

**PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM – 636 011
TAMILNADU**



**M.Sc., BOTANY (CBCS Pattern)
REGULATIONS, SCHEME & SYLLABUS
(Revised 2015)**

**Syllabus Revised By
Board of Studies in Botany
Periyar University**

Dr. S. MURUGESH

Professor & Head
Department of Botany
Periyar University
Periyar Palkalai Nagar
Salem – 636 011

Chairman

Dr. K. SELVAM

Associate Professor
Department of Botany
Periyar University
Periyar Palkalai Nagar
Salem – 636 011

Member

Dr. S. KANNAN

Professor & Head
Department of Zoology
Periyar University
Periyar Palkalai Nagar
Salem – 636 011

Member

Dr. S. LALITHA

Assistant Professor
Department of Botany
Periyar University
Periyar Palkalai Nagar
Salem – 636 011

Member

Dr. A. MARUTHUPANDIAN

Assistant Professor
Department of Botany
Periyar University
Periyar Palkalai Nagar
Salem – 636 011

Member

Dr. K. ARUMUGAM

Professor of Botany,
Annamalai University
Annamalai Nagar – 608 002

External Member

Dr. K. MANOHARAN

Professor & Head
Department of Plant Morphology &
Algology
School of Biological Science
Madurai Kamaraj University
Madurai – 625 021

External Member

MR. RAVINDRANATHAN

Owner/Entrepreneur
United Agro Industries
9/70, Sakthi Nagar,
Seelanaickanpatti, Salem

Industrial Personnel

MRS. K. YASMIN

W/o. Z. Mohammed Munawar Khan
66/107, Thirumurugan Nagar
Sivathapuram, Salem – 636 307

Alumni

CONTENTS

Sl.No	Contents	Page No.
1	I. Regulations and Scheme	05
2	1. Eligibility for Admission	06
3	2. Mode of Selection	06
4	3. Duration of the Course	06
5	4. Distribution of Credit Points	06
6	5. Course of Study	07
7	5.1. The component of Internal Examination	07
8	5.2. Theory core paper	07
9	5.3. Practical – Internal and External	07
10	5.4. Marks allotment for Attendance	07
11	6. Details of Project marks	08
12	7. Question Paper pattern	08
13	8. Passing Minimum	08
14	9. Classification of Successful Candidates	08
15	10. Ten point Scale Grading System	09
16	11. Tour Programme	09
17	12. Elective Course	09
18	13. Supportive Course	09
19	II. Course Structure	10-11
20	III. Detailed Syllabus	12
21	Semester I	13
22	Core Course I	14
23	Core Course II	17
24	Core Course III	19
25	Core Course IV	22
26	Core Course V	24
27	Semester II	26
28	Core Course VI	27
29	Core Course VII	30

30	Core Course VIII	32
31	Core Course IX	35
32	Core Course X	37
33	Semester III	39
34	Core Course XI	40
35	Core Course XII	42
36	Core Course XIII	44
37	Semester IV	45
38	Core Course XIV	46
39	Elective Course	49
40	1. Herbal Technology	50
41	2. Fungal Biotechnology	52
42	3. Mushroom Technology	54
43	4. Cytogenetics and Plant Breeding	56
44	5. Biofertilizers Technology	58
45	6. Marine Botany	60
46	7. Photobiology	63
46	Supportive Course	62
47	1. Bioremediation and Phytoremediation	63
48	2. Marine Natural Resources	65
49	3. Forest Ecology and Conservation	66
50	4. Horticulture and Gardening	68
51	5. Phytochemistry	71

Regulations & Scheme

Department of Botany
Periyar University
Degree of Master of Science (M.Sc.) Botany
Choice Based Credit System (CBCS)
Regulation, Scheme and Syllabus

1. Eligibility for Admission:

Candidate who has passed the B.Sc., degree in Botany/Plant Science/Life Sciences of the University or an Examination of any other University accepted by the Syndicate Periyar University and or as equivalent thereto shall be eligible for admission to M.Sc., Degree and undergo the prescribed course of study in an approved department of this University.

2. Mode of Selection:

Applicants have to be selected through entrance examination and also as per the norms of Tamil Nadu Government.

3. Duration of the Course:

The duration of the M.Sc., Degree shall be two years consist of four semesters under Choice Based Credit System.

4. Distribution of Credit Points:

The minimum credit requirement for M.Sc., Degree shall be 90 Credits. The break-up of credits for the programme is as follows;

Course	Course Title	No. Of Courses	Hours/ Week	Maximum Marks	Credits
Core Course	Theory and Practical	14	79	1400	61
Core Course	Project	01	20	200	12
Elective	Elective Course (I,II & III Semester)	03	13	300	12
Supportive	Supportive Course (II & III Semester)	02	08	200	08
		20	120	2100	93

5. Course of Study:

The course of study for the M.Sc., Degree shall be in Botany (CBCS) with internal assessment according to syllabi prescribed from time to time.

5.1 The component of Internal Examination;

Internal Tests (Best of two out of 3)	10 Marks
Seminar	05 Marks
Assignment	05 Marks
Attendance	05 Marks
Total	25 Marks

The allotment of marks and Scheme of examination as follows;

5.2 Theory Core Paper

External	75 Marks
Internal	25 Marks
Total	100 Marks
Duration of examination	3 Hours

5.3 Practical Internal & External

Model Practical	35 Marks
Record	05 Marks
Total	40 Marks
External	60 Marks
Total	100 Marks

5.4 Marks allotment for attendance as follows;

% of attendance	Marks
100% - 91%	5
90% - 81%	4
80% - 71%	3
70%- 61%	2
Below 60%	No marks

6. Details of Project Marks;

Submission of Dissertation	100 Marks
Vivo-voce	50 Marks
Internal marks The marks should be provide by Internal Examiner only (Supervisor of the student)	50 Marks
Total	200 Marks

7. Question paper Pattern:

Time: 3 Hrs.

Maximum Marks: 75

PART – A (5X5=25 Marks)

Answer All Questions (Two questions from each unit with internal choice).

PART – B (5X10=50 Marks)

Answer All Questions (Two questions from each unit with internal choice).

8. Passing Minimum:

- There shall be no Passing Minimum for Internal.
- For External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.
- In the aggregate (External + Internal) the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.
- Grading shall be based on overall marks obtained (internal + external).

9. Classification of Successful Candidates

75% and above	First Class with Distinction
60% to 74%	First Class
Below 60%	Second Class

10. Ten point scale Grade and Grade point System (recommended by UGC)

The UGC recommends a 10-point grading system with the following letter grades as given below:

Letter Grade	Grade Point
O (Out Standing)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Tour Programme:

As per Part of M.Sc., Botany Degree students shall under taken a tour and field study of different types of vegetation, ecosystems etc., under the guidance of faculty members not less than 4- 5 days.

Elective courses:

The University Department of Botany offers following Elective course subjects.

- Herbal Technology
- Fungal Biotechnology
- Mushroom Technology
- Cytogenetics and Plant Breeding
- Biofertilizers Technology
- Marine Botany
- Photobiology

Supportive Courses:

The University Department of Botany offers following Supportive course subjects to other Department students.

- Bioremediation and Phytoremediation
- Forest Ecology And Conservation
- Horticulture and Gardening
- Marine Natural Resources
- Phytochemistry

Course Structure

**DEPARTMENT OF BOTANY
PERIYAR UNIVERSITY
SALEM – 11
PG Programme M.Sc., Botany – Course Structure**

(Applicable to the candidates admitted from the academic year 2014-2015 onwards)

Semester	Core Course	Paper Code	Subject	Hrs/Week	Credits	CIA	EA	Total
I	I	14PBOTCT01	Plant Diversity : I: Algae, Fungi, Lichens and Bryophytes	5	5	25	75	100
	II	14PBOTCT02	Plant Diversity : II: Pteridophytes, Gymnosperms and Paleobotany	5	5	25	75	100
	III	14PBOTCT03	Plant Anatomy, Microtechnique & Embryology	5	5	25	75	100
	IV	14PBOTCT04	Taxonomy of Angiosperms and Economic Botany	5	5	25	75	100
	V	14PBOTCP01	Practical - I (Core I, II, III & IV)	6	3	40	60	100
	ELE.-I	14PBOTE01	Elective - 1	4	4	25	75	100
				30	27			600
II	VI	14PBOTCT05	Plant Ecology and Phytogeography	4	5	25	75	100
	VII	14PBOTCT06	Plant Physiology & Biochemistry	4	4	25	75	100
	VIII	14PBOTCT07	Biological Techniques	4	4	25	75	100
	IX	14PBOTCT08	Cell Biology, Genetics & Molecular Biology	4	4	25	75	100
	X	14PBOTCP02	Practical - II (Core VI, VII, VIII & IX)	6	3	40	60	100
	ELE-II	14PBOTE02	Elective - 2	4	4	25	75	100
	SUP.-I	14PBOTS01	Supportive - 1	4	4	25	75	100
				30	28			700
III	XI	14PBOTCT09	Microbiology & Plant pathology	7	5	25	75	100
	XII	14PBOTCT10	Plant Biotechnology & Genetic Engineering	7	5	25	75	100
	XIII	14PBOTCP03	Practical - III (Core XI & XII)	7	3	40	60	100
	ELE-II	14PBOTE03	Elective - 3	5	4	25	75	100
	SUP.-II	14PBOTS02	Supportive - 2	4	4	25	75	100
				30	21			500
IV	XIV	14PBOTCT11	Research Trends in Botany	10	5	25	75	100
	PRO.	14PBOTPR01	Project Work	20	12	50	150	200
				30	17			300
					93			2100

Total weekly contact hours : **120** Total number of credits: **93**
ELE – Elective; SUP –Supportive; PRO-Project.

Detailed Syllabus

Semester - I

Core Course - Theory

- Plant Diversity – I: Algae, Fungi, Lichens and Bryophytes
- Plant Diversity II: Pteridophytes, Gymnosperms and Paleobotany
- Plant anatomy, Microtechnique and Embryology
- Taxonomy of Angiosperms and Economic Botany

Core Course Practical - 01

SEMESTER – I
CORE COURSE - I
PLANT DIVERSITY - I: ALGAE, FUNGI,
LICHENS AND BRYOPHYTES

Paper Code	14PBOTCT01
Credits	5
Marks	25+75=100
Hours	5/Week

Unit I:

Phycology – Introduction – Definition – History and Development of Phycology – Modern Phycology – Classification of algae (F.E. Fritch) – Occurrence and Distribution of algae – range of thallus structure – Ultra structure of algae (Flagella, Chloroplast, Pyrenoids and Eyespot) – Ecology of Algae (Habit and Habitat) -Cytology of algae – Reproduction in algae – Life cycles in algae – Economic importance of algae.

Unit II:

Nomenclature – Significant features – Occurrence- Thallus organisation – Reproduction – Life cycles – Economic importance of Myxophyceae, Chlorophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae and their comparative account.

Unit III:

Mycology – Introduction – Systematics of fungi(Ainsworth) – Evolution of fungi – Ecology of fungi (Habit and Habitat) – Reproduction and life cycles – Chemistry of Fungal cell – Growth – Nutrition – Metabolism and regulation of metabolism – Diagnostic characters of Myxomycetes, Oomycetes, Zygomycetes, Ascomycetes, Basidiomycetes and Deutromycetes – Economic importance of Fungi – Fungi as symbionts.

Unit IV:

Lichens – Introduction – Components of lichens – Brief History – Occurrence – Classification – Morphology and anatomy of thallus – Different types of reproduction in lichens – Economic importance of lichens – Phycobionts (Photobionts) – Mycobionts.

Unit V:

Bryology – Introduction – Definition – Origin of Bryophytes – Evolutionary and Ecological significance – Classification of Bryophytes - Biogeography – Ecology of Bryophytes – Physiological ecology of Bryophytes – Reproduction in Bryophytes –Chemical constituents of Bryophytes – Bryophytes as indicators of Pollution - Diagnostic characters of Liverworts, Mosses, Hornworts – Life histories of Marchantia, Porella, Fossaombronia, Anthoceros and moss.

References:

Algae:

- Sharma.O.P. 2011. Algae. Tata Mc Graw Hill Education Pvt. Ltd., New Delhi.
- Sharma.O.P. 1986. Text book of Algae. Tata Mc Graw Hill Company Pvt. Ltd., New Delhi.
- Sambamurthy, A.V.S.S. 2005. Text book of Algae. IK International Publications, New Delhi.
- Gangulee, H.C. and Kar. A.K.1989. College Botany. Vol. II. New Central Book Agencies Ltd., Kolkata.
- Karl Esser. 1982. Cryptogams: Cyanobacteria, Algae, fungi, Lichens: Text book and Practical Guide. University of Cambridge. New York.
- Pandey, S.N. and Trivedi, P.S. A text book of Botany. 11th edition. Vikas Publishing House, New Delhi.
- Barsanti.L Paolo Gualtieri. 2014. Textbook of algae. Taylor and Francis Group.
- John, D, and wehr, Robert, G. 2015.Fresh water algae, sheath part hick.
- Linda, E.Graham. James.M.Graham. Lee warren Wilcox. 2009. Algae, Benjamin cummings.
- Awasthi, D.K. 2007. Cryptogams, krishna prakashan media (p)Ltd, Meerut, Delhi.

Fungi:

- Sharma, O.P. 1989. Text book of Fungi. Tata Mc Graw Hill Pvt Ltd., New Delhi.
- Rajni Gupta. 2004. A Textbook of Fungi. A.P.H. Publishing Corporation, New Delhi.
- David, H. Griffin. 1994. Fungal Physiology. Wiley-Liss, Inc., New York.
- Gangulee, H.C. and Kar. A.K.1989. College Botany. Vol. II. New Central Book Agencies Ltd., Kolkata.
- Karl Esser. 1982. Cryptogams: Cyanobacteria, Algae, fungi, Lichens: Text book and Practical Guide. University of Cambridge. New York.
- Pandey, S.N. and Trivedi, P.S. A text book of Botany. 11th edition. Vikas Publishing House, New Delhi.

Lichens:

- Thomas H. Nash. 1996. Lichen Biology. Cambridge University Press, London.
- Gangulee, H.C. and Kar. A.K.1989. College Botany. Vol. II. New Central Book Agencies Ltd., Kolkata.
- Kershaw, K.A. 1985. Physiological ecology of Lichens. Cambridge University Press, New York.

- Karl Esser. 1982. Cryptogams: Cyanobacteria, Algae, fungi, Lichens: Text book and Practical Guide. University of Cambridge. New York.
- Pandey, S.N. and Trivedi, P.S. A text book of Botany. 11th edition. Vikas Publishing House, New Delhi.
- Sambamurthy, A.V.S.S. 2005. Text book of Algae. IK International Publications, New Delhi.
- Sharma, O.P. 1989. Text book of Fungi. Tata Mc Graw Hill Pvt Ltd., New Delhi.

Bryophytes:

- Alain vanderpoorten and Bernard Griffin. 2009. Introduction to Bryophytes. Cambridge University Press. London.
- Gangulee, H.C. and Kar. A.K.1989. College Botany. Vol. II. New Central Book Agencies Ltd., Kolkata.
- Chopra.R.N. 1998. Biology of Bryophytes. New Age International Pvt. Ltd., New Delhi.
- Tuba, Z. Nancy.G. Slack. And Liyod,R. Stark. 2011. Cambridge University Press. New York.
- Reddy, S.M. 1996. University Botany.I: Algae, Bryophyta and Pteridophyta. New Age International Publishers, New Delhi.

SEMESTER – I
CORE COURSE - II
PLANT DIVERSITY - II: PTERIDOPHYTES,
GYMNOSPERMS AND PALEOBOTANY

Paper Code	14PBOTCT02
Credits	5
Marks	25+75=100
Hours	5/Week

Unit – I

Pteridophytes – Introduction – Vascular cryptogams – Characteristic features – Habitat of Pteridophytes – Lifecycles - Origin of Pteridophytes – Evolution of Sporophyte - Classification (Sporne) – Economic Importance – Pteridology in India.

Unit - II

Morphology, structure and reproduction of *Selaginella*, *Isoetes*, *Gleichenia*, *Equisetum*, *Ophioglossum*, *Marselia*, *Salvinia*, *Adiantum* and *Pteris*. Stelar evolution and sorus evolution. Telome theory - Heterospory and Seed habit. Apogamy and Apospory.

Unit – III

Classification of Gymnosperms (Sporne, 1967). Comparative study of vegetative, anatomy and reproduction structure of Coniferales and Taxales. Woods of gymnosperms.

Unit – IV

Comparative study of vegetative, anatomy and reproductive structure of Ginkgoales and Gnetales. Economic importance of gymnosperms.

Unit – V

Geological times scale. Fossilization, types and age determination. Rajmahal hills, Deccan intertrappean flora. Study of morphology, anatomy and evolutionary trends of following groups of fossil forms. Lepidodendrales, Sphenophyllales, Psilophytales, Pteridospermales, Bennettitales, Cycadales, Cordaitales and Coniferales.

References

Text Books

- Vashishta B.R. 2001. Botany for degree students – Pteridophytes. S Chand & Co Ltd; 5th edition.
- Parihar N.S. 1959. An introduction of Peridophytes. Central Book Depot. Publishers.
- Trivedi P.C. 2002. Advances in Pteridology. Pointer Publishers.
- Rashid A 1978. An introduction of Peridophytes. Vikas publishers.
- Govil C.M. 2011. Gymnosperm. Krishna Prakashan Media.
- Bhatnagar S.P. and Alok Moitra 1996. Gymnosperms. New Age International.
- Sambamurthy, A.V.S.S. 2005. A Textbook of Bryophytes, Pteridophytes, Gymnosperms and paleobotany. I.K. International Publishing House. New Delhi.

Reference Books

- Bower F.O. 1963. The Ferns
- Taylor D.V. and Hickey L.J. 1997 Flowering plants: Origin, evolution and phylogeny.
- Sporne K.R. 1996. Morphology of Pteridophytes. Hutchinson; 3rd edition.
- Arnold C.A. 1972. An introduction to Paleobotany. New York, McGraw-Hill Publishers.

SEMESTER – I
CORE COURSE - III
PLANT ANATOMY, MICROTECHNIQUE AND
EMBRYOLOGY

Paper Code	14PBOTCT03
Credits	5
Marks	25+75=100
Hours	5/Week

Unit I: Plant Anatomy I

Plant anatomy – Introduction – Historical Sketch - General structure of higher plants (Plant Organs) – the plant body and its development – Fundamental parts of the plant body – Development of the plant body – Primary and Secondary growth – Internal Organization of vascular plant – Cell types and tissues.

Unit II: Plant Anatomy II

The cell structure and its components – Development of the cell wall – Tissue – Apical Meristem - The Cambium – Vascular System - The Root (Primary and Secondary Structure) – The Stem (Primary, Secondary and Anomalous Structure) – Anatomy of the leaf and petiole – Mature Tissues – Nodal Anatomy - Wood Anatomy - Ecological Anatomy – Systematic Plant Anatomy and Seed Anatomy.

Unit III: Plant Microtechnique

Microscopy – Principles of Microscopy – Uses of Microscope – Photomicrograph – Preparation of Microscope Slides –Types of Microscope slides -Tissue dehydration – infiltrating and embedding tissues – Sectioning - Microtomy - Staining and Mounting – Whole mount methods – Squash and smears – Labelling methods – Histochemistry and Cytochemistry.

Unit IV: Embryology I

Historical account – Floral parts – Microsporangium – Morphology and development of Male gametophyte – Megasporangium – Morphology and Development of Female Gametophyte – Pollination – Palynology – Fertilization.

Unit V: Embryology II

Sexual Incompatibility – Endosperm – Embryogenesis – Polyembryony
– Parthenocarpy – Apomixis - Seed germination and Seedling growth –
Embryology relation to taxonomy and applications of Embryology.

References

PLANT ANATOMY

- Ray F. Evert. 2006. Esau's Plant anatomy- Meristems, Cells and Tissue of the Plant Body- their structure, Function and development., John Wiley Edition, Hoboken, New Jersey.
- Larry Peterson, R., Peterson, C.A. and Melville, L.H. 2008. Teaching plant anatomy through creative laboratory exercises. NRC, Canada.
- William C. Dickison. 2000. Integrative plant anatomy. Elsevier, USA.
- Charles B. Beck. 2010. An Introduction to plant structure and development. 2010. Cambridge University Press. New York.
- Pandey, S.N. and Chadha, A. 1996. Plant anatomy and Embryology. Vikas Publications, New Delhi.
- Katherine Esau. 1960. Anatomy of Seed plants. Wiley India Pvt. Ltd. New Delhi.
- Fahn, A. 1990. Plant Anatomy. Pergamon Press, New York.

MICROTECHNIQUE

- Steven E. Ruzin. 1999. Plant Microtechnique and Microscopy. Oxford University Press, New York.
- Peter Grey. 1958. Hand book of basic microtechnique. MC Graw Hill, New York.
- Marimuthu, R. 2008. Microscopy and Microtechnique. MJP Publisher, Chennai.
- Johansen. D.A. 1940. Plant Microtechnique. MC Graw Hill, New York.
- Hayat, M.A. 2000. Principles and Techniques of Electron Microscopy- Biological applications. Cambridge University Press. UK.

EMBRYOLOGY:

- Bhojwani, S.S. and Soh, W.Y. 2001. Current Trends in the embryology of angiosperms. Kluwer Academic Publishers. The Netherlands.
- Bhojwani, S.S. and Bhatnagar, S.P. 1974. The embryology of Angiosperms. Vikas Publishing House Pvt. Ltd. New Delhi
- Johari, B.M. 1963. Experimental embryology of vascular plants.
- Lersten, N.R. 2004. Flowering Plant Embryology. Blackwell Publishing, Australia.
- Maheswari, P. 1950. An introduction to the embryology of Angiosperms
- Maheswari, P. 1963. Recent advances on the embryology of Angiosperm
- Pandey, S.N. and Chadha, A. 1996. Plant anatomy and Embryology. Vikas Publications, New Delhi.
- Pullaiah, T., Lakshminarayanan, K. and Hanumantha Rao, B. 2001. Text book of embryology of angiosperms, Regency Publications, New Delhi.
- Raghavan, V. 1997. Molecular embryology of flowering plants. Cambridge University Press. UK.

**SEMESTER – I
CORE COURSE - IV**

**TAXONOMY OF ANGIOSPERMS AND
ECONOMIC BOTANY**

Paper Code	14PBOTCT04
Credits	5
Marks	25+75=100
Hours	5/Week

Unit – 1

Systems of classification: Artificial system: Linnaeus: Natural system de Candolle, Bentham & Hooker: Phylogenetic system: Engler and Prantl, Hutchinson and Takhtajan. ICBN, Types and typification – Principles of priority and their limitation– problems in nomenclature, Herbarium and its potential role in teaching and research. Preparation of key, Floras, Monographs – Botanical Gardens

Unit – 2

Chemotaxonomy – micromolecules- primary and secondary metabolites. Macromolecules protein Nucleic acids polysaccharides . Numerical Taxonomy – cladistics. Biosystematics Taxonomy relation to anatomy, embryology, palynology, ecology, cytology and serology. Molecular taxonomy – RFLP.

Unit – 3

Study of diagnostic characters of the following family Magnoliaceae, Mesnispermaceae, Polygalaceae, Caryophyllaceae, Oxalidaceae, Meliaceae, Rhamnaceae, Vitaceae, Sapindaceae, Combretaceae, Lythraceae and Aizoaceae..

Unit – 4

Study of diagnostic characters of Rubiaceae, Oleaceae, Gentianaceae, Boraginaceae, Bignoniaceae, Podestemaceae, Loranthaceae, Orchidaceae, Liliaceae, Commelinaceae, Musaceae, Arecaceae, Cyperaceae and Poaceae,.

Unit – 5

Economic importance of Cereals - Wheat, Rice, Maize, Sorghum, Barley. Legumes:, Black gram, Red gram, Chick pea, Pigeon pea. Fruits:

Banana, Grapes, Citrus, Mango. Spices and Condiments: Ginger, Pepper, Cardamom, Clove. Beverages from plants: Tea, Coffee and Cocoa. Fibres- Cotton, Jute, Sun hemp. Timber - Teak, Rosewood, Ebony, Sal and Mahogany. Vegetable Oil - Sun flower, Peanut, Palm Oil, Coconut and Gingili.

References

Text Books

- Nalk, V.N., 1984. Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Company Ltd., New Delhi. 304pp.
- Singh, G 1999. Plant Systematics – Theory and Practice. Oxford and IBH Publishing Co. Pvt Ltd., New Delhi. 35pp.
- Sharma, O.P. 1958. Plant Taxonomy. Tata McGraw Hill Publishing Company Ltd., New Delhi. 482pp.
- Gurucharan Singh. 2008. Plant Sytematics – Theory and Practices. Oxford and IBH Publishing Co. Pvt. Td. New Delhi.
- Michael G. Simpson. 2010. Plant Systematics. Elsevier Academic Press. USA.
- Pandey S.N. and Mishra. S.P. 2009. Taonomy of Angiosperms. Ane Books Pvt. Ltd. New Delhi.
- Pandey, B.P. 2012. Taxonomy of Angiosperms. S.Chand and Company Ltd., New Delhi.
- Rajkumar Gupta. 2006. Text book of Systematic Botany. CBS Publishers. New Delhi.
- Subrahmanyam, N.S. 1995. Modern Plant Taxonomy. Vikas Publishing House Pvt. Ltd. New Delhi.
- Gurucharan Singh. 2010. Plant Sytematics – An Integrated Approach. IIIrd ed. Science Publishers. US.

Reference Books

- Bensen, 1957. Plant Classification. Oxford & IBH Publishing Co., New Delhi.

- Cronquist, A. 1968. Evolution and Classification of Flowering Plants. Thomas & Nelson (Pvt.) Ltd., London.
- Davis, P.H. and Heywood, V.M. 1963. Principles of Angiosperm Taxonomy. Oliver & Boyd – London.
- Henry, A.N. and Chandra Bose, 1980. An aid to the International Code of Botanical Nomenclature, Today & Tomorrow's Printers & Publishers, Delhi.
- Lawrence, G.H.M. 1961, Taxonomy of Vascular Plants. MacMillan and Co., New Delhi.
- Street, H.E., 1978. Essay in Plant Taxonomy, Academic press, London.
- Bentham, G. 1888. Handbook of British Flora. (7th Ed., revised by A.B. Rendle in 1930). Ashford, Kent.
- Cronquist, A. 1988. The Evolution and Classification of Flowering Plants. (2nd Ed.) New Delhi. 482pp.
- Darlington, C.D. and A.P. Wylie. 1955. Chromosome Atlas of Cultivated Plants. Allen and Unwin, London.
- Hutchinson, J. 1973. The Families of Flowering Plants. (3rd Ed.) Oxford Univ. Press.
- Lawrence, G.H.M. 1951. Taxonomy of Vascular Plants. MacMillan, New York.
- Rendle, A.B. 1904. Classification of Flowering plants. Cambridge, England. 2nd. Vol.1 1930.
- Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd Ed.). Edward Arnold. London.
- Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia Univ. Press. New York, 642 pp.
- Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey.
- Pullaiah, T. 2007. Plant Taxonomy. Regency Publications, New Delhi.

**SEMESTER – I
CORE COURSE - V
PRACTICAL - 01**

**PLANT DIVERSITY I, II, PLANT ANATOMY,
MICROTECHNIQUE, EMBRYOLOGY,
TAXONOMY OF ANGIOSPERMS AND
ECONOMIC BOTANY**

Paper Code	14PBOTCP01
Credits	4
Marks	40+60=100
Hours	6/Week

ALGAE:

- Morphology and internal structures of vegetative and reproductive organs in the genera *Chlorella*, *Padina*, *Gelidium*, *Anabaena* and *Vaucheria*.
- Prepare and submit 15 herbarium sheets (Seaweeds) in the course of field study and education tour.

FUNGI:

- Study of diagnostic features of the following types of fungi - *Phytophthora*, *Albugo*, *Mucor*, *Aspergillus*, *Penicillium*, *Pilobolous*, *Saccharomyces*, *Xylaria*, *Peziza*, *Puccinia*, *Pleurotus*, *Auricularia*, *Polyporus*, *Fusarium*, *Alternaria*, *Parmelia*, and *Usnea*.

LICHENS (Slides):

- Study of Morphology and anatomical features of foliose, crustose and fruticose lichens through permanent slides

BRYOPHYTES:

- Study of morphology and internal structures of vegetative and reproductive organs in the genera of *Marchantia*, *Porella*, *Fossombronia*, *Anthoceros* and Moss.

PTERIDOPHYTES:

Study of vegetative, anatomy and reproductive structure of *Selaginella*, *Ophioglossum*, *Equisetum*, *Gleichenia*, *Marselia* and *Azola*.

GYMNOSPERMS:

Study of morphology, anatomy and reproductive structures of *Araucaria*, *Cupressus*, *Podocarpus*, *Ginkgo*, *Taxus*, *Ephedra* and *Gnetum*.

PALAEOBOTANY (SLIDES):

Study of salient features of *Lepidodendron*, *Lepidocarpon*, *Cleichenites*, *Williamsonia*, *Calamites*, *Sphenophyllum*, *Glossopteris* and *Cycads* through Permanent Slides.

PLANT ANATOMY & MICROTECHNIQUE:

- Study the structures of various Microscopes
- Study the structure of Microtome
- Staining methods (Simple/Permanent)
- Student should submit Two number of Permanent slides for practical Examination
- Study the anomalous, primary and secondary features in selected Monocot and Dicot plants
- Detailed study of TS, TLS and RLS from various wood for to identify the soft and hard wood
- Study the anatomical abnormality of C4 and CAM plants (Leaf/Stem).

EMBRYOLOGY:

- Study of pollen morphology
- Pollen germination experimental study
- Identify the different types of embryos, polyembryony, endosperm types, types of pollen grains.
- Any stage of embryo excision from Cucumber seeds.

TAXONOMY OF ANGIOSPERMS:

- Study the taxonomical descriptions for all plant parts Root, Stem, Leaves, Flowers, Fruits and seeds.
- Study of the morphological and floral characteristic and economic importance of Magnoliaceae, Mesnispermaceae, Polygalaceae, Caryophyllaceae, Oxalidaceae, Meliaceae, Rhamnaceae, Vitaceae, Sapindaceae, Combretaceae, Lythraceae, Aizoaceae, Rubiaceae, Oleaceae, Gentianaceae, Boraginaceae, Bignoniaceae, Podestemaceae, Loranthaceae, Orchidaceae, Liliaceae, Commelinaceae, Musaceae, Arecaceae, Cyperaceae, Poaceae.
- Preparation of Artificial keys
- Herbarium techniques and preparation and submission of 50 herbarium

- Floristic study of selected area

ECONOMIC BOTANY

- To study the economic importance of Cereals, Legumes, Fruits, Spices and Condiments, Fibres, Timber and Vegetable Oil.

Semester - II

Core Course - Theory

- Plant Ecology and Phytogeography
- Plant Physiology and Biochemistry
- Cell Biology, Genetics and Molecular Biology
- Biological Techniques

Core Course Practical - 02

SEMESTER – II

CORE COURSE - VI

Paper Code	14PBOTCT05
Credits	5
Marks	25+75=100
Hours	4/Week

PLANT ECOLOGY AND PHYTOGEOGRAPHY

Unit I

History and Scope of Ecology definition, branches. Ecosystem - structure and function. Factors affecting environment – Abiotic- Edaphic, Climatic, Topographic. Biotic – Alleopathy. Energetics: Productivity, Food chains, Food webs and Tropic levels, Ecological pyramids.

Unit II

Ecosystem – types – aquatic, terrestrial, desert and forest ecosystem. Estuarine and mangrove ecosystem – adaptations. Studying vegetation – types – list and count quadrat methods - density abundance frequency, Ecological niche, ecotone, edge effect.

Unit III

Ecological succession – Seral and Climax communities – Hydrosere, Xerosere. Bog succession, sand dune succession. Ecosystem components – energy flow food chain food web ecological pyramids. Biogeochemical cycle – water cycle, carbon cycle and nitrogen cycle.

Unit IV

Pollution : types – Pollutants, air, water, soil, thermal, radiation and noise pollution and their impact in environment and control measures. Green house effect, effects and its consequences. Waste recycling. Environmental Impact Assessment (EIA).

Unit V

Phytogeography – major biome in world and India. Continental drift hypothesis- Gondwana land factors involved in distribution. Endemism, Age and Area hypothesis. Hot spots, Plant exploration. Invasion and introduction.

References:

Text Books:

- Anathakrishnan, T.N. (1982)-Bioresource Ecology-Oxford & IBH Publ.Co.,Inc.,Belmont.
- Ambasht, R.S. (1974) - A text book of plant ecology (3rd Edn.) Students' Friends. & Co., Varanasi, India.
- Agarwal, K.C. (1987) - Environmental biology- Agro-botanical publications, India.
- Chawla, S. 2011. A text book of Environment & Ecology. Tata Mc Graw-Hill, New Delhi.

Reference Books:

- Billings, W.B.(1965)- Plants and the ecosystem - Wardsworth Publ.Co.,Inc., Belmont.
- Conard, H.S. Plant Ecology - Iowa state Press., Iowa.
- Odum E.P. Gray, W. Barrelet 2004. Fundamentals of Ecology. 15th edition. Thomas Asia Pvt. Ltd.
- Chapman, J.L. and Reiss, M.J. 1999. Ecology; Principles and Applications. II Ed. Cambridge University Press. New York.
- Putman, R.J. and S.D. Wratten. 1984. Principles of Ecology. University of California Press, Berkeley and Los Angeles.
- Schulze, E.D., Beck, E. And K. Muller-Hohenstein. 2005. Plant Ecology. Springer. New York.

SEMESTER – II
CORE COURSE - VII
PLANT PHYSIOLOGY
AND BIOCHEMISTRY

Paper Code	14PBOTCT06
Credits	4
Marks	25+75=100
Hours	4/Week

Unit - I

Water Potential - biological significance, water relationship of the plants, osmosis, permeability, diffusion, chemical potential, water potential, apoplast and symplast concept, SPAC. Translocation of solutes.

Unit – II

Photosynthesis – photosynthetic pigments and their distribution. Biosynthesis of chlorophyll a, b and carotenoids. PS I and PS II. Fluorescence and phosphorescence. Red drop and Emerson's effect. Photophosphorylation. Mechanism of light and dark reaction. Carbon fixation – RUBISCO, C₃, C₄ cycles and CAM pathways and their significance. Photorespiration and its significance.

Unit – III

Respiration – Aerobic and anaerobic respiration - Glycolysis, Krebs' cycle. electron transport system. Alternate oxidase, cyanide resistant respiration. OPP pathway. Mechanism of phosphorylation. Nitrogen metabolism – importance of N₂ to plants and source. Reduction of nitrate to NH₃, enzymes in nitrogen reduction. Biological N₂ fixation – asymbiotic and symbiotic fixation. Biochemistry leghaemoglobin of N₂ fixation. Reductive amination, transamination and GS-GOGAT pathway.

Unit – IV

Plant growth regulation - Physiological effects of auxins, gibberellins, cytokinins, ethylene, ABA and IAA. Stress physiology – Physical, chemical and biological stress – temperature, water, drought, salt and microbes and mechanism. Physiology of flowering - Photoperiodism, importance, induction, florigen. Vernalization - hypothesis, mechanism, hormonal involvement and significance. Biological clock.

Unit - V

Thermodynamics – Laws, enzyme as catalysts – enzyme kinetics, classification, nomenclature, properties and mechanisms of enzyme action. Primary Metabolites - Classification and structure of carbohydrates, proteins, amino acids and lipids. Biosynthesis of fatty acids, beta oxidation. Secondary metabolites - phenolic compounds, alkaloids and flavonoids. Nomenclature, structure, properties and mode of action of enzymes.

References

Text Books

- Mukjerjee S. and Ghosh A.K. (2009) Plant Physiology. New Central Book Agency; 3rd Revised edition edition.
- Jain, A. K. (2003), “Textbook of Physiology”, Arichal Publishing Company. New Delhi.

Reference Books

- Salisbury F.F. and Ross C.W. 1992. Plant Physiology. (IV edition) Wordsworth Publishing Company. California, USA.
- Hopkins W.G. 1995. Introduction to plant physiology, John Wiley and Sons, new York, USA.
- Moore T.C. 1989. Biochemistry and physiology of plant hormones, Springer Verlag. New York, USA.
- Taiz L. And Zieger E. 1998. Plant physiology, Sinauer Associates Inc. and publishers, USA.

SEMESTER – II
CORE COURSE - VIII

BIOLOGICAL TECHNIQUES

Paper Code	14PBOTCT07
Credits	4
Marks	25+75=100
Hours	4/Week

Unit I

General Principles of Biochemical analysis – Principles and Methodology of Colorimetry, Spectrophotometry, pH meter and Centrifugation techniques.

Unit II

Chromatographic techniques – Types of chromatography and their principles and methods (Column Chromatography, Adsorption Chromatography, Partition Chromatography, Ion-Exchange Chromatography, Gas-liquid Chromatography, Thin layer chromatography and HPLC. Electrophoretic techniques – Methodology, Principles, Types of Electrophoresis (Agarose gel electrophoresis, PAGE).

Unit III

Techniques in Molecular Biology – Nucleic Acids – Isolation and Purification – Southern, Western and Northern hybridization Techniques – Colony hybridization – Polymerase Chain Reaction – Genome mapping – Molecular Markers – RFLP, RAPD and AFLP.

Unit IV

Microbiological and Biotechnological techniques – Microbe and Plant Tissue – Media preparation (PDA, Nutrient Agar, CHU-10) – Bold basal medium (MS medium, Gamborg medium) – Sterilization techniques – Cytological techniques – Pretreatment, Fixatives and Stains.

Unit V

Taxonomical and Phytochemical techniques – Herbarium Methods – Monographs, Flora and Vegetation Studies – Botanical Nomenclature – Phytogeography of India. Phytochemistry- Phytochemicals – Extraction,

isolation, Characterization and identification of Terpenes, Alkaloids and Flavonoids.

References:

- Jeyaraman, J. 1981. Laboratory Manual in Biochemistry. Wiley Eastern Ltd. Mumbai.
- Plummer, D.T. An Introduction to practical biochemistry. Tata MC Graw Hill Co. New York.
- Keith Wilson and John Walker. 1995. Practical biochemistry. Univ. of Cambridge., New York.
- Chawla, H.S. 2000. Introduction to biotechnology. Oxford and IBH publishing Co., New Delhi.
- Johansen, D.A. 1940. Plant Microtechnique. MC Graw Hill Co., New York.
- Nagarajan, P. and Senthilkumar, N. 2001. Molecular biology principles and methods a practical approach, Sree Narmatha Printers, Coimbatore.
- Sharma, R.K. and S.P.S. Sangha. 2009. Basic Techniques in Biochemistry and Molecular Biology. I.K. International Pvt. Ltd, New Delhi.
- Keith Wilson and John Walker.2010. Principles and Techniques of Biochemistry and Molecular biology. Cambridge University Press, New York.
- Gurucharan Singh. 2008. Plant Sytematics – Theory and Practices. Oxford and IBH Publishing Co. Pvt. Td. New Delhi.
- Michael G. Simpson. 2010. Plant Systematics. Elsevier Academic Press. USA.
- Rajkumar Gupta. 2006. Text book of Systematic Botany. CBS Publishers. New Delhi.
- Subrahmanyam, N.S. 1995. Modern Plant Taxonomy. Vikas Publishing House Pvt. Ltd. New Delhi.
- Palanichamy, S. and M. Shunmugavelu. 1997. Research methods in Biological Sciences. Palani Paramount Publications, Palani.

- Shah.B. and Seth.A. 2010. Text book of Pharmacognosy and Phytochemistry. Elsevier India Pvt. Ltd. New Delhi.
- Harborne, J.B. 1973. Phytochemical methods – A Guide to modern technique of plant analysis. Thomsan Publications Pvt. Ltd. UK.

SEMETER – II
CORE COURSE - IX
CELL BIOLOGY, GENETICS AND
MOLECULAR BIOLOGY

Paper Code	14PBOTCT08
Credits	4
Marks	25+75=100
Hours	4/Week

Unit – I

The plant cell: Structure and function of cell wall, membrane, chloroplast, mitochondria, ribosomes, peroxisomes, golgi apparatus, nucleus, nucleolar organizer and ER. Cell cycle – mitosis and meiosis, pairing, crossing over and cytokinesis.

Unit - II

Chromosomes: Morphology and chemistry; molecular organization of centromere and telomere. Karyotype. Polytene, lampbrush and B-chromosomes. Ploidy: Haploid, diploid; aneuploidy and euploidy – polyploids – significance. In –situ hybridization – FISH and GISH.

Unit – III

Mendelian theory – Laws of inheritance - monohybrid, dihybrid, test cross, back cross. Epitasis, Interaction of genes, complementary genes, linkage, gene mapping, Sex determination. Cytoplasmic inheritance involving chloroplast.

Unit – IV

Chromatin organization – DNA replication, C- value paradox. Transcription, RNA splicing – post transcriptional modification. Enzymes involving in replication and transcription. Translation – targeting of proteins to different cellular compartments.

Unit – V

Plastome – structure and function. Transcription and processing of chloroplast RNA. Transit peptides and protein transport into chloroplast. Mitochondrial genome – import of protein into mitochondria.

References

Text Books

- Gupta P.K 2013 Genetics and Cytogenetics. 7th Edition. Rastogi Publications.

- Ahluwalia K.B 2005 (First Edition). Genetics. New Age International Private Ltd. Publishers, New Delhi.
- Sariau C 2004 (Sixth Edition) Genetics. TATA McGraw-Hill Publishing Company Ltd., New Delhi.
- Pawar C.B 2003 (First Edition). Genetics Vol. I and II. Himalaya Publishing House, Mumbai

Reference Books

- Derobertis E.D. and De Robertis E.M.F. 2002. Cell and Molecular Biology 8th Edition. Lee and Fab International edition, Philadelphia.
- Cooper G. 1996. The cell – A molecular approach. ASM Press, Washington
- Buchanan B.B. Gruissem W., Jones R.L. (2008). Biochemistry and Molecular Biology. American Society of Plant Physiologist, Maryland, USA.
- Sheeler P and Binachi D 2004. Cell and Moecular Biology, Third edition, Wiley New York, USA.
- Hartk D.L and Jones, E.W 1998 Genetics: Principles and Analysis (Fourth Edition). Jones and Bartlett Publishers, Massachusetts, USA.
- Khush, G.S 1973. Cytogenetics of Aneuploids. Academic Press, New York, London.
- Karp, G. 1999. Cell and Molecular Biology : Concept and Experiments. John Wiley and Sons, Inc., USA.
- Lewin, B. 2000. Gene VII. Oxford University Press, New York, USA.
- Lewis, R. 1997. Human Genetics : Concepts and Application (Second Edition). WCB McGraw Hill, USA.

SEMESTER – II	Paper Code	14PBOTCP02
CORE COURSE - X	Credits	3
PRACTICAL - 02	Marks	40+60=100
TAXONOMY OF ANGIOSPERMS, ECONOMIC BOTANY, PLANT PHYSIOLOGY, BIOCHEMISTRY, BIOLOGICAL TECHNIQUES, CELL BIOLOGY, GENETICS AND MOLECULAR BIOLOGY	Hours	6/Week

PLANT ECOLOGY:

- Determination of linear changes in vegetation by using line and belt transect methods.
- Determination of frequency, density, abundance, dominance, FICC, dominance index, similarity index and diversity index by using quadrat frame.
- To find out the bulk density of a given soil sample
- To study soil density and porosity

PHYTOGEOGRAPHY:

- To determine the vegetational cover in a given area
- To prepare list of Endangered, Endemic and threatened species in a Selected areas.

PLANT PHYSIOLOGY & BIOCHEMISTRY

- Extraction and estimation of chlorophyll a, b and carotenoids in C₃ and C₄ plants by Arnon (1949).
- Leaf anatomy of C₃ and C₄ plants
- Preparation of buffers – Phosphate and Citrate buffers.
- Preparation of the standard curve of protein (BSA).
- Separation of amino acids by chromatography.
- Separation of amino acids by Thin Layer Chromatography.
- Estimation of reducing and non reducing sugars by Nelson's method (1994).
- Estimation of soluble starch by Hansen and Moller (1975).
- Estimation of soluble protein by Lowry's method (1951).
- Estimation of free amino acids by Bates and Waldren (1973).
- Estimation of lipid by volumetric method.

- Determination of catalase and peroxidase activity by Chance and Maehly (1955).

BIOLOGICAL TECHNIQUES

- Hands on experience in the use of instruments like Spectrophotometer, pH meter, Centrifuge, Thin layer chromatography, Agarose gel electrophoresis, PAGE and PCR
- Extraction methods of plant samples
- Qualitative tests for the identification of terpenes, alkaloids and flavonoids

CELL BIOLOGY, GENETICS AND MOLECULAR BIOLOGY

- Karyotyping of monocot (mitosis).
- Karyotyping of dicot (mitosis).
- Induced aberration of chromosomes
- Genetic cross analysis monohybrid and dihybrid, test cross, back cross
- Isolation of plant genomic DNA.
- Analysis of nuclear DNA by agarose gel electrophoresis.
- Demonstration of PCR

Semester - III

Core Course - Theory

- Microbiology and Plant pathology
- Plant Biotechnology and Genetic Engineering

Core Course Practical - 03

**SEMESTER – III
CORE COURSE - XI**

MICROBIOLOGY AND PLANT PATHOLOGY

Paper Code	14PBOTCT09
Credits	5
Marks	25+75=100
Hours	7/Week

Unit I

Microbiology – Scope and History – Characterization, Classification and Identification of Microorganisms – Morphology, Structure, Nutrition and growth of Bacteria – Metabolism, Cultivation, Reproduction, Pure culture, cultural Characteristic of Bacteria.

Unit II

Virology: Morphology and Classification of viruses – Replication of viruses and transmission viruses – Isolation and Purification of Viruses – General account of mycoplasmas – A brief account of viroids, prions, satellite RNA and Virusoids.

Unit III

A Brief account on Microalgae and Microfungi – Their role in Microbiology - Microbial genetics – Microorganisms in Environment (Soil, Air and Water) – Microorganisms in Industry, Agriculture and Food – Microorganisms in human diseases – Basic methods in Microbiology.

Unit IV

Plant Pathology – Introduction – History – Plant Diseases their nature, Classification and Importance – Disease caused by fungi (Blast of paddy, Red rot of Sugarcane) – Bacteria (Blight of paddy, Black arm of Cotton) Virus (Bunchy top of Banana & TMV) – Mycoplasma (little Leaf diseases) – A brief account on Nematodes and Phytoplasma – Non-Parasitic diseases.

Unit V

Plant Pathogens – Variation in Plant pathogens – Epidemiology and forecasting of Plant diseases – Host Parasite Interrelationship and Interaction –Environment and nutrition in relation to disease development – Defence mechanism – Principles of Plant diseases – integrated disease studying plant diseases – Integrated disease management – Biotechnology in relation to Plant Pathology.

References:

Microbiology:

- Schlegel, H.S. 1986. General Microbiology 6th Ed. (Translated by M. Kugut) Cambridge University Press, London.
- Pelczer, Read and Chan. 1986. Microbiology. Tata MC Graw Hill, New Delhi.
- Ahemed, M. And S.K. Basumatary. 2006. Applied Microbiology. MJP Publishers, Chennai.
- Rao, A.S. 1997. Introduction to Microbiology. Prentice Hall of Pvt. Ltd., New Delhi.

Plant Pathology:

- Mishra, A., A. Bohra and A. Mishra. 2011. Plant Pathology-Disease and Management. AgroBios, Jodhpur.
- Pathak, Khatri and Pathak. 1996. Fundamentals of Plant Pathology. AgroBios, Jodhpur.
- Pandey, B.P. 1982. Plant Pathology – Pathogen and Plant disease. S.Chand & Company Pvt. Ltd, New Delhi.

SEMESTER – III
CORE COURSE - XII
PLANT BIOTECHNOLOGY AND
GENETIC ENGINEERING

Paper Code	14PBOTCT10
Credits	5
Marks	25+75=100
Hours	7/Week

Unit I

Biotechnology as Interdisciplinary and Multidisciplinary approach - Plant Tissue Culture – Introduction - Objectives and Goals – Laboratory organisation – Nutrient medium – Sterilization Techniques – Types of Cultures (seed, embryo, Root, callus, organ, cell, protoplast and axillary bud cultures) – Cell suspension culture and Secondary metabolites - Plant Micropropagation - Somatic embryogenesis – embryogenesis - Organogenesis – Protoplast Isolation and Fusion.

Unit II

Application of tissue culture in agriculture – crop improvement – horticulture and forestry. Application of Biotechnology in Conservation of plant genetic resources – Gene banks – Cryopreservation – Germplasm Conservation – Application in Genetically Modified Organisms (Fruits, Vegetables, Crops and Cereals) – Transgenic plants – Genetics and Genomics of *Arabidopsis thaliana*

Unit III

Intellectual Property (IPR) – Intellectual Property Rights – Intellectual Property Protection – IPR and Plant Genetic Resources – Patent Systems – Sources of patent Information – Patenting Methods – Patenting of higher plants, genes and DNA sequences – Plant Breeders Rights and Farmers Rights – A brief account on Geographical Indication (GI).

Unit IV

Tools of Genetic engineering – Restriction types of Enzymes (Exo and Endo nucleases) – Different types of enzymes used in Genetic engineering (Methylase, SI nuclease, Ligase, Alkaline Phosphatase, Reverse transcriptase, T4 kinase, Terminal transferase, adaptors and Linkers) – Vectors and their types – Plasmid (pBR 322, pUC Vectors), Agrobacterium based Plasmids, Bacteriophage vectors, Cosmids, Phagemids, YAC, CaMV, Gemini Virus, Shuttle and Expression vectors.

Unit V

Cloning Strategies – Basic Methods – rDNA technology – Genomic and cDNA library – Hybridization techniques – Labelling methods – Gene transfer

mechanisms and Nucleotide sequencing methods – Application of genetic engineering in various fields.

References:

- Dubey, R.C. 2008. A Textbook of Biotechnology. S.Chand Company Pvt. Ltd. New Delhi.
- Singh, B.D. 1998. Biotechnology. Kalyani publishers, Ludhiana.
- Primrose, S, R. Twynman and P.Old. 2005. Principles of gene manipulation. Blackwell Science Ltd., New Delhi.
- Smith, R.H. 2000. Plant tissue Culture – techniques and Experiments. Academic Press, New York.
- Dwivedi, P. 2004. Plant Tissue culture. Scientific publishers, New Delhi.
- Reinert, J, Bajaj, Y.P.S. 1997. Plant Cell and Organ Culture. Narosa publishing House, New Delhi.
- Chawla, H.S. 2000. Introduction to biotechnology. Oxford and IBH publishing Co., New Delhi.
- Harry Levine. 2006. Genetic Engineering: A Reference Hand book. ABC – CLIO, Inc, California.

SEMESTER – III
CORE COURSE - XIII
PRACTICAL – 03
MICROBIOLOGY, PLANT PATHOLOGY,
PLANT BIOTECHNOLOGY AND
GENETIC ENGINEERING

Paper Code	14PBOTP03
Credits	3
Marks	40+60=100
Hours	7/Week

Microbiology:

- Cleaning and Sterilization of Glassware
- Preparation of culture media
- Sterilization techniques
- Serial dilution techniques – Pure culture (Pour/Streak/Spread)
- Differential staining methods of bacteria by using Gram stain.
- Antibacterial assay - disc diffusion/agar well method.

Plant Pathology:

- Isolation of pathogens from diseased tissues (leaf, stem and fruit) by serial dilution method.
- Symptoms and identification of diseases caused by fungi (Blast of paddy, red rot of sugar cane), Bacteria (Blight of paddy, Black arm of Cotton) Virus (Bunchy top of Banana & TMV), – Mycoplasma (little Leaf diseases).
- Isolation of pathogenic microorganisms from infected tissues
- Collection and preservation of specimens from infected plants.
- Calculation of Spore load on seeds using Haemocytometer

Plant Biotechnology:

- Preparation of media for plant tissue culture
- Sterilization, inoculation and incubation of explants
- Isolation of protoplasts
- Protoplast fusion
- Callus induction in Carrot

Genetic Engineering:

- Isolation of DNA from Plants
- Principles and applications of agarose gel electrophoresis

Semester - IV

Core Course - Theory

- Recent Trends in Botany

SEMESTER – IV
CORE COURSE - XIV

RESEARCH TRENDS IN BOTANY

Paper Code	14PBOTCT11
Credits	5
Marks	25+75=100
Hours	10/Week

Unit I

Plant Genomics and Proteomics – Introduction – Plant Genome - Structural genomics - genome sequencing strategies - Functional genomics – genome annotation, gene expression study using microarrays functional annotation of genes – Introduction to proteomics – Applications to plant biology – General view of proteomics – Analytical tools in proteomics – subcellular proteomics – plant with biotic and abiotic factors interaction with proteomics.

Unit II

Bioinformatics and Computational Biology – Introduction, aim and importance of bioinformatics – Database and Mining – Genomics, Transcriptomics and Metabolomics - primary and secondary databases DNA sequence databases - Gen bank: a practical approach – Phylogenetic analysis (PHYLP, TREE) DNA databank, Nucleotide sequence databank (EMBI Bank) -Sequence alignment.

Unit III

Phytochemistry– Introduction to Phytochemicals – Antioxidants – Alkaloids – Anthocyanins – carotenoids – flavonoids – Hydroxycinnamic acids – Xanthophylls – plants with phytochemicals – Production of Phytochemicals from medicinal plants – Extraction of phytochemicals – Developing new drugs from Ethnomedicines.

Unit IV

Pharmacognosy – Introduction – history – Indian System of medicine – natural sources of Drugs – Crude drugs – Classification of crude drugs – Collection and Processing of crude drugs – Phytoconstituents of therapeutic value – Histochemical tests for phytochemicals – Drugs containing carbohydrates/glycosides/lipids/Volatile oils/Resin/Alkaloids/Tanninis – Analytical pharmacognosy – Anatomical features of selected medicinal plants (Senna leaf, Datura leaf, Cinchona bark, Nuxvomica seed).

Unit V

Nanobiotechnology – Overview –Biomaterial Science – Fabrication and Characterization of nanostructures –Nanotechnology in Biomedical applications – Health and Environmental impacts of nanotechnology.

Biostatistics - Methods of collection and classification of data; Primary and secondary data, qualitative and quantitative data. Frequency distribution, graphical representation, normal distribution - Mean -Median and Mode - Mean deviation, Standard deviation, variance, standard error, co-efficient of variation - Linear regression and correlation (simple and multiple).

References:

- RanjithaKumari, B.D. 2008. Plant Proteomics. APH Publishers, New Delhi.
- Sanaj.J. and Thelen, J.J. 2007. Plant proteomics. Springer, New York.
- Agarwal, G.K. and Rakwal, R. 2008. Plant Proteomics Technologies; Strategies and Applications. John Wiley & Sons, Inc, USA.
- Balaji, S. 2010. Nanobiotechnology. MJP Publishers, Chennai.
- Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
- Thiagarajan, B. and Rajalakshmi, P.A. 2009. Computational biology. MJP Publishers, Chennai.
- Middha, S.K., Usha, T. And H.P. Prashanth Kumar. 2012. Bioinformatics. College Book House, Bangalore.
- Shah.B. and Seth.A. 2010. Text book of Pharmacognosy and Phytochemistry. Elsevier India Pvt. Ltd. New Delhi.
- Harborne, J.B. 1973. Phytochemical methods – A Guide to modern technique of plant analysis. Thomsan Publications Pvt. Ltd. UK.
- Mahajan. B.K. 1997. Methods in Biostatistics. Jay Pee Brothers Medical Publishers (P) Ltd. New Delhi.
- Bernard Rosner. 2010. Fundamentals of Biostatistics. Brooks/cole, Boston, USA.
- Agarwal, B.L. 1988. Basic Statistics. New Age International Publishers. New Delhi.

- Sahu, P.K. 2013. Research Methodology: A Guide for Researchers in Agricultural Science, Social Science and other related fields. Springer, New Delhi.

Elective Course

- Herbal Technology
- Fungal Biotechnology
- Mushroom Technology
- Cytogenetics and Plant Breeding
- Biofertilizers Technology
- Marine Botany
- Photobiology

ELECTIVE COURSE - I

HERBAL TECHNOLOGY

Paper Code	14PBOTE01
Credits	4
Marks	25+75=100
Hours	4/Week

Unit I

Historical background, Present status, Scope of Medicinal Botany – Indigenous medical system – Bioprospecting, Indigenous Knowledge system, Ayurveda, Siddha, Unani, Homeopathy, Tibetan and Folklore system of medicine. Need to Preserve Knowledge system.

Unit II

Distribution of Indian medicinal plants; Introduction, Important medicinal plants, ecodistribution, mapping distribution in different biogeographic zones. Diversity hot spots – Endemism – Rare, endangered and threatened species.

Unit III

General methods of phytochemical and biological screening – Natural sources – Extraction – Purification and isolation of plant constituents – Alkaloids – glycosides – Volatile oils – Study of some herbal formulation techniques as drug cosmetics.

Unit IV

Post harvest technology of medicinal plants: Importance of post harvest technology in medicinal crops: factors responsible for deterioration of medicinal produce – pre and post harvest factors. Maturity indices for harvesting medicinal plants and pre harvest treatments. Systems of storage of harvested produce – packaging principles and methods of processing. Important medicinal products – essential oils, volatile and non volatile oils, oleo resins – active principles.

Unit V

Conservation of medicinal plants – in-situ and ex-situ conservation. Centers of medicinal plant conservation in India – IBPGRI, CIMAP, CDRI, NBGRI, MSSRF, KFRI, TAMPCOL, TBGRI, TKDL and FRLHT.

References:

- Natesh, S. 2001. The changing scenario of herbal drugs: Role of Botanists. *Phytomorphology*. (Golden Jubilee Issue)., Pp.75-97.
- Jonne Bernes – Herbal Medicines, Pharmaceutical Press, London.
- Sushil Kumar – Medicinal Plants in Skin care, CIMAP, Lucknow.
- Swaminathan, M.S. and Kochar, S.L. 1989. Plants and Society. McMillan Publishers, London.
- Muthcheliam, K. 2013. Yuirvirimam. Monisha Publishers, Madurai. (Tamil Version).
- Swain, T. 1963. Chemical Plant Taxonomy, Academic Press, London.
- Stace, C.A. 1985. Plant Taxonomy and Biosystematics, Edward Arnold, London.
- Akerele, O.O. Heywood, V. and Singe, H. 1991. Conservation of medicinal plants. Cambridge University Press, U.K.
- Cutler, S.J. and Cutler, S.H.G. 2000. Biologically active natural Products – Pharmaceuticals. CRC Press, USA.

ELECTIVE COURSE - II
FUNGAL BIOTECHNOLOGY

Paper Code	14PBOTE02
Credits	4
Marks	25+75=100
Hours	4/Week

Unit I

Fungal Biotechnology – Introduction – Role of Fungi in Biotechnology – Historical development of fungal biotechnology – fungal structure and Morphology – Fungal nutrition – Nutritional strategies adopted by fungi – A glance at fungal taxonomy – biotechnological importance of fungi – genetic manipulation of industrial fungi.

Unit II

Production techniques in fungal biotechnology – Fermented technology – Organic acids – Industrial alcohols – Polysaccharides – Chitosan by Fermentation – Enzymes – Lipids – Gibberellins – Vitamins and Aminoacids.

Unit III

Fungi in Medical Biotechnology – Production of antibiotics and other medically useful products – Antitumour and antiviral agents from fungi – Immunoregulators – Ergot alkaloids – Fungal transformations of Steroids – Biotransformations - Medical applications of fungal enzymes – Medicinal value of higher fungi.

Unit IV

Biosynthesis of Terpenyl Esters – Generation of Aromatic flavour compounds – Bioprocess technology - Novel Industrial Uses for Fungi – Fungi as Agents of Biodeterioration and Biodegradation.

Unit V

Fungi in Food industry – Fungi in Agricultural Biotechnology – Biotechnology and the control of Pathogenic fungi – Recent application in Fungal Biotechnology.

References:

- Wainwright. 1992. An introduction to fungal biotechnology. John Wiley & Sons, New York.
- Kelvin Kavanagh. 2011. Fungi: Biology and Applications. John Wiley & Sons, London.
- Whipps, J.M. and Lumsden, R.D. 1989. Biotechnology of fungi for improving plant growth. Cambridge University Press, USA.
- Arora, D.K. 2004. Hand book of Fungal Biotechnology. Marcel Dekker Inc., USA.
- Tkaez, J.S. and Lange, L. 2004. Advances in Fungal Biotechnology for Industry, Agriculture and Medicine. Academic/Plenum Publications, New York.

ELECTIVE COURSE - III
MUSHROOM TECHNOLOGY

Paper Code	14PBOTE03
Credits	4
Marks	25+75=100
Hours	4/Week

Unit - I

Introduction – History – scope of edible Mushroom cultivation – Types of edible mushroom available in India – Medicinal and other uses, poisonous mushroom. *Calocybe indica*, *Volvariella volvacea*, *Pleurotus citrinopileatus* *Agaricus biosporus*.

Unit – II

Pure culture – preparation of medium (PDA and Oatmeal Agar medium) Sterilization – preparation of test tube slants- mother spawn in saline bottle – cultivation of white button mushroom (*Agaricus bisporus*).

Unit - III

Cultivation of paddy straw mushroom (*Volvariella volvacea*) and oyster mushroom (*Pleurotus spp.*) with details of bed and spawn preparation, cultivation and harvest. Low cost mushroom farm design of production

Unit – IV

Storage and nutrition: short-term storages, long term storages, drying, storages in salt solution, nutritive value – amino acids, mineral elements nutrition – carbohydrates, crude fibre content – vitamins.

Unit – V

Insects and pest attacking mushroom – fungal, bacterial, viral diseases. Food preparation from mushroom; soup, cutlet, omelette, somasa, pickles, curry. Cost benefit ration – marketing in India and abroad, export value.

Text Books

- Handbook of cultivation, Processing and packing, published by Engineers India Research Institute, 4449, Nai Sarah, Main Road, Delhi 110006.
- Tewari, Pankaj Kapoor S.C. 1988. Mushroom cultivation. Mittal Publication, New Delhi.
- Nita Bhahi 1984-1988. Hand book of Mushrooms, II edition, Vol-1 and II.

Reference

- Atkinson G.F. 1961. Mushroom, edible, poisonous, et., Hafner Publishers, New York.

ELECTIVE COURSE - IV

CYTOGENETICS AND PLANT BREEDING

Paper Code	14PBOTE04
Credits	4
Marks	25+75=100
Hours	4/Week

Unit - I

Introduction to cytogenetics. Mitotic and meiotic cell division Meiosis: modes of meiosis, chromosome disjunction. Mechanism and theories of crossing over, Synaptonymal complex.

Unit II

Structural variations in chromosomes, their cytological consequences, Gene mapping and other uses, Structural hybrids, B-chromosome its origin and consequences Numerical variation in chromosomes, sources and consequences, euploidy and aneuploidy, classification, natural and induced polyploids.

Unit III

Cytogenetics of Wheat, Cotton, Tobacco, Triticale (Karyotyping). Incompatibility and Male sterility, their types, mechanisms and applications in plant breeding.

Unit IV

Genetic diversity in plants, Importance of genetic diversity in crop improvement and its erosion. Hybridization: inter and intra varietal crosses. Heterosis. Apomixis; types of apomixes in higher plants, significance in plant breeding.

Unit – V

Concepts, classification of mutation, physical and chemical mutagens, their mechanism of action, molecular basis of gene mutations, Role of mutations in Plant Breeding.

Text books

- Gupta P. K. 1999 Cytogenetics. Rastogi Publication Meerut.
- Prasad G. 1998 Introduction to Cytogenetics. Kalyani Publishers, New Delhi.
- Sinha U. and Sinha S. 1998 Cytogenetics, Plant Breeding and Evolution. Vikas Publishing house Pvt. Ltd. New Delhi
- Swaminathan M. S., Gupta P. K. and Sinha U. 1974 Cytogenetics of Crop Plants MacMillan India Ltd. New Delhi.

References

- Khush G. S. 1973 Cytogenetics of aneuploides. Academic Press New York USA.
- Burnham C. R. 1962 Discussions in Cytogenetics. Burgess Publishing Co. Minnesota.
- Harti D. L. and Jones E. W. 1998 Genetics: Principles and Analysis 4th Edition. Jones and Baw Publishers Massachusetts USA.
- Karp G. 1999 Cell and Molecular Biology : Concepts and Experiments, John Wiley and Sons Inc USA.
- Fikui K. and Nakayama S. 1996 Plant chromosomes; Laboratory Methods CRC Press Boca Ration Florida.
- Swanson C. P., Merz T. and Young J. 1973 Cytogenetics. Prentice Hill of India Private Ltd. New Delhi.

ELECTIVE COURSE - V

Paper Code	14PBOTE05
Credits	4
Marks	25+75=100
Hours	4/Week

BIOFERTILIZERS TECHNOLOGY

Unit I

Biofertilizers – Introduction – Types of Biofertilizers – Applications of Biofertilizers - Nitrogen fixation – Nitrogen fixing microorganisms (symbiotic and asymbiotic) – Phosphate solubilising microorganisms -Fungi, Mycorrhizae (VAM AND AM Fungi).

Unit II

Application and Evaluation techniques of crop response to biofertilizers – Simplified anaerobic digester for Biofertilizers – Modified anaerobic Fermenter for Biofertilizer – Operation condition for anaerobic digestion of Biofertilizers.

Unit III

Soil fertility and fertilizers – Soil Microbiology and Biofertilizers - Biogas production from organic biofertilizers – Biogas from liquid biofertilizers derived from Banana and Coffee processing

Unit IV

Vermiculture and Vermitechnology – Introduction – Advantages of vermicomposting – Earthworms – Ecological types of Earthworms – Vermicomposting and their application in organic culture – Compost making.

Unit V

Organic farming – Organic manures – Methanogenesis – Pest and disease management systems in agriculture – Biopesticides – Sustainable agriculture – Production – marketing of Biofertilizers.

References:

- The Complete technology book on biofertilizers and organic farming. NIIR, New Delhi.
- Somani, L.L., P. Shilpkar and D. Shilpkar. 2011. Biofertilizers commercial production technology and Quality control. Agrotech Publishers Academy, Udaipur.
- The complete technology book on Vermiculture and vermicompost. NIIR, New Delhi.

ELECTIVE COURSE - VI

Paper Code	14PBOTE06
Credits	4
Marks	25+75=100
Hours	4/Week

MARINE BOTANY

Unit I

Marine plant groups and Organisms – Brief account on Marine Phytoplankton – Seaweeds, Seagrasses and Mangroves – Marine fungi, Actinomycetes, Lichens, Bacteria, Corals and Fossil Mangroves.

Unit II

Marine Ecology – Abiotic factors (Chemicals, Physical and Geological) – Biotic factors – floral and faunal components- Types of coasts and Estuaries – Impact of climate Change in marine ecosystem – Algal blooms – Red tide. Ecological significance of Algae (Seaweeds), Mangroves, Seagrasses and Corel reefs.

Unit III

Photosynthesis of algae (Micro and macro) in sea – algal plastids – Photosynthetic pigments – carbon fixation – Photosynthetic rate – C₃ and C₄ characters in algae. Photosynthesis of mangroves – carbon fixation – Photosynthetic enzymes – accumulation of free aminoacids – photorespiration – Nutrition – Salinity regulation and Metabolism of Seaweeds and Mangroves and their methods of regeneration – Biogeochemical role of algae.

Unit IV

Seaweed Polysaccharides – Commercial and economical products of Seaweed (Agar, Algin and Carrageenan) and Low molecular weight compounds in algae – Methods of collection and preservation of Marine algae – Commercial cultivation of seaweeds (Traditional and Recent methods) – Application and uses of Seaweeds - Economic importance of seaweeds.

Unit V

Seaweed, Seagrasses, Mangroves and Coral reefs research in India and World. Marine Pollution – human Impact - Conservation strategies of Marine vegetation - Use of Remote sensing techniques in mapping of marine vegetation with GIS.

References:

- Laura Barsanti and Paolo Gudtier. 2006. Algae- anatomy, Biochemistry and Biotechnology. CRC Taylor and Francis, New York.
- Jackson, D.F. 1972. Algae and Men. Plenum Press.
- Kannupandi, T. 1998. Coral reefs of India. State of Art report. ENVIS Publication Series 2/98.
- Krishnamurthy, V. 1985. Marine Plants. Seaweed Research and utilization Association, madras.
- Stein, J.R. 1973. Hand book of Phycological methods. Cambridge University Press.
- Swaminathan, M.S. 2003. Bioresources status in Selected Coastal Location. DBT.
- Chapman, V.J. 1976. Coastal Vegetation. Pergamon press. New York.
- Daves, C.J. 1985. Marine Botany Physiology and Ecology of Seaweeds.
- Dawson. 1960. Marine Botany.
- Naskar, Kumundrajan and Rathindranath mandal.1999. Ecology and biodiversity of Indian mangroves. Vol.I and II.

ELECTIVE COURSE - I

PHOTOBIOLOGY

Paper Code	14PBOTE06
Credits	4
Marks	25+75=100
Hours	4/Week

Unit I

What is light – Principles of photochemistry – What is photobiology – Plant photosensory biology – Plants and their light environment – the light signals – The photoreceptors – Cellular transduction chains – Whole plant responses to light – Plant populations and their ecology.

Unit II

Photosynthesis as Energy conversion – Energy conversion in chloroplast – Pigment systems of Red and BGA – Photosynthetic Electron Transport – Protection Mechanisms Against Photo-Oxidative destruction of the Photosynthetic Apparatus – Mechanism of Photophosphorylation – Biochemical process – Anoxygenic photosynthesis of phototropic bacteria.

Unit III

The leaf as photosynthetic system - Measurement of the Rate of Photosynthesis - Gross and Net Photosynthesis - Limiting Factors of Net Photosynthesis - Ability of Leaves to Adapt Photosynthetically - Temperature Dependence of Net Photosynthesis - Influence of Oxygen on Net Photosynthesis - Regulation of CO₂ Exchange by Stomata

Unit IV

Photomorphogenesis - Action Spectra – Pigments - Phytochrome - Mode of Action of Phytochrome in Photomorphogenesis - Four Case Studies on the Effects of Phytochrome - Cooperation Between Photosensors - A Positive UV-B Effect: Synthesis of Flavone Glycosides in Cell Suspension Cultures - Photomorphogenesis of Fungi.

Unit V

Effects of Ionising Radiation - Exciting and Ionising Radiation - Types of Ionising Radiation - Process of Ionisation - Some Thoughts on the Target Theory - Effect of Ionising Radiation on Cell Components - Repair of Radiation Damage in DNA - Effect of Ionising Radiation - on Higher Level Organisation in Cells.

References

- Pedro J. Aphalo, Andreas Albert, Lars Olof Björn, Andy McLeod, T. Matthew Robson and Eva Rosenqvist. 2012. Beyond the visible A handbook of best practice in plant UV photobiology. European Coopartion in Science and Technology.
- Hans Mohr and Peter Schopfer. 1995. Plant Physiology. Springer, UK.
- Pedro J. Aphalo. 2006. Light signals and the growth and development of plants – a gentle introduction. University of Helsinki, Finland.
- Mukjerjee S. and Ghosh A.K. (2009) Plant Physiology. New Central Book Agency; 3rd Revised edition edition.
- Jain, A. K. (2003), “Textbook of Physiology”, Arichal Publishing Company. New Delhi.
- Salisbury F.F. and Ross C.W. 1992. Plant Physioly. (IV edition) Wordsworth Publishing Company. California, USA.
- Hopkins W.G. 1995. Introduction to plant physiology, John Wiley and Sons, new York, USA.
- Moore T.C. 1989. Biochemistry and physiology of plant hormones, Springer Verlag. New York, USA.
- Taiz L. And Zieger E. 1998. Plant physiology, Sinauer Associates Inc. and publishers, USA.

Supportive Course to other Departments

- Bioremediation and Phytoremediation
- Marine Natural Resources
- Forest Ecology and Conservation
- Horticulture and Gardening
- Phytochemistry

SUPPORTIVE COURSE - I

**BIOREMEDIATION AND
PHYTOREMEDIATION**

Paper Code	14PBOTS01
Credits	4
Marks	25+75=100
Hours	4/Week

Unit I

Bioremediation – In-situ and Ex-situ bioremediation – Constraints and priorities of bioremediation – evaluating bioremediation – Biodegradation – Factors affecting process of biodegradation – Methods in determining biodegradability – contaminant availability for biodegradation.

Unit II

Bioremediation of surface soils – biodegradation in soil ecosystems – types of soil treatments – bioreactors – Subsurface aerobic bioremediation – Bioremediation in fresh water and marine systems – Anoxic and anaerobic bioremediation – bioremediation of hydrocarbons, Phenols and Heterocyclic compounds.

Unit III

Biological treatment of sewage – Environmental pollution control – Bioaugmentation and Biostimulation – Biofilms in treatment of waste water – Aerobic biofilms – bioreactors for waste water treatment – reactors types and design – Waste water treatment using aquatic plants – Root zone treatment – Development of waste water biotechnology using new biocatalysts.

Unit IV

Sources of heavy metal pollution – microbial interaction with inorganic pollutants – microbial metal resistance – microbial transformation – accumulation and concentration of metals – Biosorption – Biotechnology and heavy metal pollution – Oil field microbiology – Hydrocarbon degradation.

Unit V

Pathway construction – Biochemical background – Operon regulation – Vectors – hybrid path ways and enzymes – Non-catabolic genes for catabolic pathway constructions. – Molecular probes – Bioluminescence – fingerprinting – T-RLFP – PCR – Immunological techniques – Hybridization techniques – plasmid mediated Bioaugmentation.

References:

- Alexander, M. 1999. Biodegradation and bioremediation. Academic Press.
- Baker, K.H. and Herson, D.S. 1994. Bioremediation. Mc Graw Hill Inc, New York.
- Bitton, G. 1999. Waste water Microbiology, Wiley – Liss.
- Crawford, R.L. and Crawford, D.1996. Bioremediation: Principlea and Applications. Cambridge University Press, UK.
- Singh, A. and Ward, O.P. 2004. Applied Bioremediation and Phytoremediation. Springer.
- Wainwright, M. 1999. An introduction to Environmental Biotechnology, Kluwer Academic Publishers, Boston.

SUPPORTIVE COURSE – II

Paper Code	14PBOTS02
Credits	4
Marks	25+75=100
Hours	4/Week

MARINE NATURAL RESOURCES

Unit I

A brief account on Marine Environment – Biotic and Abiotic factors of marine Ecology – Types of coasts - Marine Natural Resources – Wild Bioresources - food, feed, fodder, fire wood. Timber, medicinal products, potential genetic resources – Ornamental – Domestic Bioresources – Crops, Cereals, pulses, oil crops, horticultural crops, live stock, aquaculture and apiculture.

Unit II

Bioactive Metabolites of Marine Algae, Fungi and bacteria – Introduction – Secondary metabolites of marine algae (Macro and Micro) – Bacteria and Fungi.

Unit III

Bioactivity of Marine Organisms – Introduction – bacteria and Fungi – phytoplanktons – Seaweeds and Seagrasses – Actinomycetes – Utilization and applications of seaweeds and seagrasses in livelihood activities.

Unit IV

Biosynthesis of Bioactive metabolites of marine organisms – Introduction – problems of biosynthesis studies – Biosynthesis of metabolites of algae, BGA and macro algae.

Unit V

Bioactive marine toxins – toxins from micro algae – dinoflagellates – bacteria and macro algae – Biological, toxicological and clinical evaluation of marine natural resources – types of screening – screening models and activity – Anticancer screening – testing methods – toxicity evaluation – uses of animals in experiment – clinical trials.

References:

- Bhakuni, D.S. and Rawal, D.S. 2005. Bioactive marine natural products. Springer, New York.

SUPPORTIVE COURSE - III
FOREST ECOLOGY AND CONSERVATION

Paper Code	14PBOTS03
Credits	4
Marks	25+75=100
Hours	4/Week

Unit - I

Forest ecosystem- Forest as an ecosystem, distribution of forests, types of forest, economics and ecology of forest. History of Silviculture, major tropical forest formations- vegetation dynamics- species richness of tropical forest- covers types.

Unit - II

Forest soils – distinguishing features - soils and vegetation development, physical and chemical properties- Types and properties of soils under different forest ecosystems.

Unit – III

Morphology of trees- flowering and seed production- cambial development, crown and root system development. Stand development - height, diameter, basal area and volume growth of even aged and uneven aged stands - stand physiognomy and canopy architecture of tropical trees. Forest influences - radiation, temperature, precipitation patterns, and wind.

Unit – IV

Holistic and Sustainable approach of eco-system management and conservation of biological diversity and its significance.

Unit – V

Role of forests in protection of species regulation of climate and production of various produce. Depletion of biodiversity from forest and the world forest conservation policies. Biological control of insect pests and diseases of forest trees. Molecular tools for developing disease resistance trees.

Text and Reference Books

- Daniel, Helms and Baker, 1979. Principles of Silviculture McGraw-Hill Book Company
- Lamprecht, 1986. Silviculture in the Tropics-. Verlag Paul Parey, Hamburg und Berlin.
- P-296
- Bakshi BK. 1976. Forest Pathology. Controller of Publications, GOI.
- Stebbings EP. 1977. Indian Forest Insects. JK Jain Bros.

SUPPORTIVE COURSE - IV

Paper Code	14PBOTS04
Credits	4
Marks	25+75=100
Hours	4/Week

HORTICULTURE AND GARDENING

Unit – I

Importance and scope of horticulture – Divisions of horticulture – climate, soil, nutritional needs – water irrigation – plant propagation method- cutting, layering, grafting , budding, stock-scion relationship.

Unit – II

Fruit crops – Induction of flowering, flower thinning fruit setting, fruit developments – cultivation of important fruit crops – Mango, lime, and Guava – Vegetable crops: classification, cultivation of important vegetable crops: Tomato, Brinjal and *Dolichos lablab*.

Unit – III

Storage of fruits and vegetables – preservation of fruits and vegetables nursery – micro propagation – Hardening and translation – Germ palm maintenance of sweet potato.

Unit – IV

Principles and methods of designing a flower garden badges, sedges, fence, tress, climbers – rookeries, terrace garden lawn making and maintenance, water garden – cultivation of water plants

Unit – V

Indoor gardening – house plant, light, humidity, watering, designing Bonsai plants, watering, pruning, dwarfing. Landscaping – principles, types of park. Elements and principles of flower design.

Text book

- Manibushan Rao. K. (1991). Text book of horticulture. McMillan publication.

References

- Kumar. N. (1986). Introduction to horticulture. Rajalakshmi publication
- Subbha Roa, N.S,1997. Biofertilizers in Agriculture and Forestry. Inda Book House Limited.
- Trivedy . P.P. 1987. Home gardening. ECA Publication. New Delhi.

SUPPORTIVE COURSE - V

PHYTOCHEMISTRY

Paper Code	14PBOTS05
Credits	4
Marks	25+75=100
Hours	4/Week

Unit I

Introduction to Phytochemicals – Types – Phytoconstituents and their therapeutic value – Polysaccharides in plants - Secondary metabolites in plants - Pharmaceutical proteins in plants – Plant hormones.

Unit II

Production of phytochemicals from medicinal plants – Histochemical studies for medicinal plants - Biopharmaceuticals in plants – Extraction, Isolation and purification methods of phytochemicals – Developing new drugs from ethnomedicines – Drug industries from India.

Unit III

Traditional herbal medicine – Natural sources of drugs – Classification of Crude drugs – Quality control of the crude drugs - Standardization and Evaluation of herbal drug formulations – Pharmacognosy of medicinal and aromatic plants.

Unit IV

Indian Traditional Medicinal plants and their phytoconstituents; *Aloe vera*, *Withania Somnifera*, *Rowolfia serpentina*, *Embllica officinalis*, *Saroca asoca*, *Aegle marmelos*, *Tinospora cordifolia*, *Gloriosa superba*, *Solanum nigrum*, *Catharanthus roseus*, *Tribulus terrestris*, *Adhatoda vasica*, *Gymnema sylvestre*, *Andrographis paniculata*, *Momardica charantia*, *Syzygium cuminii* and *Pterocarpus marsupium*.

Unit V

Marine phytochemistry – Definition – Marine plant products and their phytochemicals – Bioactive compounds – Isolation and purification methods – Seaweed and Seagrasses phytochemicals and their pharmacognosy.

References

- Evans W.C. and Trease E. 2009. Pharmacognosy. Elsevier, New York.
- Jarald E.E. and Jarald S. E. 2009. Text book of Pharmacognosy and Phytochemistry. CBS Publishers & Distributors, New Delhi
- Nitin Suri. 2010. Phytochemical Techniques. Oxford Book Company, Rajasthan.
- Atul Roy. 2012. Herbal Drug Industry. Oxford Book Company, Rajasthan.
- Roseline. A. 2011. Pharmacognosy. MJP Publishers, Chennai.
- Mishra. S.R. 2010. Plant Biochemistry. Discovery Publishing House, New Delhi.