops- fertilizer.
- b) Mechanical: Field sanitation- collection- and destruction of diseased plant-debris- For pests hand picking- and destruction of egg masses- shaking of plants- rope dragging- netting- bagging-physical barriers- use of sticky bands- tinbands- and light traps.
- c) Physical: Heat - and soil solarizations.

- d) Chemical: Brief account and uses of Bactericides- Fungicides- Insecticides- Nematicides- Acaricides- Molluscicides- Rodenticides- Herbicides- and disadvantages of pesticides.
- e) Biological: Introduction, biological control of Insect pests- and diseases
- f) Legal Plant Introduction- domestic quarantine- need of plant quarantine-quarantine in India

REFERENCE BOOKS:

1. Bap Reddy, D. and Joshi, N.C. (1991). *Plant Protection in India* (Second Edition). Allied Publishers Ltd., New Delhi.
2. Bilgrami, K.S. and Dubey, R.C. (1985). *Text book of Modern Plant Pathology*. Vikas Publishing House Private Limited, New Delhi.
3. Mehrotra, R.S. (2003). *Plant Pathology* (Second edition). Tata McGraw-Hill Education, New Delhi.
4. Pandey, B.P. (2001). *Plant Pathology*. S. Chand & Company Limited, New Delhi.
5. Rangasami, G. and Mahadevan, A. (1998). *Diseases of Crop Plants in India*. Prentice Hall of India Ltd. New Delhi.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20UBO2CC2	Plant Pathology and Plant Protection					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1		✓	✓	✓	✓	✓	✓		✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓	✓	
CO3	✓	✓		✓		✓	✓	✓	✓		
CO4	✓	✓	✓		✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓		

Number of Matches(✓) = 39 Relationship: High

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
84	12	0	11	63

SEMESTER - II

Course code: 20UBO2CP2

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE PRACTICAL - II PLANT DIVERSITY-I PLANT PATHOLOGY AND PLANT PROTECTION (P)

Course Outcomes:

On successful completion of the course, the students will be able to:

- Understand the history and importance of plant pathology.
- Inculcate the importance of plant disease management.
- Identify the causative organism, symptoms and control measure of plant disease.
- Acquire knowledge on plant protection
- Understand the methods of plant protection.

Collect and identify common diseases of following infected plants.

- Tikka disease of ground nut
- Early blight of potato
- Loose smut of wheat
- Bacterial blight of paddy
- Leaf curl of tomato
- Bunchy top of banana
- Isolation and identification of plant pathogenic fungi.
- Isolation and identification of host inoculation of phytopathogenic bacteria.

Herbarium specimens of bacterial diseases; Citrus Canker - Angular leaf spot of cotton -
Viral diseases: TMV - Vein clearing - Fungal diseases: Early blight of potato - Black
stem rust of wheat - and White rust of crucifers.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
II	20UBO2CP2	Plant Pathology and Plant Protection (P)	3	3						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓	✓		✓	✓
CO2	✓	✓	✓		✓	✓	✓	✓	✓	
CO3	✓	✓	✓		✓	✓		✓		✓
CO4	✓	✓	✓	✓		✓	✓	✓	✓	
CO5	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches(✓) = 39 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
15	15	0	0	0

SEMESTER - III

Course code: 20UBO3CC3

Instruction: Hours: 6

Credit: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE -III

(BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY)

Course Outcomes:

On successful completion of the course, the students will be able to:

- To get knowledge about classification, mode of reproduction and detailed study of some important bryophytes.
- Students Gain adequate knowledge on general characters, classification and economic importance of Pteridophytes.
- To impart knowledge to stellar evolution of pteridophytes.
- Student will be able to understand general characters, distribution, classification by spore and detailed study of some genera.
- Student gets knowledge in the methods of fossil and fossilization.

Unit I: Bryophytes

Classification of Bryophyta (Watson) structure- and reproduction of the following classes each with a suitable example: Hepaticopsida (*Marchantia*) -Anthocerotopsida (*Anthoceros*) - and Bryopsida (*Funaria*) (Examples may be changed according to the availability of the specimens) - Position of Bryophytes in the evolution of higher plants.

Unit II: Pteridophytes

Classification of Pteridophyta (Reimer)-General characteristics- structure -and reproduction of the taxa belonging to each of the following classes: Psilotopsida (*Psilotum*) -Lycopsidea (*Lycopodium/Selaginella*).

Unit III:

General characteristics- structure - and reproduction of the taxa belonging to each of the following classes: Sphenopsida (*Equisetum*) -Pteropsida (*Adiantum/ Marsilea*) - Stellar evolution in Pteridophytes- Heterospory and Seed Habits.

Unit IV: Gymnosperms

Classification of Gymnosperms (Smith/Sporne) -General characteristics- structure - and reproduction of the taxa belonging to each of the following orders: Cycadales (*Cycas*) - Coniferales (*Pinus*) -Gnetales(*Gnetum*) -Economic importance: Oil- resin - timber, etc.

Unit V: Paleobotany

Introduction to fossils - and fossilization processes such as compression- casts- molds- petrification - impressions and coal balls - Geological time scale - Study of the following fossils: Rhynia-*Lepidodendron*- *Calamites* - and *Williamsonia seawardiana*.

REFERENCE BOOKS:

BRYOPHYTES

1. Rashid, A. (1998). *An Introduction to Bryophyta*. Vikas Publishing House (P) Ltd., New Delhi.
2. Srivastava, N.N., (1996). *Bryophyta*. Pradeep Prakashan, Meerut.

PTERIDOPHYTES

1. Rashid, A. (1999). *An Introduction to Pteridophyta*. Vikas Publishing House (P) Ltd., New Delhi.
2. Sharma, O.P. (1990). *Textbook of Pteridophyta*. MacMillan India Ltd., New Delhi.
3. Sundara Rajan, S. (1994). *Introduction to Pteridophyta*. New Age International Publishers Ltd., Wiley Eastern Ltd., New Delhi.
4. Vashista, P.C. (1997). *Botany for Degree Students Pteridophyta*. S. Chand and Company Ltd., New Delhi.

GYMNOSPERMS

1. Bhatnagar, S.P. and Alok M. (1997). *Gymnosperms*. New Age International (P) Ltd., Publisher, New Delhi.
2. Sharma, O.P. (1997). *Gymnosperms*. Pragati Prakashan, Meerut.
3. Srivastava, H.N. (1998). *Gymnosperms*. Pradeep Publications, Jalandhar.
4. Vashishta, P.C. (1996). *Botany for Degree Students-Gymnosperms (2nd Edn.)*. S. Chand and Company Ltd., New Delhi.

PALEOBOTANY

1. Stewart, W.N. (1983). *Paleobotany and the Evolution of Plants*. Cambridge University Press, Cambridge, London.
2. Venkatachala, B.S., Shukla, M. and Sharma, M. (1992). *Plant Fossils-a Link with the Past (A Birbal Sahni Birth Centenary Tribute)*. Birbal Sahni Institute of Paleobotany, Lucknow.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
III	20UBO3CC3	Plant Diversity-II, Bryophytes, Pteridophytes, Gymnosperms and Paleobotany	6	6						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓		✓	✓	✓
CO2	✓	✓		✓	✓	✓	✓		✓	✓
CO3	✓	✓	✓		✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓		✓	✓	✓	✓	
CO5	✓	✓	✓		✓	✓	✓	✓		✓
Number of Matches(✓) = 40 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
36	0	0	0	36

SEMESTER - III

Course code: 20UBO3CP3

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE PRACTICAL - III

PLANT DIVERSITY-II

(BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY) (P)

Course Outcomes:

On successful completion of the course, the students will be able to:

- Students are capable to become practical knowledge about micro-preparation and observation of permanent slides of genera.
- Understand the internal structural variation of pteridophytes through T.S and L.S.
- Understand the internal structural variation of gymnosperms through T.S and L.S.
- Understand the importance of fossil forms
- And interprets it's geological type scale.

(BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY)

1. Micropreparation and observation of the following bryophyte specimens *Marchantia*-*Anthoceros* -and *Polytrichum*.
2. Micropreparation and observation of the following pteridophyte specimens *Lycopodium* -*Equisetum* - and *Adiantum*.
3. Micropreparation and observation of the following gymnosperm specimens *Cycas* -and *Pinus*.
4. Observation of following permanent fossil slides
Rhynia, *Lepidodendron*, *Calamities* and *Williamsonia*.
5. Botanical tour to witness the specimens in their natural habitats.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
III	20UBO3CP3	Plant Diversity -II Bryophytes, Pteridophytes, Gymnosperms and Paleobotany (P)	3	3						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓		✓	✓	✓
CO2	✓	✓	✓	✓		✓	✓	✓	✓	
CO3	✓	✓		✓	✓	✓		✓	✓	✓
CO4	✓	✓	✓	✓		✓	✓	✓		✓
CO5	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches(✓) = 40 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
10	6	1	2	1

SEMESTER - III

Course code: 20UBO3NME1

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 25

External Marks: 75

NON-MAJOR ELECTIVE I

BIOFERTILIZERS AND BIOPESTICIDES

Course Outcomes

- Acquired knowledge regarding biofertilizers and its consequences in the environment.
- Develop skill regarding isolation, identification and mass production of bacterial biofertilizers.
- Develop skill on blue green algal biofertilizer production and its application.
- Students will get awareness to mitigate the usage of synthetic fertilizers.
- Learned about the benefits of organic farming and its relation to waste management.

Unit I

Biofertilizers: Definition- kinds of microbes as bio fertilizers- Rhizobium isolation- mass multiplication- commercialization- and field application.

Unit II

Cultural method- and isolation- mass multiplication of *Azospirillum*- *Azotobacter*- *Azolla*- and *Anabaena*-andtheirfieldapplication.

Unit III

Mycorrhiza- concept-VAM association- types- isolation- inoculum production- and application.

Unit IV

Pesticides- Definition- Introduction- concept-types of pesticides- and disadvantages-Biological Magnification concept.

Unit V

Biopesticides -Bacterial origin (*Bacillus thuringiensis*)- mechanism of action- and application- fungal origin- plant origin- and viral origin-commercialization.

REFERENCE BOOKS:

1. Subba Rao, N.S. (2000). *Soil Microbiology*. Oxford and IBH Publishing Co. Ltd., New Delhi.
2. Varma, A. and Hock, B. (1995). *Mycorrhiza*. Springer-Verlag, Berlin.
3. Wicklow, D.T. and Soderstrom, B.E. (1997). *Environmental and Microbial Relationships*. Springer-Verlag, Berlin.
4. Yaaco Vokan (1994). *Azospirillum/Plant Associations*. CRC Press, Boca Raton, FL.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
III	20UBO3NME1	Non Major Elective I- Biofertilizer and Biopesticides	2	2						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓		✓	✓	✓
CO2	✓	✓		✓	✓	✓		✓	✓	✓
CO3	✓	✓	✓		✓	✓	✓		✓	
CO4	✓	✓	✓	✓		✓	✓	✓	✓	✓
CO5	✓	✓	✓		✓	✓	✓	✓		✓
Number of Matches(✓) = 40 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
35	11	0	1	23

SEMESTER - IV

Course code: 20UBO4CC4

Instruction: Hours: 4

Credit: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE IV PLANT ANATOMY AND EMBRYOLOGY

Course Outcomes

On successful completion of the course, the students will be able to:

- Outline the fundamental concepts of plant anatomy and embryology.
- Distinguish different type of tissue system and their organization.
- Recognize the anatomical features of plant organs and secondary growth.
- Evaluate the structural organization of flower and the process of pollination and fertilization.
- Students able to understand endosperm and its types and know the structure and development of monocot and dicot embryos.

Unit I

Anatomy: Structure - and function of simple - & complex tissues. Meristematic tissues: definition- structure - function - & classification - apical organization and theories- apical cell theory - Histogen theory & Tunica - Corpus theory - Root apex: Histogen theory -& Korper-Kappe theory - Secretary tissues: external glands -& nectarines and laticifers.

Unit II

Tissue systems - Primary structure of root- stem -& leaves - Epidermal tissue system: epidermis- cuticle- trichome- stomata - bulliform cells - cork and silica cells. Ground tissue systems: cortex- endodermis- pericycle - pith & pith rays - Vascular tissue systems - different types of vascular bundles - and their arrangement in root and stem - Nodal anatomy - leaf trace - leaf gap - branch trace - and branch gap.

Unit III

Stem thickening in monocots and dicots - Dicot root thickening - Anomalous secondary growth of *StemBougainvillea- Bignonia - Nyctanthes-* and *Dracaena-* Periderm structure - and development- Phellem- Phellogen- Phelloderm - Rhytidome and lenticels.

Unit IV

Embryology Structure - and development of anthermicrosporogenesis - development of male gametophyte - dehiscence of anther - structure of pollen - and its germination - and viability.

Unit V

Structure and types of ovule - development of ovule megasporogenesis - development of an embryosac monosporic (Polygonum type) - bisporic (Allium type) - and tetrasporic (Peperomia

type) - Structure of mature embryo sac - double fertilization-apomixes - Development of an endosperm and embryo in dicots and monocots - polyembryony - structure of fruit and seed.

REFERENCE BOOKS:

ANATOMY

1. Cutter, E.G. (1978). *Plant Anatomy Part-I: Cells and Tissues* (2nd Edn.), *Plant Anatomy Part-II: Experiments and Interpretations*. Edward Arnold, London.
2. Esau, K. (1965). *Vascular Differentiation in Plants*. Holt, Rinehart and Winston, New York.
3. Esau, K. (1980). *Plant Anatomy* (2nd Edition). Wiley Eastern Ltd., New Delhi.
4. Fahn, A. (1997). *Plant Anatomy*. Pergamon Press, Oxford.
5. Foster, A.S. (1960). *Practical Plant Anatomy*. Van Nostrand and East-West Press, New Delhi.
6. Govindarajulu, A. (1980). “*Marangal*” (*Trees*) (In Tamil). Tamilnadu Textbook Society, Chennai.
7. Krishnamurthy, K.V. (1980). *Wood*. Tetrahedron Publications, Tiruchirappalli.
8. Vasishtha, P.C. (1977). *A Text Book of Plant Anatomy*. S. Nagin and Co., New Delhi.

EMBRYOLOGY

1. Bhojwani, S.S. and Bhatnagar, S.P. (2000). *The Embryology of Angiosperms* (4th Edition). Vikas Publishing House (P) Ltd., UBS Publisher’s Distributors, New Delhi.
2. Johri, B.M. (1982). *Experimental Embryology of Vascular Plants*. Springer - Verlag, Heidelberg.
3. Maheswari, P. (1985). *An Introduction to the Embryology of Angiosperms*. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Maheswari, P. (1963). *Recent Advances in the Embryology of Angiosperms*. International Society of Plant Morphologists, University of Delhi.
5. Rogland, A. (2000). *Developmental Botany (Embryology of Angiosperms)*. Saras Publications, Nagercoil.
6. Swamy, B.G.L. and Krishnamoorthy, K.V. (1980). *From Flower to Fruit*. Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20UBO4CC4	Plant Anatomy and Embryology					4	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓		✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO3	✓	✓	✓		✓	✓	✓	✓	✓		
CO4	✓	✓	✓		✓	✓	✓	✓	✓		
CO5	✓	✓		✓	✓	✓		✓	✓	✓	
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
66	0	0	0	66

SEMESTER - IV

Course code: 20UBO4CP4

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE PRACTICAL - IV **(ANATOMY AND EMBRYOLOGY) (P)**

Course Outcomes:

On successful completion of the course, the students will be able to:

- Understand external and internal structure of plants.
- Students are capable to become practical knowledge in T.S. of stem and Leaf (Monocot and Dicot).
- To get acquire knowledge in secondary thickening dicot stem and anomalous secondary thickening in the stems.
- Get knowledge on structure and development plant embryo.
- Students get adequate knowledge in internal structure of anther, L.S. of ovule, types of ovules and dicot embryo dissection.

Plant Anatomy and Embryology

1. Anatomical observation of monocot and dicot leaf stem and root (monocot Grass/Canna and dicot *Tridax*)
2. Normal secondary thickening in dicot stem (*Azadiracta indica*).
3. Anomalous secondary thickening (*Boerhavia, Nyctanthes, and Dracaena*).
4. T.S of young and mature anther (*Datura metal*)
5. Dissection of dicot embryo and endosperm (*Cucumis and Tridax*).
6. Observation of simple and complex tissues (Charts/permanent slides).
7. Observation of vascular bundle orientation (Charts/permanent slides).
8. L.S. of ovule and types of ovule (Charts/permanent slides).

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20UBO4CP4	Anatomy and Embryology (P)					3	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3	✓	✓	✓		✓	✓	✓	✓		✓	
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓		✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
8	8	0	0	0

SEMESTER - IV

Course code: 20UBO4NME2

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 25

External Marks: 75

NON-MAJOR ELECTIVE II

HORTICULTURE

Course Outcomes:

On successful completion of the course, the students will be able to:

- Learn the importance of horticulture - career and occupational opportunities
- Know about hydroponics and its importance
- Learn the techniques of gardening - Types, Methods & Tools
- Learn about Floriculture - Cultivation of commercial flower crops
- To gain knowledge about in green house.

Unit I

Horticulture: Importance-and scope of Horticulture- Classification of horticultural crops fruits- vegetables crops- climate- soil- water- manures- nutrition needs of horticultural crops- Limitations of horticulture.

Unit II

Plant propagation- concept- Methods cutting- layering- grafting- budding- stock scion relationship- Use of plant regulators in horticulture.

Unit III

Garden designs- types of gardens- formal- informal- and kitchen garden- units of garden- hedge- border- Topiary arches- and lawn maintenance.

Unit IV

Floriculture-concept- cultivation of commercial flower- rose and jasmines- Cultivation of important fruit trees- Mangoes -and Banana.

Unit V

Green house- Indoor gardening- Bonsai- flower arrangements- nursery management- and maintenance.

REFERENCE BOOKS:

1. Bose, T.K. and Mukherjee, D. (1972). *Gardening in India*. Oxford & IBH Publishing Co., Kolkatta.
2. Edmond, J.B., Musser, A.M. and Andrews, F.S. (1951). *Fundamentals of Horticulture*. McGraw-Hill Book Company, Inc., New York.
3. Jitendra Singh. (2014). *Basic Horticulture*. Kalyani Publishers, Chennai.
4. Kumar, N. (1997). *Introduction to Horticulture*. Rajalakshmi Publications, Nagercoil.

5. Lex Lauries and Victor, H.R. (1950). *Floriculture-Fundamental and Practices*. McGraw Hill Publishers, New York.
6. Naik, K.C. (1963). *South Indian Fruits and Their Culture*. Vardhachary & Co., Madras.
7. Randhawa, G.C. (1973). *Ornamental Horticulture in India*. Today & Tomorrow Publishers, New Delhi.
8. Sandhu, M.K. (1989). *Plant Propagation*. Wiley Eastern Ltd., New Delhi.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
IV	20UBO4NME2	Non Major Elective II- Horticulture	2	2						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓		✓	✓		✓
CO2	✓	✓	✓		✓	✓		✓	✓	✓
CO3	✓	✓		✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓		✓	✓	✓		✓	✓
CO5	✓	✓		✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 39 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
41	4	1	7	29

SEMESTER - IV

Course code:
20UBO4SBE1:1
Instruction: Hours: 2
Credit: 2

Exam Hours: 3
Internal Marks: 25
External Marks: 75

SKILL BASED ELECTIVE I

MUSHROOM CULTURE TECHNOLOGY

Course Outcomes:

On successful completion of the course, the students will be able to:

- Students understand the importance of mushrooms
- Students know the characteristics of mushrooms
- Acquire knowledge on mushroom production technologies
- Students know the applications of mushroom biotechnology
- Students know the cultivation methods of different mushrooms

Unit I

Introduction - history - scope of edible mushroom cultivation - Types of edible mushrooms available in India - *Volvariella volvacea*- *Pleurotus citrinopileatus*- *Agaricus bisporus*.

Unit II

Pure culture - preparation of medium (PDA -and Oatmeal agar medium)sterilization - preparation of test tube slants to store mother culture - culturing of *Pleurotus* mycelium on petriplates - preparation of mother spawn in saline bottle - and polypropylene bag - and their multiplication.

Unit III

Cultivation Technology - Infrastructure- substrates (locally available)-Polythene bag- vessels- inoculation loop-low cost stove-sieves- culture rack- mushroom unit (Thatched house) -water sprayer- tray-small polythene bag- Mushroom bed preparation - paddy straw- sugarcane trash- maize straw- banana leaves- Factors affecting the mushroom bed preparation - Low cost technology- Composting technology in mushroom production.

Unit IV

Storage and nutrition: Short term storage (Refrigeration - upto 24 hours)-Long term Storage (canning, pickles, papads)- drying- storage in salt solutions-Nutrition Proteins - amino acids - mineral elements nutrition -Carbohydrates-Crude fibre content - Vitamins.

Unit V

Food Preparation- Types of foods prepared from mushroom- Soup- Cutlet- Omelette-Samosa- Pickles- Curry- Research Centres National level-and Regional level-Cost benefit ratio - Marketing in India -and abroad- Export Value.

TEXT BOOK:

1. Mani.A.Selvaraj.A.M, Narayanan.L.M&Arumugam.N (1999) „Microbiology“ - General and Applied, Saras Publications., Nagercoil.
2. A Text Book of Microbiology - Dubey - S.Chand& Co.

REFERENCES :

1. Anantha Narayanan &JayaramPanicker - Medical Microbiology.
2. Pelezas Jr.M.J., Chan, E.C.S and Kreig.N.R (1993) Microbiology - Concepts &Applications, Mc.Graw Hill New York ISBN.
3. Kuby.J (1999) Immunology, W.G.Freeman& Co., New York 5. Roitt.I.M (1988) Essentials of Immunology EIBSEdn. London.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20UBO4SBE1:1	Mushroom Culture Technology					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1		✓	✓	✓		✓	✓	✓		✓	
CO2	✓	✓	✓	✓		✓	✓		✓	✓	
CO3	✓	✓		✓	✓	✓	✓		✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓		✓	✓	✓	✓	✓	✓		✓	
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
61	-	1	41	19

SEMESTER - IV

Course code:
20UBO4SBE1:2
Instruction: Hours: 2
Credit: 2

Exam Hours: 3
Internal Marks: 25
External Marks: 75

SKILL BASED ELECTIVE II

SEAWEED TECHNOLOGY

Course Outcomes:

On successful completion of the course, the students will be able to:

- Analyze the major cultivation methods of seaweeds, along with detailed life history of selected high-value seaweed species from India
- Develop their understanding on commonly occurring Seaweeds of Indian coasts along with the current understanding of its biology
- Analyze the properties of mangroves, other aquatic angiosperms Seaweeds
- Reflect upon the values and uses of aquatic plants
- Acquire knowledge on the Polysaccharides in Seaweeds

Unit I

Structure- Reproduction -and life history of Rhodophyta- Phaeophyta -and Chlorophyta.

Unit II

Seaweed resources in India-and abroad-Ecology of Seaweeds: Distribution- Nutrients -and Environment.

Unit III

Biochemistry- Polysaccharides- Bioactive compounds- Chemical constituents - and Growth regulators in Seaweeds.

Unit IV

Methods of commercial cultivation of Seaweeds- Commercial uses of Seaweeds - Agar- Carrageenan- Alginic acid -and their uses in various industries.

Unit V

Common methods for extraction of various cell wall Polysaccharides in seaweeds.

REFERENCES :

1. Lobban, C.S. and M.J. Wynne (Eds.) 1981 Biology of Seaweeds. Blackwell Scientific Publications, Oxford.
2. Barsanti, Laura and Paolo Gualtieri 2003 Algae-Anatomy, Biochemistry and Biotechnology. Taylor & Francis, London, New York.

3. Tait, R.V and F.A. Dipper 1998 Elements of Marine Ecology. Elsevier Ltd.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20UBO4SBE1:2	Seaweed Technology					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓		✓	
CO2	✓	✓	✓	✓	✓	✓	✓		✓		
CO3	✓	✓	✓			✓	✓	✓	✓		
CO4	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓		✓	✓	✓	✓	✓		✓	
Number of Matches(✓) = 38 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
22	0	0	1	21

SEMESTER - IV

Course code:
20UBO4SBE1:3
Instruction: Hours: 2
Credit: 2

Exam Hours: 3
Internal Marks: 25
External Marks: 75

SKILL BASED ELECTIVE II

AGRI BASED MICROENTERPRISES

Course Outcomes:

On successful completion of the course, the students will be able to:

- To provide an adequate knowledge about importance of organic manures.
- To provide an adequate knowledge about importance of biofertilizers.
- To understand the methods of plant propagation by seeds
- Student will able to understand the types of gardening
- Inculcate an enthusiasm and awareness about nursery management.

Unit I

Organic manures -and fertilizers- Composition of fertilizers - NPK content of various fertilizers- Common organic manures bone meal- cow dung- poultry waste- oil cakes- organic mixtures -and compost- Preparation of compost aerobic -and anaerobic- advantages of both- vermicompost preparation- Vermiwash.

Unit II

Biofertilizers definition- types *Trichoderma- Rhizobium*-PGPR- Biopesticides-Panchakaviyam Tobacco-and Neem decoction-Biological control- Sustainable agriculture.

Unit III

Soil components- Preparation of potting mixture- Common Garden tools -and implement-. Methods of plant propagation by seeds- advantages and disadvantages- Vegetative propagation - advantages and disadvantages- Natural methods of vegetative propagation- Artificial methods cutting- grafting- budding -and layering- Use of growth regulators for rooting.

Unit IV

Gardening Types of garden ornamental- indoor garden- kitchen garden- Terrace garden- vegetable garden for marketing- Rockery -and artificial ponds- Ornamental garden designing - garden components flower beds- borders- hedges- edges- drives and paths- garden adornments.

Unit V

Lawn - preparation by seeds- by transplanting seedling - and by turfing-Annuals- Biennials- Shrubs- Trees- Cycads and Palms- Bonsai preparation- Pruning of plants- Types of Nurseries - Management aspects -and Maintenance- Plant growth structures advantages of green house

-polished- fernery and orchidarium.

REFERENCE:

1. Adams, M.R. and M.O. Moss. 1995 Food Microbiology. Panima Publishing.
2. Casida, L.E. (Jr.),2005 Industrial Microbiology. New Age International.
3. Chandha.,K.L2003 Handbook of Horticulture. ICAR. New Delhi.
4. Frazier and Westhoff. 1988 Food Microbiology.Tata McGraw Hill.
5. George Acquciah. 2004 Horticulture Principles and Practices. II Edn. Prentice Hall. India.
6. George J. Banwant. 2004 Basic Food Microbiology.CBS Publishers and Distributors.
7. Gopal Chandha De. 2002 Fundamentals of Agronomy.Oxford and IBH Publishing House.
8. Hudson. T., Hartmann., Dale E. Kester.2001 Plant Propagation, Principles and Practices. 6th Edn.Prentice Hall. India.
9. James M. Jay.2005 Modern Food Microbiology.CBS Publishers and Distributors.
10. Kaul, T.N.. Biology and Conservation of Mushroom (2002) Oxford and IBH Publishing Co.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20UBO4SBE1:3	Agri Based Microenterprises					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓		✓		✓	
CO2		✓	✓	✓	✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO4	✓		✓	✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓		✓	✓		✓		
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
69	2	11	10	46

SEMESTER - V

Course code: 20UBO5CC5

Instruction: Hours: 5

Credit: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE V CELL BIOLOGY & GENETICS

Course Outcomes:

On successful completion of the course, the students will be able to:

- Compare the structure and function of cells & explain the development of cells
- It brings fundamental concepts as well as recent developments of cell structure, ultrastructure of organelles, cellular activities, physiology and genetic control mechanisms which are basic to understand cellular phenomena.
- Analyse the structures and chemical properties of DNA
- Understand the fundamentals of Mendel's Principle
- Acquire the knowledge on sex linkage, crossing over and sex influenced characters

Unit I

Plant cell structure -and function- Ultra structure of Prokaryotic cell -and Eukaryotic cell- Cell wall -Structure- chemistry and functions- Plasma membrane - Structure- Chemistry and function.

Unit II

Cell Organelles- Ultra Structure and origin of the following: Endoplasmic Reticulum- Golgicomplex- Lysosomes- Mitochondria- Chloroplast- Ribosomes -and Microbodies.

Unit III

Structure and Functions of Nucleus- Nuclear Envelope- Nucleoplasm- Nucleolus- Chromosome - Euchromatin -& heterochromatin- Giant chromosomes Polytene -and Lambrush chromosomes.

Unit IV

Genetics- Monohybrid -and Dihybrid cross- test cross- back cross- Mendel's Laws- Deviation from Mendelian ratio - incomplete dominance- lethal factor- complementary factor- supplementary factor- duplicate and inhibitory- Polygenic inheritance - Inheritance of Wheat Kernel -and ear length in Maize.

Unit V

General principles of Gene Regulation- Gene Regulation in prokaryotes - Operon concept-*lac* Operon- Positive and negative control- Catabolite Repression- Gene Regulation in Eukaryotes- Transcriptional- Translational -and Post translational control in eukaryotic cells- Gene silencing.

REFERENCE BOOKS:

Cell Biology:

1. Turner, P.C. A.G. MC Lennan. A.D. Bates And M.R.H. White. 1998. Instant Notes in Molecular. Biology. Viva Books Pvt. Ltd. Chennai.
2. Verma.P.S and Agarwal, V.K. 2007. Cytology. S. Chand & Co. Chennai.
3. Wolfe, S.L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co, Clifornia.
4. De Robertis, E.D.P & De Robertis, E.M.F (1980) Cell and molecular biology, Holt Saunders International Editions, Philadelphia, Tokyo.
5. Rastogi, S.C. (1992) Cell biology, Tata McCraw Hill Publishing Co., Ltd., New Delhi.
6. Sundararajan, S., (2000) Cytology, Anmol Publication (P) Ltd., New Delhi.
7. Verma, P.S., Cytology, S. Chand & Co., Calcutta.

GENETICS

1. Agarwal, V.K. (2000). *Simplified course in Genetics* (B.Sc., Zoology). S. Chand & Company Ltd., New Delhi.
2. Ahluwalia, K.B. (1990). *Genetics*. Wiley Eastern Ltd., Madras.
3. Gupta, P.K. (2000). *Genetics*. Rastogi Publishers, Meerut.
4. Jain, H.K. (1999). *Genetics-Principles, Concepts & Implications*. Oxford & IBH Publishing Co., (P) Ltd., New Delhi.
5. Lewin, B. (1990). *Genes IV*. Oxford University Press, Oxford.
6. Meyyan, R.P. (2000). *Genetics & Evolution*. Saras Publication, Nagercoil.
7. Pandey, B.P. (2012). *Cytology, Genetics and Molecular Genetics*. Tata McGraw-Hill Education Private Ltd., New Delhi.
8. Renganathan, T.K. and Shanmugavel, S. (1996). *Genetics & Genetic Engineering*. Commercial Offset Printers, Sivakasi.
9. Sandhya Mitra (1994). *Genetics - A Blue Print of Life*. Tata McGraw-Hill Education Private Ltd., New Delhi.
10. Sarin, C. (1994). *Genetics*. Tata McGraw-Hill Education Private Ltd., New Delhi.
11. Winter, P.C., Hickey, G.I. and Fletcher, H.L. (1999). *Instant Notes in Genetics*. Viva Books (P) Ltd., New Delhi, Mumbai, Chennai.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBO5CC5	Cell Biology and Genetics					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓		✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓		✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓		
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
53	0	0	0	53

SEMESTER - V

Course code: 20UBO5CC6

Instruction: Hours: 5

Credit: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE VI

PLANT ECOLOGY AND PHYTOGEOGRAPHY

Course Outcomes:

On successful completion of the course, the students will be able to:

- Students learned about the interaction between biotic and abiotic components of the environment.
- Know about the concept of energy flow in the ecosystem.
- Students will acquire knowledge regarding vegetation and its analysis.
- Know about different pollutions, consequences in the environment and its mitigation.
- Students will know about the floristic regions and plant formation of the planet

Unit I

Biotic- and abiotic factors -and their influence on vegetation - a brief account of microbes- plants- animals- soil- wind- light- temperature- rainfall and fire- Biogeochemical cycles(Nitrogen, Carbon)

Unit II

Ecosystem concept- processes and components - Food chain - food web - energy flow- pyramids - Nutrient cycling - Types of ecosystems - coastal - and grassland.

Unit III

Autecology - and Synecology - Vegetation - Units of Vegetation - Formation- Association- Consociation - Society development of vegetation - Migration ecesis- colonization - Methods of study of vegetation (Quadrat and transect).

Unit IV

Plant succession -Hydrosere - and Xerosere - Ecological classification of plants - Morphological - and anatomical features of plants - and their correlation to the habitat factors.

Unit V

Phytogeography - principles- vegetation types of India - Tropical rain forest - Sholas – andDeciduous Forest - Sand dunes - Mangrove vegetation - and Scrubjungle - Phytogeographical regions of India-Biodiversity- Hotspot- Endemism - Plant Indicators.

REFERENCE BOOKS:

Plant Ecology &Phytogeography

1. Arumugam, N. (1994). *Concepts of Ecology* (Environmental Biology). Saras Publications, Nagercoil, Tamilnadu.
2. Chandrasekaran, P. (1996). *Chutruch choozhal Maasupadu* (Environmental Pollution) T.K. Printers, Pudukkottai, Tamilnadu.
3. Kumar, H.D. (1992). *Modern Concepts of Ecology* (7th Edn.). Vikas Publishing Co., New Delhi.
4. Sharma, P.D. (2000). *Ecology & Environment*. Rastogi Publications, Meerut, India.
5. Vashishta, P.C. (1990). *Plant Ecology*. Vishal Publications, Delhi, Jalandhar.
6. Verma, P.S. and Agarwal, V.K. (1999). *Concept of Ecology* (Environmental Biology). S. Chand & Co., New Delhi.

Phytogeography

1. Good, R. (1997). *The Geography of flowering Plants* (2nd Edn.). Longmans, Green & Co., Inc., London & Allied Science Publishers, New Delhi.
2. Mani, M.S. (1974). *Ecology & Biogeography of India*. Dr. W. Junk Publishers, The Hague.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBO5CC6	Plant Ecology and Phytogeography					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓		✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓		✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓		✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
54	0	0	8	46

SEMESTER - V

Course code: 20UBO5CC7

Instruction: Hours: 5

Credit: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE VII

MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Course Outcomes:

On successful completion of the course, the students will be able to:

- To study morphological features of vegetative, inflorescence, fruits and seed characters.
- To impart knowledge on botanical nomenclature, classifications, merits and demerits of various systems of classifications.
- To understand the systematics of the selected families of the flowering plants with their economic importance.
- Acquire knowledge on classification of plant families, their characteristics and its economic importance.

Unit I

Morphology- Leaf-Phyllotaxy- simple - compound - and modifications - inflorescence-types - Flower: description of floral parts- Fruitstypes.

Unit II

Introduction to principles of Taxonomy - and their importance - Classification: Natural-Bentham and Hooker- ArtificialLinnaeus -Binomial nomenclature- International Code Nomenclature for Algae- Fungi - Plants ICBN - A brief outline of modern methods of plant identification: Chemotaxonomy - numerical taxonomy - serotaxonomy - and molecular techniques- Preparation - maintenance - and significance of Herbarium -A brief note on important Indianand world herbaria.

Unit III

Detailed study of the characters- and plants of economic importance of the following families -*Annonaceae- Capparidaceae- Tiliaceae- Rutaceae- Anacardiaceae - Leguminosae (Papilionaceae, Cesalpinaceae and Mimosaceae) - and Cucurbitaceae.*

Unit IV

Detailed study of the characters- and plants of economic importance of the following families *Rubiaceae- Asteraceae- Apocynaceae- Asclepiadaceae- Solanaceae- Verbenaceae - Euphorbiaceae - Orchidaceae - and Poaceae.*

Unit V

Study of binomial - family and morphology useful parts and uses for any four plants for each of the following plant products: fibre- resin- timber- cosmetics- cereals- pulses - bevarages and oil.

REFERENCE BOOKS:

TAXONOMY

1. Gurcharan Singh (1999). *Plant Systematics - Theory & Practice*. Oxford & IBH Publishing Co. (P) Ltd., New Delhi.
2. Jaques, H.E. (1999). *Plant Families-How to know them?*. Agro Botanical Publishers (India), Bikaner.
3. Mathews, K.M. (1987-90). *Flora of Tamilnadu Carnatic (1-4vols.)* Rapinat Herbarium, Trichy.
4. Naik, V.N. (1996). *Taxonomy of Angiosperms (9th Ed.)*. Tata McGraw-Hill Publishing Co., (P) Ltd., New Delhi.
5. Palaniyappan, S. (2000). *Angiospermgalin Vagaippadu (Taxonomy of Angiosperms)*. V.K. Publishing House, Chennai.
6. Pandey, B.P. (1997). *Taxonomy of Angiosperms*. S. Chand & Company Pvt. Ltd., New Delhi.
7. Sharma. O.P. (2007). *Plant Taxonomy*. Tata McGraw-Hill Publishing Co., New Delhi.
8. Sivarajan V.V. (1993). *Introduction to the Principles of Plant Taxonomy (2nd Edn.)*. N.K.P. Robson (Ed.). Oxford & IBH Publishing Co. (P) Ltd., New Delhi.
9. Subramanian, N.S. (1999). *Laboratory Manual of Plant Taxonomy (2nd Ed.)*. Tata McGraw-Hill Publishing Co., New Delhi.
10. Vashista, P.C. (1997). *Taxonomy of Angiosperms*. S. Chand & Company Pvt. Ltd., New Delhi.

ECONOMIC BOTANY

1. Ashok Bendre and Ashok Kumar (1998-99). *Economic Botany*. Rastogi Publications, Meerut.
2. Govinda Praksh and Sharma, S.K. (1975). *Introductory Economic Botany*. Jai Prakash Nath, Meerut.
3. Pandey, B.P. (2000). *Economic Botany*. S. Chand & Company Ltd., New Delhi.
4. Sambamurthy, A.V.V.S. and Subrahmanyam, N.S. (1989). *A Text Book of Economic Botany*. Wiley Eastern Ltd., Madras.
5. Sen, S. (1992). *Economic Botany*. New Central Book Agency, Calcutta.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBO5CC7	Morphology, Taxonomy and Economic Botany					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓		✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓		✓	✓	
CO4	✓	✓	✓		✓	✓	✓	✓		✓	
CO5	✓	✓	✓		✓	✓	✓		✓	✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
54	25	0	0	29

SEMESTER - V

Course code: 20UBO5CP5

Instruction: Hours: 4

Credit: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE PRACTICAL - V

(CELL BIOLOGY & GENETICS, PLANT ECOLOGY AND PHYTOGEOGRAPHY & MORPHOLOGY, TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY) (P)

Course Outcomes:

On successful completion of the course, the students will be able to:

- Compare the structure and function of cells & explain the development of cells
- Have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage
- Students will develop field skill pertaining to vegetation analysis.
- To enable the student for quantitative estimation of water samples from different environment
- To study morphological features of vegetative, inflorescence, fruits and seed characters.
- Analyze the characteristics of different plant communities.
- Evaluate the significance of herbarium

CELL BIOLOGY

1. Observation of plant cells in Onion peeling and *Rheo* leaf
2. Cell division: Mitosis and Meiosis Squash technique in onion Root tips - and *Tradescantia*/ - *Rheo* flower bud respectively
3. Photographs: Ultra Structure of cell organelles

GENETICS

1. Problems on simple monohybrid - and dihybrid ratios - Simple problems on interaction on factors included in the theory.

Plant Ecology and Phytogeography:

1. Study of morphological and anatomical features of hydrophytes - and xerophytes.
2. Study of morphological features of epiphytes parasites and halophytes.
3. Determination of minimum size of the quadrat by species area curve method.
4. Random sampling frequency estimation.
5. Determination of soil and water pH from different environment.
6. Estimation of Carbonate bicarbonate.
7. Estimation of Chloride.

MORPHOLOGY, TAXONOMY & ECONOMIC BOTANY

1. Training in dissection- observation - identification and sketching of floral parts of plants belonging to the families mentioned in the syllabus along with floral diagrams and floral formula.
2. Description of plants in technical terms with reference to the families in the syllabus
3. Economic plants covered in theory part in taxonomy - and economic botany and - their importance.

FIELD STUDY

Conduct field trip to study the families and acquire knowledge regarding plants.
Submission of 20 herbarium sheets during autonomous practical examination.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
V	20UBO5CP5	Cell Biology and Genetics & Plant Ecology and Phytogeography Morphology, Taxonomy of Angiosperms and Economic Botany (P)	4	3						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓	✓		✓	✓
CO2	✓	✓		✓	✓	✓	✓	✓		✓
CO3	✓	✓	✓	✓		✓	✓	✓	✓	✓
CO4	✓	✓	✓		✓	✓	✓	✓		✓
CO5	✓	✓	✓	✓		✓	✓		✓	✓
Number of Matches(✓) = 41 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
14	8	1	4	1

SEMESTER - V

Course code:
20UBO5MBE1:1
Instruction: Hours: 5
Credit: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

MAJOR BASED ELECTIVE I

HERBAL BOTANY

Course Outcomes:

On successful completion of the course, the students will be able to:

- Understand the Indian system of medicine
- Understand different systems of traditional medicines
- Acquire knowledge on collection and processing of herbal drugs
- Get knowledge on pharmacological importance of medicinal plants and its bioactive compounds
- Acquire knowledge on different adulterants.

Unit I:

Brief history of medicinal plants- Indian systems of medicines Siddha - Ayurvedha - and Unani systems - Classifications of crude drugs - Chemistry of drugs.

Unit II

Drugs from roots (Catheranthus and Rauwolfia) - Drugs from bark(Cinchona) - Drugs from wood (Ephedra).

Unit III

Drugs from leaves (Aloe- Atropa- Eucalyptus- Ocimum - Datura - and Cassia) - Drugs from flower (Eugenia) - Drugs from fruits - and seeds (wood apple -andCoriander - Trigonella Neem) - Under ground stem (Ginger).

Unit IV:

A brief account of drugs acting on the central nervous system - drugs used in disorders of gastrointestinal tract - and cardiovascular drugs.

Unit V:

Cultivation of medicinal plants in India - Breeding methods applied to medicinal herbs- plant tissue culture as source of biomedicine -Drug adulteration - Methods of drug evaluation.

REFERENCE BOOKS:

1. Agarwal, O.P. (2014). *Organic Chemistry Natural Products, Vol. II*. Krishna Prakashan Media (P) Ltd., Meerut.
2. Alice, D., Muthusamy and Yesuraja, M. (1999). *Mushroom Culture*. Agricultural College, Research Institute Publications, Madurai.

3. Chopra, R.N., Chopra, I.C., Handa, K.L. and Kapur, L.D. (1994). *Indigenous Drugs of India*. IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Marimuthu, T. (1991). *Oyster Mushroom*. Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
5. Nair, N.C. and Henry, A.M. (1983). *Flora of Tamil Nadu, India*. Botanical Survey of India.
6. Nita Bhal (2000). *Handbook on Mushrooms Vol. I and II* (2nd Ed.). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Pathak, V.N. and Yadav, N. (1998). *Mushroom Production and Processing Technology*. Agrobios, Jodhpur.
8. Somasundaram, S. (1997). *Medicinal Botany (Maruthuva Thavaraviyal)* (Tamil Medium Book). Elangovan Publishers, Tirunelveli.
9. Srivastava, A.K. (2006). *Medicinal Plants*. International Book distributors, Dehradun.
10. Subba Rao, N.S. (2000). *Soil Microbiology*. Oxford and IBH Publishing Co. Ltd., New Delhi.
11. Tripathi, D.P. 2005. *Mushroom Cultivation*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
12. Varma, A. and Hock, B. (1995). *Mycorrhiza*. Springer-Verlag, Berlin.
13. Yaaco Vokan (1994). *Azospirillum/Plant Associations*. CRC Press, Boca Raton, FL.

Note:No Practical for this paper.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBO5MBE1:1	Herbal Botany					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓		✓	✓	✓	✓		
CO3	✓		✓	✓	✓		✓		✓	✓	
CO4		✓	✓	✓	✓	✓	✓	✓		✓	
CO5		✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
29	10	1	16	2

SEMESTER - V

Course code:
20UBO5MBE1:2
Instruction: Hours: 5
Credit: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

MAJOR BASED ELECTIVE I

ETHNOBOTANY

Course Outcomes:

On successful completion of the course, the students will be able to:

- Understand the introduction, concept and scope of ethnobotany
- Apply techniques of conservation and propagation of medicinal plants.
- Setup process of harvesting, drying and storage of medicinal herbs
- Propose new strategies to enhance growth of medicinal herbs considering the practical issues pertinent to India
- Get knowledge on pharmacological importance of medicinal plants and its bioactive compounds

Unit I:

Ethnobotany - Introduction- concept - scope and objectives - Ethnobotany as an interdisciplinary science - The relevance of ethnobotany in the present context -Major ethnic groups in Tamil Nadu (Any five).

Unit II:

Methodology of Ethnobotanical studies - a) Field work - b) Herbarium - c) Ancient Literature - d) Temples - and sacred places - Plants used by the tribals: a) Food plants - b) intoxicants - and beverages - c) Resins - and oils - and miscellaneous uses.

Unit III:

Plants and Tribal medicine - Significance of the following plants in ethno botanical practices (along with their habitat and morphology) - a) *Azadiractha indica* -b) *Ocimum sanctum* -c) *Vitex negundo* - d) *Gloriosa superba* -e) *Tribulus terrestris* -f) *Pongamia pinnata* -g) *Cassia auriculata* -h) *Indigofera tinctoria* - Role of ethnobotany in modern medicine with special example *Rauwolfia serpentina* -*Trichopus zeylanicus*.

Unit IV:

Role of ethnic groups in conservation of plant genetic resources - Participatory forest management -Sharing of wealth concept with few examples from India.

Unit V:

Ethnobotany as a source of drug - a) Reserpine⁵ - b) Artemisin - c) Gugulipid - d) Cocaine - e) Strychnine.

REFERENCE:**Ethnobotany**

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi - 1981.
3. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
4. S.K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
5. Cotton C.M. 1997. Ethnobotany - Principles and applications John Wiley and sons
6. Chichester Rajiv K. Sinha - Ethnobotany The Renaissance of Traditional Herbal Medicine - INA SHREE Publishers, Jaipur-1996
7. Faulks, P.J. 1958. An introduction to Ethnobotany, Moredale pub. Ltd. Lon

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBO5MBE1:2	Ethno Botany					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓		✓	✓	✓	✓	✓		✓	
CO3	✓	✓	✓	✓		✓	✓	✓		✓	
CO4	✓	✓		✓	✓	✓		✓	✓		
CO5	✓	✓	✓		✓	✓	✓		✓	✓	
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
40	30	3	1	6

SEMESTER - V

Course code:
20UBO5MBE1:3
Instruction: Hours: 5
Credit: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

MAJOR BASED ELECTIVE I

INDUSTRIAL BOTANY

Course Outcomes:

On successful completion of the course, the students will be able to:

- Understand the mass cultivation of single cell protein and useful seaweeds.
- Acquire knowledge on industrial production of biofuels and its uses.
- Get knowledge on different mushroom cultivation procedures.
- Understand the applications of fermentation technology.
- Acquire knowledge on medicinal plant industry

Unit I: SCP and seaweed industry

Single cell protein (SCP)-algal single cell protein-*Spirulina* mass cultivation - and its applications-*Chlorella* mass cultivation - and its applications-mass production of bacterial SCP - mass production of *Yeast* - seaweed mass cultivation - and their applications

Unit II: Biofuel Technology

Introduction to biofuels bioethanol industrial production of bioethanol- uses of bioethanol- biodiesel manufacture of biodiesel uses - and advantages of biodiesel biogas production-uses of biogas-biohydrogen-biohydrogen production - and its uses.

Unit III: Mushroom cultivation

Nutritive value of edible mushrooms-medicinal values of mushrooms-poisonous mushrooms-morphology of common edible mushrooms-cultivation of paddy straw mushroom-cultivation of oyster mushroom-cultivation of white button mushroom-storage of mushrooms -recipes of mushrooms.

Unit IV: Fermentation technology

Introduction to fermentation technology-stages of fermentation-designing of bioreactors-formulation - and sterilization of medium-isolation - and selection of microorganism-production of stock culture-inoculum development-culture of microorganism in bioreactor-fermentation processes-upstream process - downstream process-important fermentation products.

Unit V: Medicinal plant industry

Preparation and processing of cosmaceutical agents - (peppermint oil - lavender oil - Lemon grass oil) - and natural pesticides (neem and pyrethrum) -Cultivation and - post-harvest technology of *Vinca rosea* -*Gloriosa superba*.

Text Books

1. Kumaresan V. Biotechnology. Saras Publication, Nagercoil, 2013.
2. Annie Ragland and Kumaresan. Angiosperms. Saras Publication, Nagercoil, 2013.
3. Kokate, CK Purohit AP and Gokahale. Pharmacognosy, NiraliPrakasan, 2002.

Reference books:

1. Hema Sane et al. Text book of industrial botany. Vision Publication, India, 2013.
2. Dubey RC. A Text book of Biotechnology, Chand Publication, New Delhi, 2006.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBO5MBE1:3	Industrial Botany					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓	✓	✓		✓	
CO2	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓	✓	✓		✓		✓	
CO4	✓	✓	✓		✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓		✓	✓	✓	✓		
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
50	0	9	18	23

SEMESTER - V

Course code: 20UBO5SBE2:1

Instruction: Hours: 2

Credit: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL BASED ELECTIVE II

PLANT TISSUE CULTURE AND MOLECULAR TECHNIQUES

Course outcomes:

On successful completion of the course, the students will be able to:

- To gain the knowledge on important techniques about plant tissue culture.
- Students learn about sterilization techniques
- To study and impart micropropagation techniques.
- Students learn about plant DNA extraction and quantification
- To study and impart the genetic transformation protocols and its applications.

Unit I: Introduction and Laboratory organization

Introduction Plant tissue culture- Definition, importance- advantages of plant Tissue culture - Molecular Biology Definition- and importance - Laboratory organization - Laboratory design - Laboratory requirements (a) Instruments- (b) Glass wares- (c) Chemicals Laboratory safety- (a) Handling of Chemicals- (b) Storage of Chemicals - Room Temperature -Refrigerator - Deep Freezer- (c) Personal safety-(d) Disposal methods

Unit II: Sterilization Techniques

Sterilization techniques concepts- and performance - Glass wares - Cleaning and sterilization - Medium -(a) composition and- Preparation - Murashige and Skoog- (b) Maintenance of pH- (c) Sterilization - Explant - Washing - Sterilization - Culture - Fumigation - Laminar air flow chamber(a) Cleaning- (b) UV exposure

Unit III: Micropropagation

Micropropagation Techniques - Micropropagation - Direct- and Indirect organogenesis- somatic embryogenesis - Synthetic seed - Hardening - Field visit to Commercial Plant Tissue Culture Laboratory- Limitations of Micropropagation method.

Unit IV: Plant DNA Extraction and Quantification

Plant DNA - Extraction - Separation - Agarose Gel Electrophoresis - Plant Protein: Extraction - Separation: SDS:PAGE

Unit V : Genetic transformation techniques

Indirect DNA delivery - Ti plasmid - Agrobacterium mediated transformation - Direct DNA delivery - Biolistics - Microinjection - Electroporation

REFERENCES BOOKS :

1. Rajini Sharma. Plant Tissue Culture, Campus books international, New Delhi,2000.
2. Razdan, M.K. Introduction to Plant Tissue Culture, Second edition. Oxford and IBH publishing, New Delhi, 2003.
3. Thara, K.M. ParcticalManual series-4. Biotechnology, New India Publishing Agency, New Delhi, 2009.
4. Bhojwani, S. S. and M. K. Razdan. Plant Tissue Culture: Theory and Practice, a revised edition. Elsevier Science, Netherlands, 1996.
5. Chawla, H.S. Introduction to plant biotechnology, second edition, Oxford & IBH Publishing, Co, Pvt. Ltd., New Delhi.2002.
6. Rajendra Reddy and Abhay Shankar, J.P., TissueCulture. Commonwealth Publishers, New Delhi, 2008.
7. Jwala Aggarwal and Shekhar K. Arora, Experiments in Plant Tissue Culture. Campus Book International, New Delhi, 2014.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
V	20UBO5SBE2:1	Plant tissue culture and Molecular techniques	2	2						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓	✓	✓		✓
CO2	✓	✓	✓	✓		✓		✓	✓	✓
CO3	✓	✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓		✓	✓	✓	✓	
CO5	✓	✓	✓		✓	✓	✓	✓		✓
Number of Matches(✓) = 39 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
56	0	0	0	56

SEMESTER - V

Course code: 20UBO5SBE2:2

Instruction: Hours: 2

Credit: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL BASED ELECTIVE II

TECHNIQUES IN BIOLOGY

Course Outcomes:

On successful completion of the course, the students will be able to:

- Explain the principles of Light microscopy, compound microscopy, Fluorescence microscopy and confocal microscopy
- Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Biology
- The student gets knowledge about bioinstruments like Chromatography
- The student gets knowledge about bioinstruments like Electrophoresis,
- The student gets knowledge about bioinstruments like Centrifuge.

Unit I

Microscopy: Compound Microscope - parts of compound microscope - bright field microscopy - dark field microscopy - Phase contrast microscopy - fluorescent microscopy - Electron microscopy- TEM- SEM - Tissue preparation in light - and electron Microscopy - Camera Lucida - Micrometry-Microtomy- fixatives- dehydration-infiltration - preparation of paraffin block - Microtomes- types - Staining single - and double.

Unit II

Colorimetry - and Photometry- Beer Lamberts Law - colorimeter - and spectrophotometer - Electromagnetic Spectrum - UV spectroscopy- NMR - Mass Spectroscopy - pH Meter.

Unit III

Chromatography - Principles and applications - mobile - and stationary phases -Rf value - Paper chromatography - Gel filtration chromatography- TLC- HPLC- GLC - and Ion-Exchange chromatography.

Unit IV

Electrophoresis - Principles and Applications - Separation of macromolecules by Agarose gel Electrophoresis - Poly Acrylamide Gel Electrophoresis - SDS PAGE - Pulse Iso Electric focusing - Two dimensional gel Electrophoresis.

Unit V

Centrifugation - Principles and Applications ⁵ Types of centrifuges - parts of centrifuges - Velocity gradient centrifugation - Isopycnic centrifugation - Differential centrifugation.

REFERENCE BOOKS:

1. Prasad S, Kumar U. Green House Management for Horticultural Crops. Agrobios India, 2012.
2. Pant V, Nelson. Green House Operation and Management. Bali Publication, 1991.
3. Dubey RC. A text book of Biotechnology. S. Chand and Company, 2006.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBO5SBE2:2	Techniques in Biology					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓		✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓		✓	✓	✓		✓	
CO4	✓	✓	✓		✓	✓	✓	✓		✓	
CO5	✓	✓	✓		✓	✓	✓	✓	✓		
Number of Matches(✓) =41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
58	0	0	0	58

SEMESTER - V

Course code: 20UBO5SBE2:3

Instruction: Hours: 2

Credit: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL BASED ELECTIVE II

PHYTOCHEMISTRY

Course outcomes:

On successful completion of the course, the students will be able to:

- Understand the fundamental concepts of phytochemistry
- Understand the fundamental concepts of secondary metabolites
- Understand the factors affecting secondary metabolites
- Develop the skills of cold and hot solvent extraction.
- Examine the solvent fractionation.

Unit I :

General techniques involved in biosynthetic studies - and brief introduction to the biogenesis of secondary metabolites - Primary - and secondary metabolites

Unit II :

Factors affecting secondary metabolites in medicinal plants- Alkaloids- Ephedrine- Hyoscyamine- Hyoscine- Morphine- Papaverine - Reserpine - and Ergometrine

Unit III:

Factors affecting secondary metabolites in medicinal plants - Glycosides - Digitoxin- Scillaren - and Sennosides.

Unit IV:

General Methods of extraction- Isolation- identification - tests and estimation methods for the following phytoconstituents with special emphasis on HPLC - HPTLC - and other advanced techniques - Asavone from *Acorus calamus* - Aloin from *Aloe sp.*-Vasicine from *Adhatoda vasica* -Andrographolides from *Andrographus paniculata* -Curcumin from *Curcumin longa* - Piperine from *Piper longum* -Berberine from *Berberis aristata* -Gingerol from *Zingiber officinalis* - Hesperidine from Orange peel.

Unit V :

Structural elucidation of following class of phytoconstituentsAlkaloids- Nicotine- Atropine- Morphine- Caffeine - Glycosides- Amygdalin - Strophanthidin -SteroidsCholesterol - Carotenoids- Vitamin A - Lycopine - and Betacarotene -Terpenoids- Camphor- Eugenol- Taxol- Pyrethrin - Flavonoids-Rutin - Quercetin.

Text Book:

1. Text book of Pharmacognosy, by G.E. Treese and W.C. Evans, 15th edition, W.B. Saunders Edenburg, New York.,2. Phytochemistry - Volume I to IV, by Miller Jan, Nostrant Renhold
3. Recent advances in Phytochemistry - Volume I to IV, Scikel Runeckles Appleton century Crofts
4. Lavoiser, 1995 Pharmacognosy and Phytochemistry of Medicinal plants by Jean Bruneton, Rechnique and documentation -
5. Vinod D. Rangari Pharmacognosy and Phytochemistry Part I and II
6. Gurdeep R. Chatawal Organic chemistry of natural products, Volume 1 and 2
7. I.L. Finar Organic chemistry- Vol. I and II
8. Nakanishi Golo Natural product chemistry
9. C.H. J. Wells Introduction to Molecular Phytochemistry
10. T. swain (Ed.) Comparative Phytochemistry.
11. Raphael Iran 1991 Natural products: A lab guide. IInd Edition Academic press.
12. C.K. Kokate, Purohit, Gokhlae Text book of Pharmacognosy.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBO5SBE2:3	Phytochemistry					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓		✓	
CO2	✓		✓	✓	✓	✓		✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓	✓		✓	
CO4	✓	✓	✓		✓	✓	✓	✓	✓		
CO5	✓		✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
54	2	12	36	4

SEMESTER - V

Course code: 20UBO5SBE3:1

Instruction: Hours: 2

Credit: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL BASED ELECTIVE III

ORGANIC FARMING

Course outcomes:

On successful completion of the course, the students will be able to:

- Students will learn about organic farming systems and organic farming methods.
- Students will familiarize on soil pollution, fertilizer pollution and pesticidal pollution and their effect on soil quality.
- Students know about the significance of organic farming, organic manures and biofertilizers
- Students learn about biogas technologies for organic farming waste, recycled use of water in organic farming and domestic and industrial wastes are used in organic farming system.
- Students get acquire knowledge IPR and Patenting.

Unit I

Soil - physical - chemical properties - Soil pollution - oil - chemicals -fertilizers - pesticide - and herbicide - non-degradable solids- biomagnification - consequences of land pollution - damage to soil - and crops - heavy metal contamination.

Unit II

Organic farming - definition - basic concept of organic farming - integrated plant nutrient supply management - integrated insect pest - and diseases management - integrated soil - and water management -Sustainable agriculture practice - crop rotation - crop diversification - mixed cropping - biological nitrogen fixation.

Unit III

Management of organic wastes and green manures - Farm manures- Composts- Mulches - Tillage - and Pest control -Organic manures - organic residue - chemical nature of organic manure - green manure - importance of green manure - crops of green manure - oil cake - Animal based organic manure - cow dung - poultry waste - vermicompost - methods- production - and utilization - Preservation of Panchakavya.

Unit IV

Biofertilizers classification - nitrogen fixers-*Rhizobium*-*Azotobacter*- cyanobacteria-*Azolla*-*Frankia* -*Azospirillum* - and Vesicular Arbuscular Mycorrhizae - Pest and disease management - classification of pest - integrated pest management components- cultural- mechanical - physical control of pest - Biopesticides against microbial parasites - predators and insects.

Unit V

IPR and Patenting issues - Principles of biosafety - GMO and regulations - organic produce - consumer confidence - conversion period - Inspection and certification - Accredited certifying agents National -and International- Quality assurance - logo and labeling.

Reference:

1. Sharma, A.K., 2003. Biofertilizers for sustainable agriculture, Agrobios.
2. NIIR Board, 2004. The Complete Technology Book on Biofertilizer and Organic Farming, National Institute of Industrial Research

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBO5SBE3:1	Organic Farming					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓		✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3	✓	✓	✓	✓		✓	✓	✓		✓	
CO4	✓	✓	✓		✓	✓	✓	✓		✓	
CO5		✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
77	0	5	16	56

SEMESTER - V

Course code: 20UBO5SBE3:2

Instruction: Hours: 2

Credit: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL BASED ELECTIVE III

GREENHOUSE TECHNOLOGY

Course outcomes:

On successful completion of the course, the students will be able to:

- Understand the fundamental aspect of green house technology
- Understand the fertilizer application in green house
- Acquire knowledge on irrigation systems in greenhouses.
- Understand the plant protection in green house
- Acquire knowledge on importance of green house technology

Unit I: Fundamentals of greenhouse technology

Introduction - scope - classification of greenhouses - construction of greenhouse - heating unit - cooling unit - environmental control- (light and temperature).

Unit II: Fertilizer application

Root media for greenhouses - fertilizers - organic- and inorganic- #liquid fertilizers - Concept- application of fertilizers - nutrient deficiencies- and toxicities

Unit III: Water in the greenhouses

Irrigation system in green houses- drip irrigation- micro irrigation- water quality- water sanitation

Unit IV: Plant protection in greenhouses

Diseases of greenhouse plants (bacterial- fungal- nematodes- and viral diseases)- management of pest and diseases - integrated pest management- Role of Integrated pest management.

Unit V: Applications of greenhouse technology

Importance of greenhouse technology- net houses- poly houses- low cost greenhouses- micropropagation- and methods- greenhouse planting of tissue culture transplants- advantages- and disadvantages of greenhouse technology.

Text Books (T.B.) and web links:

1. Sheela VL. Horticulture.MJP Publishers, Chennai, 2011.
2. Introduction to soil science: <http://www.agrimoon.com/wpcontent/uploads/Introduction-to-soil-science.pdf>
3. Role of greenhouse technology in agricultural engineering:
<http://scialert.net/fulltext/?doi=ijar.2006.364.372&org=10>
4. Greenhouse applications: http://www.lindegas.com/en/products_and_supply/fumigants/carbon_dioxide_in_agriculture/greenhouse_applications/index.html

Reference Books:

1. Prasad S, Kumar U. Green House Management for Horticultural Crops. Agrobios India, 2012.
2. Pant V, Nelson. Green House Operation and Management.Bali Publication, 1991.
3. Dubey RC. A text book of Biotechnology. S. Chand and Company, 2006.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
V	20UBO5SBE3:2	Greenhouse Technology	2	2						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓	✓		✓	✓
CO2	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO3	✓	✓		✓	✓	✓	✓	✓		✓
CO4	✓	✓	✓		✓	✓	✓	✓		✓
CO5	✓	✓		✓	✓	✓	✓		✓	✓
Number of Matches(✓) = 41 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
38	5	7	18	8

SEMESTER - V

Course code: 20UBO5SBE3:3

Instruction: Hours: 2

Credit: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL BASED ELECTIVE III

BIODIVERSITY AND CLIMATE CHANGE

Course outcomes:

After completing this course the learner will be able to;

- Develop understanding on the concept and issues of global environmental change
- Analyse the causes and effects of depletion of stratospheric ozone layer
- Examine the climate change and its effect on living beings
- Understand the physical basis of natural greenhouse effect on man and materials
- Evaluate human influenced driver of our climate system and its applications

Unit I

Types - Genetic - species - and ecosystem diversity- global biodiversity- Plant diversity - crop plants - and their relatives - trees and forests - Genetic Diversity - Plant genetic resources- megacentres of origin of genetic diversity -World's major plant gene banks.

Unit II

Endangered flora- their identification - and documentation- Red Data Book - Conservation strategies -*In situ* approach - biosphere reserves - reserve forests - parks and sanctuaries -*Ex situ* approach - Gene bank - seed bank - and cryopreservation- International organizations in conservation - IUCN- IBPGR- WWF - UNEP - and FAO.

Unit III

Components of the atmosphere - the greenhouse gases - & greenhouse effect - global warming - and climate change - consequences - and evidence of climate change - Greenhouse gas emissions - and the causes - electricity generation- transport -Burning fossil fuels - deforestation.

Unit IV

CO₂ capture and storage methods - Geological storage - Ocean storage - Mineral storage - & Leakage - CO₂ reuse mechanisms - CO₂ → methanol - CO₂ → hydrocarbons - and CO₂ → CO →hydrocarbons - CCS projects.

Unit V

Climate change adaptation and mitigation - strategies for emission reduction - Alternative energy sources - Energy efficiency and -conservation - Kyoto protocol - Bali Action Plan IET - CDMs and JI - Carbon credits and carbon economics - carbon footprints - UNFCCC & IPCC - climate change conference- Copenhagen & Mexico.

REFERENCE:

1. Melchias G 2001. Biodiversity and Conservation. Science Publishers,NH USA
2. Krishnamurthy KV 2003. Advanced Textbook on Biodiversity. Oxfordm& IBH, New Delhi
3. The World Conservation Strategy. *IUCN*, Switzerland

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBO5SBE3:3	Biodiversityand ClimateChange					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓		✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3	✓	✓		✓	✓	✓	✓		✓	✓	
CO4	✓	✓	✓		✓	✓	✓	✓	✓		
CO5	✓	✓	✓		✓	✓	✓		✓	✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
68	0	0	0	68

SEMESTER - VI

Course code: 20UBO6CC8

Instruction: Hours: 6

Credit: 6

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE VIII

PLANT PHYSIOLOGY, BIOCHEMISTRY

Course Outcomes:

- To become knowledgeable in plant and its water relations.
- To gain knowledge about chloroplast structure, photosynthetic pigments, the path of energy from the light reactions through Calvin cycle. To understand the energy releasing steps in Glycolysis. Students will be familiar about the mechanism of respiration.
- To acquire knowledge in plant growth regulator and its uses, understand the physiology of flowering and photoperiodism.
- The student knows basic knowledge of the biological importance of the biomolecules such as carbohydrates, lipids, protein, nucleic acid and enzymes.
- The students will be able to understand the importance of vitamins and secondary metabolites.

Unit I

Water Relations in Plants - Water potential-Definition -components - Measurement and relation of water potential- Transpiration- Definition - Significance - and Mechanism of stomatal transpiration - Starch - Sugar interconversion - synthesis of organic acid in guard cells - ATP driven H⁺ and K⁺ exchange pump - Mechanism of mineral salt absorption - Theories; Donnan equilibrium - Carrier Concept - and Cytochrome pump theory.

Unit II

Photosynthesis Principles of light absorption by plants - Photosystem I and II- composition-function - location in thylakoids - and Photophosphorylation reactions - CO₂ assimilation pathway: C₃ - C₄ cycles - and CAM- Photorespiration - Factors influencing photosynthesis - Respiration -Respiratory quotient - Fermentation - and Anaerobic processes- Glycolysis - Substrate level Phosphorylation - Entner - Doudroff pathway - Glyoxylate cycle - Krebs cycle - Electron flow components - Electron transport pathway - Oxidative phosphorylation.

Unit III

Growth hormones- Chemical nature- Bioassay - Physiological effect - and practical applications of the following Phytohormones- Auxin- ABA- Cytokinin - Gibberellic acid - and Ethylene- Photoperiodism - Florigen concept - and Vernalization.

Unit IV

Biochemistry- Enzymology - Properties of Enzymes - General classification- CoEnzyme- Isozymes - Prosthetic group - Mode of Enzyme action - Mechanism of Enzyme action- Carbohydrates - General classification - Synthesis - and breakdown of carbohydrates (starch-glycogen- pectin - Glucose) - Amino acids - and proteins - General classification of amino acids

- and proteins- Structure - synthesis - and properties of amino acids - protein structure (Primary-secondary - tertiary - and quaternary) - Ramachandran plot.

Unit V

Vitamins- Secondary metabolites - General classification of Major pathways - Phenolics (Lignins, tannins) -Flavonoids - terpenoids (steroids)-Alkaloids - pigments (Carotenoids - Anthocynins) - Lipid metabolism - General classification of Phospho- Spingo - Glycolipid biosynthesis and oxidation.

REFERENCE BOOKS:

PLANT PHYSIOLOGY

1. Dulsy Fatima, R.P. et. al., (1994). *Elements of Biochemistry*. Saras Publications, Nagercoil, Tamilnadu.
2. Jain, V.K. (1990). *Fundamentals of Plant Physiology*. S. Chand & Co., New Delhi.
3. Pandey, S.N. (1991). *Plant Physiology*. Vikas Publishing House (P) Ltd., New Delhi.
4. Salisbury, F.B. and Ross, C.W. (1999). *Plant Physiology*. CBS Publishers and Printers, New Delhi.

BIOCHEMISTRY

1. Day, P.M. and Harborne, J.B. (2000). *Plant Biochemistry*. Harcourt Asia (P) Ltd., India & Academic Press, Singapore.
2. Srivastava, H.S. (1990). *Elements of Biochemistry*. Rastogi Publications, Meerut, India.
3. Wilson, K. and Walker, J. (1994). *Principles and Techniques of Practical Biochemistry* (4th Edition). Cambridge University Press, U.K.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	20UBO6CC8	Plant Physiology and Biochemistry					6	6			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓		✓	✓	
CO3	✓	✓	✓	✓		✓	✓		✓		
CO4	✓	✓	✓		✓	✓	✓	✓	✓		
CO5	✓	✓		✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
95	0	0	0	95
		6		

SEMESTER - VI

Course code: 20UBO6CC9

Instruction: Hours: 6

Credit: 6

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE IX

EVOLUTION, BIOSTATISTICS AND BIOPHYSICS

Course outcomes:

On successful completion of the course, the students will be able to:

- Interpret the concept of Lemarkism, Neo Lamarkism, Darwinism and also understand the concept of natural selection.
- To acquire knowledge in variation.
- To learn the hypothesis of basic statistical tests in large sample.
- The student acquires the biological techniques.
- To learn the structure of atoms.

Unit I Evolution - Origin of Life - chemosynthetic theory - evidences (any five)- Evolution- Evolutionary theories of Lamarck- Darwin - De Vries - Modern synthetic theory of evolution.

Unit II

Variation- Analysis and sources- Adaptive radiation - Isolation mechanism - Concept of species- Allopatric - and Sympatric - Isolating mechanisms.

Unit III

Biostatistics: Classification of data- mean - median - and mode - Standard deviation - standard error- variance- correlation - chi square test.

Unit IV

Centrifugation - Chromatography - Paper - thin layer - and column - Colorimetry - and general account of spectrophotometry - Electrophoresis - principle- SDS PAGE - applications;

Unit V

Structure of atoms - chemical bonding - electrovalent- covalent - noncovalent - and coordinate bonds - pH - pH scale- Bronsted-Lowry concept - pH meter - and its electrodes - Buffers - Henderson-Hasselbach equation - biological buffer systems.

REFERENCE BOOKS:

BIOSTATISTICS

1. Olive, J.D. (1995). *Basic Statistics - A Primer for the Biomedical Sciences*. John Wiley and Sons, New Delhi.

EVOLUTION

1. Savage, J.M. (1969). *Evolution* (2nd Ed.). Amerind Publishing (P) Ltd., New Delhi.
2. Shukla, R.S. and Chandel, P.S. (1996). *Cytogenetics, Evolution & Plant Breeding*. S. Chand & Company Ltd., New Delhi.
3. Sproule, A. (1998). *Charles Darwin Scientists who have changed the world*. Orient Longmans, Hyderabad.

4. Verma, P.S. and Agarwal, V.K. (1999). *Concepts of Evolution*. S. Chand & Company Ltd., New Delhi.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	20UBO6CC9	Evolution ,Biostatistics and Biophysics					6	6			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓		
CO2	✓	✓	✓	✓		✓	✓		✓	✓	
CO3	✓		✓	✓	✓	✓		✓	✓	✓	
CO4	✓	✓	✓		✓	✓	✓	✓		✓	
CO5	✓	✓	✓		✓	✓	✓	✓		✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
52	0	0	0	52

SEMESTER - VI

Course code: 20UBO6CP6

Instruction: Hours: 5

Credit: 4

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE PRACTICAL - VI

PLANT PHYSIOLOGY, BIOCHEMISTRY, EVOLUTION, BIOSTATISTICS AND BIOPHYSICS) (P)

Course outcomes:

- Students will experience in plasmolysis, light intensities were influenced on transpiration, stomata size and number are responsible for transpiration rate, different coloured light are important for oxygen evolution.
- Students are capable to become practical knowledgeable in estimation of sugars, proteins, lipids
- Students will develop skills on separation of plant pigments by paper chromatography methods
- Students will develop field skill pertaining to vegetation analysis.
- To enable the student for quantitative estimation of water samples from different environment.

Plant Physiology:

1. Determination of osmotic pressure of Onion/Rheo leaf.
2. Effect of light intensity on transpiration using Ganong's Potometer.
3. Determination of stomatal frequency - and estimation of transpiration rate
4. Determination of photosynthetic rate in water plants under different CO₂ concentrations.
5. Separation of plant pigments by paper chromatography.

Biochemistry & Biophysics

1. Colorimetric estimation of sugars/starch
2. Colorimetric estimation of proteins
3. Gravimetric estimation of lipids
4. Separation of plant pigments / amino acids by paper chromatography.
5. Measurement of pH of a solution using pH meter

Biostatistics

1. Simple experiments to determine the mean - median - and mode.
2. Illustration of graphic representation of data using simple analysis.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
VI	20UBO6CP6	Plant Physiology, Biochemistry & Evolution ,Biostatistics and Biophysics (P)	5	4						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓	✓		✓
CO2	✓	✓	✓	✓		✓		✓	✓	✓
CO3	✓	✓	✓		✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓		✓	✓
CO5	✓		✓	✓	✓	✓	✓	✓		✓
Number of Matches(✓) = 40 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
12	7	1	3	1

SEMESTER - VI

Course code: 20UBO6MBE2:1

Instruction: Hours: 6

Credit: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

MAJOR BASED ELECTIVE II

PLANT BREEDING, HORTICULTURE AND LANDSCAPING

Course outcomes:

- Students able to explain about plant breeding
- To gain knowledge about mutation breeding
- Students get acquire knowledge on horticultural crops.
- Students get acquire knowledge on classification of horticulture,
- To understand planning, designing, principles in laying out a garden.

Unit I

Plant Breeding- Objectives -Plant introduction- selection - hybridization techniques- Hybrid Vigor- heterosis - Interspecific - and intergeneric.

Unit II

Mutation -Polyploidy- and its applications in plantbreeding -Breeding for crop improvement for Paddy - Groundnut - and Sugarcane.

Unit III

Horticulture - scope and importance - Horticultural crops - climate- soil - water - and nutritional needs-Plant propagation methods - cutting- layering - grafting and budding - Plant growth regulators in horticulture.- Irrigation methods -and manures-Advantages of Horticulture.

Unit IV

Classification of horticultural crops- Pomology- Olericulture- Floriculture - Spices and Plantation crops - Green house - Indoor gardening- Bonsai - Flower arrangements - Nursery- types- management and Maintenance-and their applications.

Unit V

Landscaping: Principles- elements - and design and layout - formal garden - Informal garden - Special types of gardens (bog garden - sunken garden- terrace - rock garden) - and specific areas.

REFERENCE BOOKS:

1. Allard, R.W. (1960). *Principles of Plant Breeding*. John Wiley & Sons, New York.
2. Bose, T.K., Maiti, R.G., Dhua, R.S. and Das, P. (1999). *Floriculture and Landscaping*. Naya Prakash, Calcutta.
3. Chopra, V.L. (1989). *Plant Breeding*. Oxford IBH, New Delhi.
4. Kumar, N. (1997). *Introduction to Horticulture*. Rajalakshmi Publication, India.

5. Manibhushan Rao, K. (1991). *Text Book of Horticulture*. Macmillan Publications, New Delhi.
6. Roy Choudhry, N. and Mishra, H.P. (2001). *Text book on Floriculture and Landscaping*. Raja Infotech Enterprise, India.
7. Sandhu, M.K. (1989). *Plant Propagation*. Wiley Eastern Ltd., New Delhi.
8. Sharma, J.R. (1994). *Principles and Practice of Plant Breeding*. Tata McGraw Hill, New Delhi.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
VI	20UBO6MBE2:1	Plant Breeding, Horticulture and Landscaping	6	4						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓	✓		✓	✓
CO2	✓	✓	✓		✓	✓	✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓		✓	✓
CO4	✓	✓		✓	✓	✓	✓	✓		✓
CO5	✓	✓		✓	✓	✓	✓	✓		✓
Number of Matches(✓) = 40 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
53	0	1	0	52

SEMESTER - VI

Course code:
20UBO6MBE2:2
Instruction: Hours: 6
Credit: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

MAJOR BASED ELECTIVE II

SEED SCIENCE AND TECHNOLOGY

Course outcomes:

- The students able to get knowledge about general system of seed multiplication and seed production agencies.
- The students gaining knowledge on principles of seed processing, Seed drying and methods.
- The Students enable to acquires ability to perform pre-and post-quality testing or genetic purity.
- The Students gaining knowledge on biological and technological aspects of seed production.
- The students acquire knowledge on Harvest and post-harvest seed treatment Knowledge on current varieties of field crops, consultant services.

Unit I: Seed Production

General system of seed multiplication - Seed production agencies - Identification of seed production areas - and factors affecting it - Compact area approach in seed production - Principles - and methods of seed production of varieties - and hybrids of cereals like paddy- sorghum - pearl millet and maize - pulses like chickpea - pigeon pea - green gram - black gram - oilseeds like groundnut- sesame - sunflower and castor - fibre crops like cotton - and jute - vegetables crops like tomato- brinjal - okra and chilli.

Unit II: Seed Processing

Principles of seed processing - Seed drying principles - and methods- Precleaning- grading- treatment - pelleting and packaging - Seed invigoration - and enhancement treatment - and their applications - Seed processing machines like cleaner cum grader - specific gravity separator - indented cylinder - seed treater - weighing - and bagging machines - their operation - and maintenance - Seed quality maintaineduring processing.

Unit III: Seed Quality Control

Seed legislation - Seeds Act 1966 - Seed Rules 1969 - and New Seed Bill 2004 - Seed Law Enforcement - Seed certification - history- concept- organization - phases and minimum certification standards - Field inspection principles - and methods - Inspection at harvesting - threshing and processing - Pre-and post-quality testing or genetic purity - Seed Certification Schemes - concepts and procedures - Seed Testing concepts and objectives - its role in zseed quality control.

Unit IV: Seed Storage

Requirements and types of seed storage - Factors affecting seed storage - and role of moisture-temperature - RH and moisture equilibrium - Viability nomographs - Seed deterioration causes - and methods of control- Physiological - biochemical - and molecular changes in seed ageing - Seed drying - and Packaging needs - Storage structures - Methods of stacking and their impact - Short and medium term storage - Controlled storage.

Unit V: Seed Health

Significance of seed health - Mode and mechanism of transmission of microorganisms - fungi - bacteria - and viruses - Procedures for seed health test and rules - Externally - and internally seed borne pathogens - mode of infection - development and spread - methods of detection of seed borne diseases -Important seedborne diseases of cereals- oilseeds- pulses - fibre crops - vegetables - and their control measures - Use of pesticides- botanicals - mycotoxins for seed treatments - Carry over infestation - principles of fumigation - and safe use of fumigants.

Text Books (T.B.):

1. Vanangamudi K. Seed science and Technology, New India Publishing Agency, 2014.
2. Basra A. Handbook of Seed Science and Technology Paperback, CRC press, 2008

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
VI	20UBO6MBE2:2	Seed Science and Technology	6	4						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓		✓	✓
CO2	✓	✓	✓	✓		✓	✓	✓	✓	
CO3	✓	✓	✓		✓	✓	✓		✓	✓
CO4	✓	✓	✓		✓	✓	✓	✓	✓	
CO5	✓		✓	✓	✓	✓	✓		✓	✓
Number of Matches(✓) =40 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
102	0	0	12	90

SEMESTER - VI

Course code: 20UBO6MBE2:3

Instruction: Hours: 6

Credit: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

MAJOR BASED ELECTIVE II SILVICULTURE

Course outcomes:

- The student able to apply principles of silviculture and its place in forestry establishment, intermediate operations and their effects on growth and yield.
- The graduates able to discuss applications of Silviculture of economically important species.
- The students recognize how federal, state, and local laws and regulations govern the practice of forestry and forest operations
- The students will able to understand about diagnosis and design of agroforestry systems.
- The students will able to recognize various harvesting, transportation, and processing systems used in the management of forest resources and production of forest products.

Unit I: Principle

Silviculture and its place in forestry - Stand establishment - intermediate operations - and their effects on growth - and yield - Control of understorey - and overstorey vegetation - Silviculture of pure - and mixed stands.

Unit II: Silviculture of economically important species

Tropical Species: *Acacia nilotica* - *A. auriculaeformis* - *A. mangium* - *Albizia lebbek* - *Azadirachta indica* - *Melia azedarach* - *Prosopis juliflora* - *P. cineraria* - *Pithecelobium dulce* - *Bombax ceiba* - *Ceiba pentandra* - *Casuarina equisetifolia* - *Santalum album* - *Shorea robusta* - *Tectona grandis* - *Tamarindus indica* - *Terminalia arjuna* - *T. chebula* - *Dalbergia sissoo* - *D. latifolia*.

Unit III: Silviculture of economically important species

Subtropical and temperate - *Pinus roxburghii* - *P. kesiya* - *P. wallichiana* - *P. gerardiana* - *Cedrus deodara* - *Abies pindrow* - *Picea smithiana* - *Quercus spp* - *Rhododendron spp* - and *Alnus nepalensis*.

Unit IV: Forest mensuration

Scope - importance - and units of measurement - Measuring instruments - and procedures for tree - and stand measurement - Stem form factor - and form quotient - Tree and log volume estimation with empirical formulae - tables and forest inventory - Grading of forest products - Stump and stem analysis - Inventory planning - sampling size - frequency - and probability proportional to area - Computer analysis of inventory data.

Unit V: Agroforestry

Farming systems - monoculture - multiple cropping- agroand farmforestry - Agroforestry systems - perspectives- classification -national - and global importance - benefits - and limitations - Land use systems in shifting cultivation - taungya and plantations - Choice of species - and management practices for live fences- hedgerows - protein "banks" - alley cropping - windbreaks and

shelterbelts - hill-slope - and terrace cultivation - watersheds - and woodlots - Diagnosis and design of agroforestry systems.

Text Books (T.B.) and Web link:

1. Indian Forest Management Hand Book, 53 IAM 9-H, 2012
2. <https://www.bia.gov/cs/groups/xnifc/documents/text/idc-022536.pdf>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	20UBO6MBE2:3	Silviculture					6	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓	✓	✓		✓	
CO2	✓	✓	✓		✓	✓	✓		✓	✓	
CO3	✓		✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓		✓	✓	✓		✓	✓	
CO5	✓	✓		✓	✓	✓	✓	✓	✓		

Number of Matches(✓) = 40 Relationship: High

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
82	0	0	32	50

SEMESTER - VI

Course code: 20UBO6MBE3:1

Instruction: Hours: 6

Credit: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

MAJOR BASED ELECTIVE III

PLANT BIOTECHNOLOGY AND BIOINFORMATICS

Course outcomes:

- Understand the basic principles of plant tissue culture
- Acquire knowledge on sources of biomass and bioenergy.
- Get to know the genetic transformation methods and metabolic engineering
- To study and impart the knowledge online available biological databases
- Students will able to gain about sequence analysis, alignment and protein structure visualization tools.

Unit I: Introduction - and Laboratory organization -Scope and history of plant tissue culture- culture technique - tissue culture media -MS media preparation- sterilization - explant preparation - and inoculation callus induction - organogenesis (embryogenesis) - Suspension culture - somatic embryogenesis - Artificial seed - Anther and ovule culture haploids in crop improvement - Protoplast isolation- purification- fusion - somatic hybridization - Immobilisation techniques - Bio-fertilizers- Mass cultivation - and uses of Bacterial biofertilizers - Rhizobium- Azospirillum - Algal biofertilizers - Anabaena- Nostoc - Fungal biofertilizer - Mycorrhiza (VAM)

Unit -II:

Plant Pesticides - BioInsecticides - Fermentation Technology-Production of Ethanol - Production of Penicillin - Vaccines - Types- Source - production - and uses.

Unit- III:

Biofuel - Hydrogen Production - and the conversion of light energy - Importance of biological production of hydrogen - photoproduction of hydrogen - Cell free hydrogen production - Hydrogen production from Marine organisms - Microbial production of hydrogen.

Unit -IV:

Single cell protein (SCP) - and their Nutritional value-Micro organisms used as SCP-Spirulina-Chlorella - Yeast (*Saccharomyces cerevisiae*) - Mass cultivation of Spirulina- Chlorella - and Yeast - Biogas production - Methanogenesis - Waste treatment - Aerobic - and anaerobic - Reusage of Sewage.

Unit- V :

Introduction to bioinformatics - Biological Database - Protein - and DNA sequence data base - Structure database - literature database -Pubmed-NCBI- Medline - Sequence Alignment - Database similarity searching-FASTA-BLAST - Proteomics - protein structure prediction (primary - secondary - & tertiary) - Human Genome Project.

REFERENCE BOOKS:

1. Arthur, M.L. (2005). *Introduction to Bioinformatics* (Ed:2). Oxford University Press, New York.
2. Attwood, T.K. and Parrysmith, D.J. (2001). *Introduction to Bioinformatics*. Pearson Education, New Delhi.
3. Chatterji, A.K. (2011). *Introduction to Environmental Biotechnology*. Prentice Hall India Pvt., Ltd., New Delhi.
4. Dubey, R.C. (2013). *A Textbook of Biotechnology*. S. Chand & Company Ltd., New Delhi.
5. Gupta, P.K. (1994). *Elements of Biotechnology*. Restogi Publications, Meerut.
6. Ignacimuthu, S. (1997). *Plant Biotechnology*. Oxford & IBM Publishing Co., New Delhi.
7. Kalyan Kumar De. (1997). *Plant Tissue culture*. New central Book Agency, Calcutta.
8. Kumar, H.D. (1991). *A Textbook on Biotechnology*. East west press, New Delhi.
9. Parihar, P. (2014). *A Textbook of Biotechnology*. Argobios Publications, Jodhpur
10. Purohit, S.S. (2003). *Agricultural Biotechnology*. Argobios Publications, Joshpur.
11. Trevan, M.D., Boffey, S., Goulding, K.H. and Stanbury, P. (1988). *Biotechnology - The Biological Principles*. Tata Mc Graw Hill Publishing Co., New Delhi.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	20UBO6MBE3:1	Plant Biotechnology and Bioinformatics					6	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓		✓	✓	✓	
CO2	✓		✓	✓	✓	✓	✓	✓		✓	
CO3	✓	✓	✓		✓	✓	✓		✓	✓	
CO4	✓	✓		✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓		✓	✓	✓	✓	✓		
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
85	0	0	13	72

SEMESTER - VI

Course code: 20UBO6MBE3:2

Instruction: Hours: 6

Credit: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

MAJOR BASED ELECTIVE III

WOOD SCIENCE AND TECHNOLOGY

Course outcomes:

- Students learn about physical, chemical and anatomical features of wood
- Students will be able to identify the soft woods and hard woods
- To gain knowledge about physical and mechanical properties of woods
- To get acquire knowledge in wood seasoning and preservation of woods
- Students will understand wood types.

Unit I: Identification and chemistry of wood

Physical and anatomical features of wood - Pores or vessels - different types of wood rays - non porous woods- sapwood - and heart wood- wood parenchyma - resin - and gum canals - Chemical constituents of wood- cellulose - hemicelluloses -and lignin - Wood extractives- tannins- polyphenols - volatile oils- resins - gums - and waxes.

Unit II: Developmental anatomy of woody plants

Characteristics of woody plants - Soft wood - and hard wood- process of wood formation - organization of cell wall - reaction wood- cambium- kinds - arrangement - shape - and size of cambial initials- Wood rays- wood parenchyma- resin - and gum canals

Unit III: General properties of wood

Physical properties of wood- color- weight- odor- lustre - wood density - specific gravity - moisture content - Thermal properties -conductivity - and diffusivity - Mechanical properties - stress-strain relation in wood - elastic properties- plasticity - Vibration properties-compression - tensile strength- abrasion - brittleness - and hardness.

Unit IV: Seasoning and preservation of wood

Principles of wood seasoning - objectives of seasoning - forms of moisture - diffusion of bound water - Effect of temperature - relative humidity- species - grain direction - and thickness of timber on rate of drying- Classification of timbers according to their seasoning characteristics - Stacking of timbers for air seasoning- Agents responsible for wood deterioration-Fungi- bacteria- insects - Wood preservation - basic principles - preservative chemicals.

Unit V: Wood technology

Composite wood - plywood - laminated wood - core board - sandwich board - fibre board - particle board-Improved wood-Compressed wood - Impregnated wood - Compregnated wood - Heat stabilized wood-Chemically modified wood - densified wood.

Text Book (T.B.):

1. Shrivastave MB. Wood technology. Vikas Publishing House Pvt Ltd. New Delhi, 2000.

Reference Books:

1. Brown HP. Manual of Indian Wood Technology, International Books and periodicals supply service, New Delhi, 1985.
2. Higuchi T. Biochemistry and Molecular Biology of Wood, Springer, 1997.
3. Panshin AJ and de Zeeuw C. Textbook of Wood Technology. McGraw-Hill Book Company, New York, 1980.
4. Wilson K and White DJB. The Anatomy of Wood: Its Diversity and Variability. Stobart and son Ltd., 1986.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
VI	20UBO6MBE3:2	Wood science and Technology	6	4						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓	✓		✓	✓
CO2	✓	✓	✓		✓	✓	✓	✓	✓	
CO3	✓		✓	✓	✓	✓		✓		✓
CO4	✓	✓	✓	✓		✓	✓	✓		✓
CO5	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches(✓) =39 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
88	0	0	0	88

SEMESTER - VI

Course code: 20UBO6MBE3:3

Instruction: Hours: 6

Credit: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

MAJOR BASED ELECTIVE III

ENVIRONMENTAL IMPACT ASSESSMENT

Course Outcomes:

- The students will be able to understand the EIA
- To know the role of public in EIA management
- To know the role of public in EIA techniques
- Understand the Public consultation and participation in EIA
- Know the EIS formulation

Unit I

Introduction - Principles - and purposes of IEE - and EIA and its significance for the society - Cost - and benefits of EIA - EIA involvement during project life cycle.

Unit II

EIA management -principles -& management of EIA - main stages in EIA processes- screening- scoping- prediction - mitigation - and alternatives auditing.

Unit III

EIA techniques- checklists- matrices - network method - remote sensing - and GIS.

Unit IV

Public consultation - and participation in EIA process - EIA guidelines - and review process.

Unit V

EIS formulation - New approaches to EIA - and SEA (strategic environmental assessment)

REFERENCE:

1. Anonymous 2006. *Report of the National Forest Commission*. Govt. of India, New Delhi.
2. Claussen E, Cochran VA and Davis DP. 2001. *Climate Change: Science, Strategies and Solutions*. Pew Centre on Global Climate Change, USA.
3. Committee on Abrupt Climate Change. 2002. *Abrupt Climate Change: Inevitable Surprises*. National Research Council, Ocean Studies Board, National Academics Press, Washington.
4. Koskela J, Buck A and Teissier du Cros E. 2007. *Climate Change and Forest Genetic Diversity: Implications for Sustainable Forest Management in Europe*. Biodiversity International, Rome, Italy.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
VI	20UBO6MBE3:3	Environmental Impact Assessment					6	4				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓		✓	✓	✓	✓	✓			
CO2	✓		✓	✓	✓	✓	✓	✓		✓		
CO3	✓	✓		✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓		✓	✓	✓	✓		✓		
CO5	✓	✓	✓		✓	✓		✓	✓	✓		
Number of Matches(✓) = 40 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
29	0	0	0	29

SEMESTER – I& III

Course code:

20UBO1AC1/20UBO3AC3

Exam Hours: 3

0000

Instruction: Hours: 3

Internal Marks: 25

Credit: 3

External Marks: 75

ALLIED BOTANY-I

MORPHOLOGY, TAXONOMY, ANATOMY AND EMBRYOLOGY

Course Outcomes:

On successful completion of the course, the students will be able to:

- Understand morphological and reproductive characters different plant families.
- Generalize the characters of the families according to Bentham & Hooker's system of classification
- Get knowledge on important plant families, their characteristics and its economic importance.
- To gain knowledge of plant cells, tissues and their functions.
- Get knowledge on structure and development plant embryo.

Unit I

Morphology Leaf: Phyllotaxy - simple - compound and -modifications - inflorescence:types;
Flower: description of floral parts - Fruits:types.

Unit II

Taxonomy - Introduction to principles of Taxonomy and their importance - Classification: Natural - Bentham and Hooker - Artificial :Linnaeus - Binomial nomenclature - International Code Nomenclature for Plants (ICN) IUCN.

Unit III

Detailed study on salient features -description - distribution - and economic importance of the families: *Annonaceae* -*Rutaceae* -*Fabaceae* -*Caesalpiniaceae* -*Rubiaceae* - *Apocyanaceae*, - *Euphorbiaceae* - and *Poaceae*.

Unit IV

Anatomy: Structure and function of simple & - complex tissues - Meristematic tissues: concept - structure - function - & classification - Tissue systems: Primary structure of root -stem - & leaves.

Unit V

Embryology: Structure and development of Anther- Microsporogenesis -Male gametophyte development -Structure - types -and development of Ovule - Megasporogenesis - Female

gametophyte development (Polygonum type) - Endosperm (Nuclear - Cellular - Helobial and Ruminant) - Development of Embryo - Dicot (Capsella).

TEXT BOOKS

1. Pandey, B.P. Taxonomy of Angiosperms S. Chand and Co (p) Ltd. New Delhi, 2013.
2. Rendle, A.B. The classification of Flowering plants Vol. 1 and II, Vikas publishing house (P) Ltd. U.P., 1979.
3. Vashista, P.C. Taxonomy of Angiosperms, S. Chand and Co. New Delhi, Jullunder, 1997.

REFERENCES BOOKS:

1. Pandey, B.P. Plant Anatomy, S. Chand and Company Ltd, New Delhi, 2001.
2. Vashista, P.C. A Text Book of Plant Anatomy, S. Nagin & co., Jullunder and New Delhi, 1987.
3. Bhojwani, S.S. and Bhatnagar, S.P. The Embryology of Angiosperms (4th Edn.) Vikas Publishing House (P) Ltd., & UBS Publishers Distributors, New Delhi, 2000.
4. Maheswari, P. Recent Advances in the Embryology of Angiosperms, International Society of Plant Morphologists - Uniof Delhi, 1973.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
I	20UBO1AC1/20UBO3A C3	Allied course I- Botany I	3	3						
Course Outcome s (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓	✓		✓	✓
CO2	✓	✓		✓	✓	✓	✓		✓	✓
CO3	✓	✓	✓	✓		✓	✓	✓		✓
CO4	✓	✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓		✓	✓	✓		✓	✓
Number of Matches(✓) = 39 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
47	11	0	0	36

SEMESTER -II&IV

Course code:

20UBO2AC2/20UBO4AC4

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 25

External Marks: 75

ALLIED BOTANY- II

THALLOPHYTES, BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PLANT PHYSIOLOGY

Course Outcomes

On successful completion of the course, the students will be able to:

- To understand general characters and classification of algae.
- Learn about the general characters, classification, reproduction and life cycle of fungi.
- To get knowledge about classification, mode of reproduction and detailed study of some important bryophytes.
- To impart knowledge to general characters, classification and stellar evolution of pteridophytes.
- Acquire knowledge on the physiological functions of plants.

Unit I

15 hours

Thallophytes : Algae: General characters - study of structure - and life histories of the following genera - *Oscillatoria* - *Volvox* - *Oedogonium* - *Sargassum* - and *Polysiphonia*

Unit II

15 hours

Fungi: Study of structure - and reproduction of the following genera *Albugo* and *Penicillium* - Economic importance of fungi.

Unit III

15 hours

Bryophytes - Pteridophytes - and gymnosperms - Bryophytes - Structure - and life cycle of *Lycopodium* - General characters' of Gymnosperms - structure - and life cycle of *Cycas*.

UNIT IV

15 hours

Plant physiology - Absorption of water - Ascent of sap - Transpiration - Major and minor elements - Specific role - and symptoms of mineral elements - Growth Hormones - Auxins - Gibberellins - Ethylene - and cytokinins.

UNIT V

15 hours

Photosynthesis - mechanism of photosynthesis -C₃ - and C₄ cycle - Factors affecting photosynthesis - Respiration - mechanism of respiration - Glycolysis- Kreb's cycle -Factors affecting Respiration.

Text Books

1. Gangulee, H.C & Kar A.K. College Botany Vol I and II, Books and Allied (Pvt.)Ltd., Calcutta, 1980.
2. Vashistha, B.R. Botany for Degree students, Vol I and II Chand & Co, New Delhi, 1995.
3. Sharma, O.P. Text book of Algae. Tata McGraw Hill Publishing Co., Ltd., New Delhi, 1990.
4. Srivastava, N.N. Bryophyta. Pradeep Prakashan, Meerut, India, 1996.
5. Sharma, O.P. Textbook of Pteridophyta, MacMillan India Ltd., New Delhi, Madras, 1990.
6. SundaraRajan, S Introduction to Pteridophyta, New Age International Publishers Ltd., Wiley Eastern Ltd., New Delhi. Madras 1994.
7. Vashista, P.C. Botany for Degree Students -Pteridophyta. S. Chand & Co., New Delhi, 1997.
8. Rasheed, A. An Introduction to Pteridophyta, Vikas Publishing Co., New Delhi, 1999.
9. Chopra, G.W & Verma, Y. Gymnosperms, Pradeep Publications, Jalandhar, 1988.
10. Vashista, P.C. Botany for Degree Students - Gymnosperms (2nd Edn.) S.Chand & Co., New Delhi. 1996.
11. Sharma, O.P. Gymnosperms, Pragati Prakashan, Meerut, India, 1997.
12. Jain, V.K. Fundamentals of Plant Physiology, S.Chand & Co, New Delhi. 2000.
13. Pandey, S.N. 1991. Plant Physiology, Vikas Publishing House (P) Ltd., New Delhi, India.
14. Verma, V. Text book of Plant Physiology, Ane Books India, New Delhi. 2007.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
II	20UBO2AC2/20UBO4A C4	Allied Botany II	3	3						
Course Outcome s (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	✓	✓	✓	✓			✓	✓	✓	✓
CO2	✓	✓	✓		✓	✓		✓	✓	✓
CO3	✓	✓	✓	✓		✓	✓	✓		✓
CO4	✓	✓	✓		✓	✓	✓		✓	✓
CO5	✓	✓		✓	✓	✓		✓	✓	✓
Number of Matches(✓) = 40 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
43	0	0	0	43

SEMESTER -II& IV

Course code:

20UBO2AP1/20UBO4AP2

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

ALLIED BOTANY PRACTICAL-1

MORPHOLOGY, TAXONOMY, ANATOMY AND EMBRYOLOGY (P)

Course outcomes:

On successful completion of the course, the students will be able to:

- Understand morphological characters different plant families.
- To gain knowledge on various types of inflorescence
- Get knowledge on important plant families, their characteristics and its economic importance.
- Acquire knowledge on anatomy and developmental biology of the plants.
- Get knowledge on structure and development plant embryo

Morphology:

1. Phyllotaxy types
2. Venation Types
3. Types of inflorescence -Raceme -Cyme - Mixed - and special
4. L.S. of Dicot flower-Hypogynous/ Epigenous
5. Mounting of floral parts
6. Construction of floral diagram and floral formula.

Taxonomy:

1. Detailed of study of the plants belonging to the families mentioned in theory.

Anatomy

1. Structure of Dicot stem
2. Structure of Monocot stem

3. Structure of Dicot root
4. Structure of Monocot root

Embryology

1. T.S. of anther -*Datura*
2. Structure of ovule
3. Isolation of Dicot embryo -*Tridax*
4. Microproperation of anther and observation of ovules (permanent slide)

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20UBO2AP1/20UBO4AP2	Allied Botany practical-I					3	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2		✓	✓	✓		✓	✓	✓	✓		
CO3	✓	✓		✓	✓	✓		✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓		✓	✓		✓	✓	
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
15	9	1	4	1

SEMESTER – I & III

Course code:

20UBO1AC1/20UBO3AC3

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 25

External Marks: 75

ALLIED BOTANY-I

MORPHOLOGY, TAXONOMY, ANATOMY AND EMBRYOLOGY

Course Outcomes:

On successful completion of the course, the students will be able to:

- Understand morphological and reproductive characters different plant families.
- Generalize the characters of the families according to Bentham & Hooker's system of classification
- Get knowledge on important plant families, their characteristics and its economic importance.
- To gain knowledge of plant cells, tissues and their functions.
- Get knowledge on structure and development plant embryo.

Unit I

Morphology - Root system and root modification - Leaf: Phyllotaxy - simple - compound and - modifications - inflorescence-types;-Flower: description of floral parts - Fruits:types.

Unit II

Taxonomy - Introduction to principles of Taxonomy and their importance - Classification: Natural-Bentham and Hooker - Artificial:Linnaeus - Engler&Prantel classification - Binomial nomenclature - International Code Nomenclature for Plants (ICN) IUCN.

Unit III

Detailed study on salient features - description - distribution - and economic importance of the families: *Annonaceae* - *Rutaceae* - *Fabaceae* - *Caesalpinaceae* - *Rubiaceae* - *Apocyanaceae*, *Euphorbiaceae* - and *Poaceae*.

Unit IV

Anatomy: Structure and function of simple & complex tissues - Meristematic tissues: definition - structure - function - & classification - Tissue systems: Primary structure of root - stem - & leaves - Dicot and Monocot

Unit V

Embryology: Structure and development of Anther- Microsporogenesis - Male gametophyte development - Structure - types - and development of Ovule - Megasporogenesis - Female gametophyte development (Polygonum type) - Endosperm (Nuclear - Cellular - Helobial and Ruminant) - Development of Embryo - Dicot (Capsella)- and Monocot.

TEXT BOOKS

- Pandey, B.P. Taxonomy of Angiosperms S. Chand and Co (p) Ltd. New Delhi, 2013.
- Rendle, A.B. The classification of Flowering plants Vol. 1 and II, Vikas publishing house (P) Ltd. U.P., 1979.
- Vashista, P.C. Taxonomy of Angiosperms, S. Chand and Co. New Delhi, Jullunder, 1997.

REFERENCES BOOKS:

- Pandey, B.P. Plant Anatomy, S. Chand and Company Ltd, New Delhi, 2001.
- Vashista, P.C. A Text Book of Plant Anatomy, S. Nagin & co., Jullunder and New Delhi, 1987.
- Bhojwani, S.S. and Bhatnagar, S.P. The Embryology of Angiosperms (4th Edn.) Vikas Publishing House (P) Ltd., & UBS Publishers Distributors, New Delhi, 2000.
- Maheswari, P. Recent Advances in the Embryology of Angiosperms, International Society of Plant Morphologists - Uniof Delhi, 1973.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
I	20UBO1AC1/20UBO3A C3	Allied course I- Botany I	3	3						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓	✓		✓	✓

CO2	✓	✓		✓	✓	✓	✓		✓	✓
CO3	✓	✓	✓	✓		✓	✓	✓		✓
CO4	✓	✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓		✓	✓	✓		✓	✓
Number of Matches(✓) = 39 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
51	11	0	0	40

SEMESTER -II&IV

Course code:

20UBO2AC2/20UBO4AC4

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 25

External Marks: 75

ALLIED BOTANY- II

THALLOPHYTES, BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PLANT PHYSIOLOGY

Course Outcomes

On successful completion of the course, the students will be able to:

- To understand general characters and classification of algae.
- Learn about the general characters, classification, reproduction and life cycle of fungi.
- To get knowledge about classification, mode of reproduction and detailed study of some important bryophytes.
- To impart knowledge to general characters, classification and stelar evolution of pteridophytes.
- Acquire knowledge on the physiological functions of plants.

Unit I

15 hours

Thallophytes : Algae: General characters - study of structure - and life histories of the following genera - *Oscillatoria* - *Volvox* - *Oedogonium* - *Sargassum* - and *Polysiphonia*

Unit II**15 hours**

Fungi: Study of structure - and reproduction of the following genera : - *Albugo* and - *Penicillium* - Economic importance of fungi.

Unit III**15 hours**

Bryophytes - Pteridophytes - and gymnosperms - Bryophytes - Structure - and life cycle of *Lycopodium* - General characters' of Gymnosperms - structure - and life cycle of *Cycas* - and *Pinus*.

UNIT IV**15 hours**

Plant physiology - Absorption of water - Ascent of sap - Transpiration - Major and - minor elements - Specific role - and symptoms of mineral elements - Growth Hormones - Auxins - Gibberellins - Ethylene - and cytokinins.

UNIT V**15 hours**

Photosynthesis - mechanism of photosynthesis - C₃ - and C₄ cycle - Factors affecting photosynthesis - Respiration - mechanism of respiration - Glycolysis - Krebs' cycle - Hatch and Slack pathway - Factors affecting Respiration.

Text Books

1. Gangulee, H.C & Kar A.K. College Botany Vol I and II, Books and Allied (Pvt.) Ltd., Calcutta, 1980.
2. Vashistha, B.R. Botany for Degree students, Vol I and II Chand & Co, New Delhi, 1995.
3. Sharma, O.P. Text book of Algae. Tata McGraw Hill Publishing Co., Ltd., New Delhi, 1990.
4. Srivastava, N.N. Bryophyta. Pradeep Prakashan, Meerut, India, 1996.
5. Sharma, O.P. Textbook of Pteridophyta, MacMillan India Ltd., New Delhi, Madras, 1990.
6. SundaraRajan, S. Introduction to Pteridophyta, New Age International Publishers Ltd., Wiley Eastern Ltd., New Delhi. Madras 1994.
7. Vashista, P.C. Botany for Degree Students - Pteridophyta. S. Chand & Co., New Delhi, 1997.
8. Rasheed, A. An Introduction to Pteridophyta, Vikas Publishing Co., New Delhi, 1999.
9. Chopra, G.W & Verma, Y. Gymnosperms, Pradeep Publications, Jalandhar, 1988.

10. Vashista, P.C. Botany for Degree Students - Gymnosperms (2nd Edn.) S.Chand& Co., NewDelhi. 1996.
11. Sharma,O.P. Gymnosperms, PragatiPrakashan, Meerut, India, 1997.
12. Jain, V.K. Fundamentals of Plant Physiology, S.Chand& Co, New Delhi. 2000.
13. Pandey, S.N. 1991. Plant Physiology, Vikas Publishing House (P) Ltd., New Delhi, India.
- T.B.14. Verma, V. Text book of Plant Physiology, Ane Books India, New Delhi. 2007.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20UBO2AC2/20UBO4A C4	Allied Botany II					3	3			
Course Outcome s (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	
CO1	✓	✓	✓	✓			✓	✓	✓	✓	
CO2	✓	✓	✓		✓	✓		✓	✓	✓	
CO3	✓	✓	✓	✓		✓	✓	✓		✓	
CO4	✓	✓	✓		✓	✓	✓		✓	✓	
CO5	✓	✓		✓	✓	✓		✓	✓	✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
47	0	0	0	47

SEMESTER -II & IV

Course code:

20UBO2AP1/20UBO4AP2

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

ALLIED BOTANY PRACTICAL-1

MORPHOLOGY, TAXONOMY, ANATOMY AND EMBRYOLOGY (P)

Course outcomes:

On successful completion of the course, the students will be able to:

- Understand morphological characters different plant families.
- To gain knowledge on various types of inflorescence
- Get knowledge on important plant families, their characteristics and its economic importance.
- Acquire knowledge on anatomy and developmental biology of the plants.
- Get knowledge on structure and development plant embryo

Morphology:

1. Phyllotaxy types
2. Venation Types
3. Types of inflorescence - Raceme - Cyme - Mixed - and special
4. L.S. of Dicot flower - Hypogynous/ Epigenous
5. Mounting of floral parts
6. Construction of floral diagram and floral formula.

Taxonomy:

1. Detailed study of the plants belonging to the families mentioned in theory.

Anatomy:

1. Structure of Dicot stem
2. Structure of Monocot stem
3. Structure of Dicot root
4. Structure of Monocot root
5. Structure of Dicot leaf

Embryology

1. T.S. of anther - *Datura*
2. Structure of ovule
3. Isolation of Dicot embryo - *Tridax*
4. Micropreparation of anther and observation of ovules (permanent slide)

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
II	20UBO2AP1/20UBO4AP2	Allied Botany practical-I	3	3						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓		✓	✓	✓
CO2		✓	✓	✓		✓	✓	✓	✓	
CO3	✓	✓		✓	✓	✓		✓	✓	✓
CO4	✓	✓		✓	✓	✓	✓	✓		✓
CO5	✓	✓	✓	✓		✓	✓		✓	✓
Number of Matches(✓) = 39 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
16	9	1	5	1

SEMESTER – I

Course code: 22UBO1AC1/22UBO3AC3

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 25

External Marks: 75

ALLIED BOTANY-I

PLANT DIVERSITY, PHYSIOLOGY AND PLANT BIOTECHNOLOGY

Objectives

1. To expose the diversity of plant kingdom and their salient features
2. To acquire skills for engaging themselves in self-employment especially in the broad field of Mushroom Culture.
3. To expose various avenues of opportunities in the field of plant biotechnology considering its recognition, importance and utility value.

Course Outcomes

On successful completion of the course, the students will be able to:

- To understand general characters and classification of algae.
- Learn about the general characters, classification, reproduction and life cycle of fungi.
- To get knowledge about classification, mode of reproduction and detailed study of some important bryophytes.
- To impart knowledge to general characters, classification and stellar evolution of pteridophytes.
- Acquire knowledge on the physiological functions of plants.

Unit I Algae and Fungi

Algae: General characteristics of algae - and its importance - Structure - reproduction - and life cycle of *Chlamydomonas* - and *Ectocarpus*.

Fungi: General characteristics of fungi - and its importance - Structure of *Albugo* - and *Penicillium*.

Unit II Bryophytes and Pteridophytes

Bryophytes: General characteristics of *bryophytes* - Structure - reproduction and - life cycle of *Riccia*.

Pteridophytes: General characteristics of pteridophytes - Structure - reproduction - and life cycle of *Lycopodium*.

Unit III Gymnosperms

Gymnosperms: General characteristics of gymnosperms - and its importance - Structure - reproduction - and life cycle of *Cycas* - and *Pinus*.

Unit IV Plant Physiology

Absorption of water - Photosynthesis - Light - and dark reaction (C3 cycle only) - Respiration. Plant growth regulators - Auxin - and cytokinin.

Unit V Plant Biotechnology

Plant tissue culture - Basic Principles - M.S. medium preparation - Callus culture - and regeneration

Text Books:

1. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1996). Introductory Mycology (4th edition). John Wiley and Sons (Asia), Singapore.
2. Dubey, R.C. (2013). A Textbook of Biotechnology. S. Chand & Company Ltd., New Delhi.
3. Ignacimuthu, S. (1997). Plant Biotechnology. Oxford & IBM Publishing Co., New Delhi.
4. Jain, V.K. (1990). Fundamentals of Plant Physiology. S. Chand & Co., New Delhi.
5. Kalyan Kumar De. (1997). Plant Tissue culture. New central Book Agency, Calcutta.
6. Pandey, B.P. (2001). College Botany Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd., New Delhi.
7. Pandey, S.N. (1991). Plant Physiology. Vikas Publishing House (P) Ltd., New Delhi.

Semester	Code	Title of the Course	Hours	Credits						
I	22UBO1AC1/22UBO3A C1	Allied course I- Botany I	3	3						
Course Outcome s (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	✓		✓	✓	✓	✓	✓		✓	✓
CO2	✓	✓		✓	✓	✓	✓		✓	✓
CO3	✓	✓	✓	✓		✓	✓	✓		✓
CO4	✓	✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓		✓	✓	✓		✓	✓
Number of Matches(✓) = 39 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
36	0	0	0	36

SEMESTER- II&IV

Course code:

22UBO2AC2/22UBO4AC4

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 25

External Marks: 75

ALLIED BOTANY- II MORPHOLOGY, TAXONOMY, ANATOMY, EMBRYOLOGY AND HORTICULTURE

Objectives

1. To make the students aware of basic concepts in morphology, taxonomy, anatomy and embryology.
2. To help students for acquiring skills to engage themselves in selfemployment through horticulture

Course Outcomes:

On successful completion of the course, the students will be able to:

- Understand morphological and reproductive characters different plant families.
- Generalize the characters of the families according to Bentham & Hooker's system of classification
- Get knowledge on important plant families, their characteristics and its economic importance.
- To gain knowledge of plant cells, tissues and their functions.
- Get knowledge on structure and development plant embryo.

Unit I Morphology

Inflorescence types Racemose- cymose - and mixed- special types - cyathium - hypanthodium - verticillaster - and thyrus - Technical description of flower - and floral diagram.

Unit II Plant Taxonomy

General outline of Bentham and Hooker's system of classification - Study of the range of characters and economic importance of Annonaceae - Rutaceae - Rubiaceae - Solanaceae - Euphorbiaceae - and Poaceae.

Unit III Plant Anatomy

Tissues- simple - and complex - Primary structure of dicot stem - root - and leaf - Secondary thickening in dicot stem.

Unit IV Embryology

Structure of mature anther - pollen grain - development of male gametophyte - structure of mature ovule - development of female gametophyte (Polygonum type only) - and fertilization.

Unit V Horticulture

Horticulture: scope - and importance - propagation methods - cutting - layering - and grafting techniques - indoor plants - bonsai techniques.

Reference Books:

1. Bhojwani, S.S. and Bhatnagar, S.P. (2000). The Embryology of Angiosperms (4th Edition). Vikas Publishing House (P) Ltd., UBS Publisher's Distributors, New Delhi.
2. Esau K. (1980). Plant Anatomy (2nd Edition) Wiley Eastern Ltd., Madras.
3. Ganguly A.K. (1971). General Botany, Vol.I. The New Book Stall, Calcutta.
4. Gurcharan Singh (1999). Plant Systematics - Theory & Practice. Oxford & IBH Publishing Co. (P) Ltd., New Delhi.
5. Jitendra Singh. (2014). Basic Horticulture. Kalyani Publishers, Chennai.
6. Kumar, N. (1997). Introduction to Horticulture. Rajalakshmi Publications, Nagercoil.
7. Maheswari, P. (1985). An Introduction to the Embryology of Angiosperms. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
8. Rogland, A. (2000). Developmental Botany (Embryology of Angiosperms). Saras Publications, Nagercoil.
9. Subramaniyan, N.S. (1999). Laboratory Manual of Plant Taxonomy (2nd Ed.). Tata McGraw-Hill Publishing Co., New Delhi.
10. Vashista, P.C. (1997). Taxonomy of Angiosperms. S. Chand & Company Pvt.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
II	22UBO2AC2/22UBO4A C2	Allied Botany- II	3	3						
Course Outcome s (COs)	Programme Outcomes(POs)			Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	✓	✓	✓	✓			✓	✓	✓	✓
CO2	✓	✓	✓		✓	✓		✓	✓	✓
CO3	✓	✓	✓	✓		✓	✓	✓		✓
CO4	✓	✓	✓		✓	✓	✓		✓	✓
CO5	✓	✓		✓	✓	✓		✓	✓	✓
Number of Matches(✓) = 40 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
38	6	0	0	32

SEMESTER- II/IV

Course code:

22UBO2AP1/22UB04AP2

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

ALLIED BOTANY PRACTICAL-I

PLANT DIVERSITY AND PHYSIOLOGY AND PLANT BIOTECHNOLOGY & MORPHOLOGY, TAXONOMY, ANATOMY, EMBRYOLOGY AND HORTICULTURE

Course outcomes:

On successful completion of the course, the students will be able to:

- Understand morphological characters different plant families.
- To gain knowledge on various types of inflorescence
- Get knowledge on important plant families, their characteristics and its economic importance.
- Acquire knowledge on anatomy and developmental biology of the plants.
- Get knowledge on structure and development plant embryo

1. Micro preparations of algae – fungi - bryophytes - pteridophytes - gymnosperms and demonstrating their description and identity included in the syllabus.
2. Micro preparations of stem - root - and leaf of dicot and their identification.
3. Micro preparation of anther and observation of ovules (permanent slides).
4. Description of the plants and salient features of the families included in the syllabus.
5. Dissection flower and construction of floral diagram.
6. Comment on simple experimental setups in plant physiology included in the syllabus.
7. Propagation techniques.
8. Horticultural implements /tools.
9. Bonsai

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
II	22UBO2AP1/22UB04AP2	Allied Botany practical-I	3	3						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓		✓	✓	✓
CO2		✓	✓	✓		✓	✓	✓	✓	
CO3	✓	✓		✓	✓	✓		✓	✓	✓
CO4	✓	✓		✓	✓	✓	✓	✓		✓
CO5	✓	✓	✓	✓		✓	✓		✓	✓
Number of Matches(✓) = 39 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

Total No. of topics	Local	Regional	National	Global
9	6	1	1	1