Department of Botany
Kakatiya University, Warangal, Telangana State

M. Sc., Botany

Revised Syllabus
(Semester System & CBCS)

w.e.f. Academic Year 2016-17

Department of Botany, Kakatiya University, Warangal, Telangana State

Meeting of the Board of Studies in Botany for approval of M.Sc., Botany Revised Syllabus Semester system

The Board of Studies for P.G course in Botany was held on 28.06.2016 at 11 a.m. in the chamber of Head, Department of Botany, K.U. The following members were present.

1. The Chairperson, BOS in Botany (Prof. Ajmeera Ragan)	Chairman
2. The Head, Department of Botany, KU.	Member
3. Dr. M. Surekha, Department of Botany, KU.	Member
4. Dr. T. Christopher, Department of Botany, KU.	Member
5. Dr. Md. Mustafa, Department of Botany, KU.	Member
6. Prof. R.R. Venkat Raju, Department of Botany Sri Krishnadevaraya University, Anantapur	External Member
7. Dr. K.R.K Reddy, Managing Director, Sri Biotech Limited, Hyderabad	External Member (From Industry)
8. Dr. C.S. Reddy, Scientist NRSA, Hyderabad	External Member (From R&D)

Resolution

1. It is resolved to approve the revised Syllabus of M.Sc. Botany for I, II, III and IV semesters (Theory and Practicals) with effect from 2016-2017 academic year.
2. It is resolved to approve two elective papers i.e. Economic Botany and Environmental pollution offered by the department in II and IV semesters respectively under CBCS for the students of other departments in the University campus.
3. It is resolved to conduct the practical examination to the M.Sc. I and III semesters only by internal examiners appointed by the University while II and IV semesters by external and internal examiners appointed by the University.
4. It is resolved to evaluate the theory papers of all four semesters (Semester end examinations) by external and internal examiners appointed by the University.
5. Resolved to implement the credit system and 100 credits were fixed as indicated in the statement enclosed.
6. Board revised and approved the syllabus for Ph.D. Eligibility Test and Pre-Ph.D. written examination.
7. Approved the list of experts for paper setting, valuation of theory and practical answer scripts, adjudication of M.Phil. and Ph.D. dissertations, and subject experts for faculty appointments/ promotions.

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DEPARTMENT OF BOTANY, KAKATIYA UNIVERSITY, WARANGAL
M.SC. BOTANY
w.e.f. Academic Year 2016-17

SEMESTER-I

Subject Code	Subject Paper	Theory/ Practical	Instruction Hrs./ Week	Credits	Evaluation		Total
					Internal*	External**	
BOT-101	Biology and Diversity of Algae, Fungi, Bacteria and Viruses	Theory (Paper-I)	4	4	20	80	100
BOT-102	Biology and Diversity of Bryophyta, Pteridophyta and Cycadophyta	Theory (Paper-II)	4	4	20	80	100
BOT-103	Systematics of Magnoliophyta and Ethnobotany	Theory (Paper-III)	4	4	20	80	100
BOT-104	Biostatistics, Techniques in Plant Biology and Bioinformatics	Theory (Paper-IV)	4	4	20	80	100
BOT-Pr.105	Biology and Diversity of Algae, Fungi, Bacteria and Viruses + Biology and diversity of Bryophyta, Pteridophyta, Cycadophyta	Practical*** (Paper I)	4+4=8	2+2=4	100	--	100
BOT-Pr -106	Systematics of Magnoliophyta and Ethnobotany + Biostatistics, Techniques in Plant Biology and Bioinformatics	Practical (Paper II)	4+4=8	2+2=4	100	--	100
	SEMINARS	--	--	01	25	--	25
	Total		**32**	**25**	**305**	**320**	**625**

*Examination Duration: 1 hour; (Best of one out of two); **Examination duration: 3 hours;
***Examination duration: 4 hours.

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DEPARTMENT OF BOTANY, KAKATIYA UNIVERSITY, WARANGAL
M.SC. BOTANY
w.e.f. Academic Year 2016-17

SEMESTER-II

Subject Code	Subject Paper	Theory/ Practical	Instruction Hrs./ Week	Credits	Evaluation		Total
					Internal*	External**	
BOT-201	Cytology, Genetics and Cytogenetics	Theory (Paper-I)	4	4	20	80	100
BOT-202	Ecology, Evolution Phytogeography	Theory (Paper-II)	4	4	20	80	100
BOT-203	Plant Development and Reproductive Biology	Theory (Paper-III)	4	4	20	80	100
BOT-204	Plant Resources Utilization	Theory (Paper-IV)	4	4	20	80	100
BOT-Pr-205	Cytology, Genetics and Cytogenetics + Ecology, Evolution Phytogeography	Practical*** (Paper I)	4+4=8	2+2=4	--	100	100
BOT-Pr-206	Plant Development and Reproductive Biology + Plant Resources Utilization	Practical (Paper II)	4+4=8	2+2=4	--	100	100
	SEMINARS	--	--	01	25	--	25
	Total		**32**	**25**	**105**	**520**	**625**

*Examination Duration: 1 hour; (Best of one out of two); **Examination duration: 3 hours;
***Examination duration: 4 hours;

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DEPARTMENT OF BOTANY, KAKATIYA UNIVERSITY, WARANGAL
M.SC. BOTANY
w.e.f. Academic Year 2016-17

SEMESTER-III

Subject Code	Subject Paper	Theory/ Practical	Instruction Hrs./ Week	Credits	Evaluation		Total
					Internal*	External**	
BOT-301	Plant Physiology and Biochemistry	Theory (Paper-I)	4	4	20	80	100
BOT-302	Molecular Biology and Bioengineering	Theory (Paper-II)	4	4	20	80	100
BOT-303	**Elective-I**	Theory (Paper-III)	4	4	20	80	100
Elective I (a)	Plant Biosystematics						
Elective I (b)	Microbial Ecology						
Elective I (c)	Medicinal Plant Chemistry and Pharmacognosy						
BOT-304	**Elective-II**	Theory (Paper-IV)	4	4	20	80	100
Elective II (a)	Plant Cell, Tissue and Organ Culture						
Elective II (b)	Advanced Plant Physiology						
Elective II (c)	Plant Breeding						
BOT-Pr-306	Plant Physiology and Biochemistry + Elective I	Practical*** (Paper I)	4+4=8	2+2=4	100	--	100
BOT-Pr-307	Molecular Biology and Bioengineering + Elective -II	Practical (Paper II)	4+4=8	2+2=4	100	--	100
	SEMINARS	--	--	01	25	--	25
	Total		**32**	**25**	**305**	**320**	**625**

*Examination Duration: 1 hour; (Best of one out of two);

**Examination duration: 3 hours; ***Examination duration: 4 hours;

Note: A student needs to choose one elective each from Paper-III and Paper-IV

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DEPARTMENT OF BOTANY, KAKATIYA UNIVERSITY, WARANGAL
M.SC. BOTANY
w.e.f. Academic Year 2016-17

SEMESTER-IV

Subject Code	Subject Paper	Theory/ Practical	Instruction Hrs./ Week	Credits	Evaluation		Total
					Internal*	External**	
BOT-401	Biodiversity : Conservation and Management	Theory (Paper-I)	4	4	20	80	100
BOT-402	Plant Biotechnology	Theory (Paper-II)	4	4	20	80	100
BOT-403	**Elective-I**	Theory (Paper-III)	4	4	20	80	100
Elective I (a)	Ethnobotany						
Elective I(b)	Crop Improvement						
Elective I (c)	Agricultural Biotechnology						
BOT-404	**Elective-II**	Theory (Paper-IV	4	4	20	80	100
Elective II (a)	Biocontrol of Plant Diseases and Insect pests						
Elective II (b)	Industrial Microbiology						
Elective II (c)	Applied Phycology						
BOT-Pr-406	Biodiversity : Conservation and Management+ Elective I	Practical*** (Paper I)	4+4=8	2+2=4	--	100	100
BOT-Pr-407	Plant Biotechnology + Elective II	Practical (Paper II)	4+4=8	2+2=4	--	100	100
	SEMINARS	--	--	01	25	--	25
	Total		**32**	**25**	**105**	**520**	**625**

*Examination Duration: 1 hour; (Best of one out of two);

**Examination duration: 3 hours; ***Examination duration: 4 hours;

Note: A student needs to choose one elective each from Paper-III and Paper-IV

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SEMESTER-I

THEORY SYLLABUS

PAPER-I (BOT-101): BIOLOGY AND DIVERSITY OF ALGAE, FUNGI, BACTERIA AND VIRUSES

Unit-I: ALGAE

1) Algae-General characters and Classification of Algae, Thallus Diversity, Reproduction and Life cycles in Algae, Cultivation and economic importance of Algae.
2) General account of
   a) Cyanophyceae and their potential applications.
   b) Morphology and reproduction in Chlorophyceae (*Pandorina*, *Hydrodictyon*, *Zygnema* and *Cladophora*).
3) General account of Xanthophyceae and Bacillariophyceae.
4) a) General account of Pheophyceae–*Laminaria*.
   b) General account of Rhodophyceae–*Gracilaria*.

Unit-II: FUNGI

1) Fungi-General account, Cell ultrastructure, Cell wall composition, Nutrition, Vegetative and Reproductive structures, Heterothallism, Heterokaryosis and Parasexuality, Recent trends in Classification, AFTOL Classification, Origin and Phylogeny of Fungi.
2) Morphology, Reproduction, Life Cycles and Economic Importance of
   a) Myxomycota – A General Account
   b) Eumycota: Mastigomycotina–*Phytophthora*
   c) Zygomycotina: *Rhizopus*
   d) Ascomycotina: *Saccharomyces, Aspergillus, Peziza*
   e) Basidiomycotina: *Melampsora, Ustilago, Agaricus*
   f) Deuteromycotina: *Alternaria, Colletotrichum*
3. Habitat, habit, morphology, physiology and reproduction in Lichens.
4. Ecology and Economic Importance of Lichens.

Unit-III: BACTERIA AND VIRUSES

1) Bacteria: General account, Classification as per Bergey's Manual of Systematic Bacteriology.
2) Recombination in Bacteria: Conjugation, Transformation, Transduction, Economic importance.
3) Viruses: History, morphology (Ultrastructure and Symmetry), nucleic acid diversity, Nomenclature and ICTV classification of Viruses.
4) Replication of viruses (T-even phages and TMV).

Unit-IV: PLANT PATHOLOGY

1) Plant pathology: General introduction, pathogenesis, symptoms, etiology, dispersal of pathogens, classification of pathogens.
2) Plant diseases caused by fungi and their management: Mildews (Downy and Powdery), rusts and smuts, wilts
3) Plant diseases caused by bacteria, Viruses and Phytoplasma.
   Bacteria: leaf spot of cotton, bacterial leaf blight of rice.
   Viruses: Chilli mosaic, Rice tungro.
   Phytoplasma: Little leaf of brinjal, Sesame phyllody.
4) Outlines of plant disease control, physical, chemical, biological control and disease resistance.

Suggested Readings:

1) Alexopoulus. C.J., Mims. C.W. & Blackwell. M. 1996. Introductory Mycology. 4th Edition. Replika Press, North Delhi.
2) Aneja, K.R. 2003. Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International Publishers, New Delhi.
3) Bold, H.C. & Wyne, M.J. 1978. Introduction to the Algae. Prentice-Hall., New Jersey.
4) Flint, S.J., Enquist. L.W., Krug. R.M., Racaniello. V.R. & Skalka. A.M. 2000. Principles of Virology, Molecular Biology, Pathogenesis and Control. ASM Press, Washington DC.
5) Fritsch, F.E. 1935. The structure and reproduction of Algae. 2 vols. Cambridge University Press.
6) Graham, J.E, Lee W. Wilcox & L.E. Graham. 2008. Algae. 2nd ed. Benjamin Cummings.
7) Kaur Sethi, I. & Surinder, K.W. 2011. Text Book of Fungi and the Allies. MacMillan Publishers, New Delhi.
8) Kumar, H.D. 2000. Introductory Phycology. East West Press., New Delhi.
9) Lee, R.W. 2007. Classification of Algae.
10) Matthew, R.H. 2004. Plant Virology. 4th Edition. Academic Press - An Imprint of Elsevier. California, USA.
11) Mehrotra, R.S. & Aneja, K.R. 2003. An Introduction to Mycology. New Age International Publishers, New Delhi.
12) Morris, I. 1967. An Introduction to the Algae. Cambridge University Press, UK.
13) Prescott et al. 2003. Microbiology. McGraw Hill Education, New York.
14) Prescott, G.W. 1969. The Algae – A Review. Houghton Mifflin Company, Boston.
15) Ram Reddy, S. & Reddy, S.M. 2007. Essentials of Virology. Scientific Publishers, Jodhpur.
16) Reddy, S.M. & Ram Reddy. S. 2000. Microbiology a Laboratory Manual. BSC Publishers & Distributors,
17) Round, F.E. 1986. The Biology of Algae. Cambridge University Press, New York.
18) Sharma, K. 2005. Manual of Microbiology Tools and Techniques. Ane Book, New Delhi.
19) Smith, G.E. (Ed.). 1950. Fresh Water Algae. Cambridge University Press, New York.
20) Smith, K.M. 1968. Plant Viruses. Elsevier, New York.
21) Stainer. R.T., Ingraham. J.L., Wheelis. M.L. & Painter P.R. 1987. General Microbiology. 5th Edition. MacMillan, London.
22) Sullia, S.B. & Shantharam, S. 2001. General Microbiology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
23) Verma, H.N. 2003. Basics of Plant Virology. IBH Publishing Co. Pvt. Ltd., New Delhi.

SEMESTER-I

THEORY SYLLABUS

PAPER-II (BOT-102): BIOLOGY AND DIVERSITY OF BRYOPHYTA, PTERIDOPHYTA AND CYCADOPHYTA

Unit-I: BRYOPHYTA

1) Bryophyta: Introduction, Origin, Distribution and Classification of Bryophytes.
2) Morphology, Anatomy and Reproduction in
   a) Hepaticopsida: *Marchantia, Sphagnum*
   b) Anthocerotopsida: *Anthoceros*
   c) Bryopsida: *Polytrichum*
3) Evolution of Gametophytes and Sporophytes in Bryophytes.
4) Ecological and Economic Importance of Bryophytes.

Unit-II: PTERIDOPHYTA

1) Pteridophyta: Origin and Evolution in Pteridophytes.
2) Morphology, Anatomy and Reproduction in
   a) *Psilotum*
   b) *Selaginella*
   c) *Isoetes*
   d) *Ophioglossum*
   e) *Adiantum*
3) Stelar Evolution, Telome theory, Heterospory and seed habit in Pteridophytes.
4) General account of Fossil Pteridophytes.

Unit-III: CYCADOPHYTA (GYMNOSPERMS)

1) Cycadophyta: Introduction, Evolution and Classification of Gymnosperms.
2) Distribution of Gymnosperms in India.
3) Morphology and Reproduction in
   a) Cycadales: *Cycas*
   b) Gingkoales: *Ginkgo biloba*
   c) Coniferales: *Taxus*
   d) Ephedrales: *Ephedra*
   e) Gnetales: *Gnetum*
4) Economic importance of Gymnosperms.

Unit-IV: PALEOBOTANY

1) Paleobotany: Scope and Objectives, Geological time scale, Paleoclimate and Evolution of plants.
2) Fossilization, Fossil types, Techniques in Paleobotany.
3) General account of Fossil Gymnosperms with special reference to *Williamsonia, Pentoxylon.*
4) Paleobotanical studies in India, Birbal Sahni Institute of Paleobotany and its contributions.

Suggested Readings:

1) Arnold. C.A. 1974. An Introduction to Paleobotany. McGraw Hill Book Co. Inc., New York.
2) Chamberlain. C.J. 1935. Gymnosperms Structure and Evolution. University of Chicago Press, USA.
3) Evans. A.J. 1936. Morphology of Vascular Plants (Lower Groups). McGraw Hill Book Company, New York.
4) Parihar. N.S. 1996. Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
5) Sambamurthy. A.V.S.S. 2005. A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Pvt. Ltd.
6) Saxena. P. & Pathak. C. 2012. A Textbook of Pteridophyta. Wisdom Press, New Delhi.
7) Sharma. O.P. 1996. Gymnosperms. Pragathi Prakashan, Meerut.
8) Sharma. O.P. 2006. Pteridophyta. MacMillan India Ltd., New Delhi.
9) Sporne. K.R. 1962. The Morphology of Pteridophytes. Hutchinson University Library, London.
10) Sporne. K.R. 1965. Morphology of Gymnosperms. HUP. London.
11) Sporne. K.R. 1965. Morphology of Pteridophytes. HUP. London.
12) Sporne. K.R. 1967. The Morphology of Gymnosperms. Hutchinson University Library, London.
13) Stewart. W.N. & Rothwell. G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press, USA.
14) Vashista. P.C. 2005. Gymnosperms. S.Chand & Co., New Delhi.
15) Vashista. P.C. 2005. Pteridophyta. Rev. Ed. By Sinha & Anil. S.Chand & Co., New Delhi.

SEMESTER-I

THEORY SYLLABUS

PAPER-III (BOT-103): SYSTEMATICS OF MAGNOLIOPHYTA AND ETHNOBOTANY

Unit-I: INTRODUCTION AND ROLE OF TAXONOMY

1) Brief introduction, History of development of systems of classification till Angiosperm Phylogeny Group (APG).
2) Applications of plant Systematics in understanding evolution
3) Taxonomic Structure, Taxonomic Hierarchy-Species to Division. Evaluation of Taxonomic Categories.
4) Plant Identification: Traditional and Modern methods.

Unit-II: TAXONOMIC TOOLS, NOMENCLATURE AND EVIDENCE

1) Floristics and Herbaria: Definition, Functions, Herbarium preparation; History of development of Herbaria (e.g. KEW, CNH, MH and Deccan Circle) and their Functions. Role of Botanical Gardens, Floras, *e*Floras and Monographs in plant identification.
2) Nomenclature: Brief History, de Candollean rules and ICBN. An account of International Code of Nomenclature (ICN) for Algae, Fungi and Plants.
3) Evidence for Systematics-I: Anatomy, Embryology, Palynology, Cytology, Genetics and Phytochemistry.
4) Evidence for Systematics-II: Molecular Systematics.

Unit-III: SYSTEMATICS

1) Parallelism vs. Convergence; Numerical Taxonomy, Phenetic vs Phyletic systems, Cladistics: A brief introduction. Apomorphy and Synapomorphy.
2) System of Classification of Armen Takhtajan: Relative merits and demerits.
3) Angiosperm Phylogenetic Group (APG): Formation to APG I- IV and updates.
4) Study of selective major clads of Magnoliophyta: Basal Angiosperms, Monocots: Commelinids (Arecales: Arecaceae; Poales: Poaceae and Cyperaceae; Zingiberales: Zingiberaceae), Eudicots (Tricolpates): Fabids (Fables: Leguminosae; Cucurbitales: Cucurbitaceae; Malphigiales: Euphorbiaceae, Phyllanthaceae), Malvids (Malvales), Campanulids (Asterales: Asteraceae; Apiales: Apiaceae) and Lamids (Solanales: Solanaceae; Lamiales: Lamiaceae).

Unit-IV: ETHNONBOTANY

1) History, Scope, Objectives and Interdisciplinary nature of Ethnobotany.
2) Ethnobotany: The concept and its role in modern medicine.
3) Ethnic tribes of Telangana with special reference to Gonds, Koyas and Chenchus: Their life styles and dependence on Forests. Shifting Cultivation. Prior Informed Content (PIC), Traditional Botanical Knowledge (TBK)
4) Ethnomedicine, Ethnic Foods and Magico-religious beliefs.

Suggested Readings:

1) Angiosperm Phylogeny Group Website. 2015. Consult www.apgweb.
2) APG III. 2009. An Update of the Angiosperm Phylogeny Group Classification for the Orders and Families of Flowering Plants: APG III. Bot. J. Linnaean Soc. 106: 105-121.
3) Davis. P.H. & Heywoos. V.H. 1973. Principles of Angiosperms Taxonomy. Rober.E.Kreiger Pu. Co., New York.
4) Gamble & Fischer. 1915-1935. Flora of Presidency of Madras. 3 vols. BSMS, Dehra Dun.
5) Grant. V. 1971. Plant Biosystematics. Academic Press, London.
6) Harrison. H.J. 1971. New Concepts in Flowering Plant Taxonomy. Hieman Educational Books Ltd., London.
7) Heslop-Harrison. J. 1967. Plant Taxonomy. English Language Books Soc. & Edward Arnold Pub. Ltd., UK.
8) Heywood. V.H., Brummit. R.K., Culham. A., & Seberg. O. 2007. Flowering Plant Families of the World. Firefly Books Ltd., New York.
9) Judd. W.S., Christopher. S. Campbell., Elizabeth A. Kellogg., Peter F. Stevens., & Micheal J. Donoghue. 2016. Plant Systematics: A Phylogenetic Approach. 4th Ed. Sinauer.
10) Lawrence. G.H.M. 1951. Taxonomy of Vascular Plants. McMillan, New York.
11) Mondal. A.K. 2011. Advanced Plant Taxonomy. New Central Book Agency Pvt. Ltd., Kolkata.
12) Naik. V.N. 1992. Taxonomy of Angiosperms. 2nd Edn. Tata McGraw Hill.
13) Pullaiah. T. 2005. Taxonomy of Angiosperms. Regency Publications, New Delhi.
14) Pullaiah. T. et al. 1997. Flora of Andhra Pradesh. 4 Vols. Scientific Publishers, Jodhpur
15) Radford. A.E. 1986. Fundamentals of Plant Systematics. Harper and Row Publications, USA.
16) Radford. A.E. et al. 1974. Vascular Plant Systematics. Harper & Row, New York.
17) Ravi Prasad Rao. B. 2012. Flora of Sri Krishnadevaraya University Campus. SKU, Anatapur.
18) Ravi Prasad Rao. B. 2014. Plant Name Directory. Anusha Printers, Hyderabad
19) Simpson, Micheal. G. 2006. Plant Systematics. Elseiver & Academic Press.
20) Singh, Gurucharan. 2012. Plant Systematics: Theory and Practice. Oxford & IBH, New Delhi.
21) Sivarajan. V.V. 1991. Introduction to Principles of Plant Taxonomy. Oxford & IBH.
22) Stace. C.A. 1989. Plant Taxonomy and Biosystematics. 2nd Edition. Edward Arnold Ltd., London.
23) Takhtajan. A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.
24) Woodland. D.W. 1991. Contemporary Plant Systematics. Prentice Hall, New Jersey.

SEMESTER-I

THEORY SYLLABUS

PAPER-IV (BOT-104): BIOSTATISTICS, TECHNIQUES IN PLANT BIOLOGY AND BIOINFORMATICS

Unit-I: BIOSTATISTICS

1) Biostatistics: Introduction (Variables–Random, Discrete and Continuous Variables), Population, Sample and Methods of Sampling, Diagrammatic representation of Data (Line, Bar and Pie Diagrams), Graphical representation of Data (Frequency Curve, Polygon and Histograms).
2) Measures of Central Tendency (Mean, Median and Mode), Measures of Dispersion – Range, Variance, Coefficient of Variance, Standard Deviation (SD) and Standard Error (SE).
3) Probability Distributions: Normal, Binomial and Poisson; Probability Applications.
4) Correlation and Regression Chi-Square Test (Introduction, Characteristics, Applications), Test of Significance, T-Test and Analysis of Variance (ANOVA).

Unit-II: TECHNIQUES IN PLANT BIOLOGY

1) Principles and Applications of Microscopy: Light Microscope, Phase Contrast and Electron Microscope-SEM &TEM, Biochemical buffers; pH–Measurement of pH.
2) Centrifugation: Basic principles of Sedimentation; Preparative Ultracentrifugation; General Principles, Definitions and Applications of Chromatography; Paper Chromatography, Thin-layer Chromatography (TLC), Gas-Liquid Chromatography (GLC), High-Performance Liquid Chromatography (HPLC).
3) Principles, Definitions and Applications of Electrophoresis, PAGE Agarose Gel Electrophoresis; UV-Visible Spectrophotometer; Introduction to Fluorescence Spectroscopy.
4) Autoradiography: Isotopes used in Biology.

Unit-III: APPLICATIONS OF INFORMATION TECHNOLOGY

1) Basics of Computers: Concepts of Hardware and Software, Disc Operating Systems, Storage media such as disks and CDROM.
2) Introduction to Windows, MS-Excel, Data Processing.
3) UNIX and LINUX.
4) Internet and Networking Concepts.

Unit-IV: BIOINFORMATICS

1) Importance of Biological Data Bases; DNA Data Bank.
2) Protein Sequence Data Bases.
3) Genomic and Proteomics; An Introduction.
4) Gene and Protein chips.

Suggested Readings:

1) Bryan Bergeron M.D. 2008, Bioinformatics Computing.PHI Publications New Delhi.
2) Cantor, C.R. and P.R. Schimel. Biophysical chemistry by, W.H. Freeman & Co.,
3) Cooper, T.G. The tools of Biochemistry .Wiley Eastern.
4) David J.Holmes and Hazel peck. Analytical biochemistry.
5) Freeman Dyson 1999, Origin of life , Cambridge University Press
6) Glasel A. and M.P.Duetscher.1995. Introduction to Biophysical Methods for protein and nucleic acid Research. Academic Press.
7) Goon,A.M., Gupta,M.K. and Dasgupta,B.(1986) Fundamentals of Statistics (Vol.2). The world press Private limited, Calcutta.
8) Gupta,S.C. and Kapoor,V.K.(1993) Fundamentals of applied statistics. Sulthan Chand and Sons, New Delhi.
9) Gupta,S.P(2001) Statistical methods. Sulthan Chand and Sons, New Delhi.
10) Khan I and Khanum (2008) Fundamentals of Biostatistics, Ukaaz Publications, Hyderabad.
11) KJS Khurana and Rajeev Markanday 2015, IBPS Regional Rural Banking. S. Chand & Co. Pvt. Ltd, Delhi.
12) Morris, S.J.and P.Morris Separation Methods in biochemistry. Pitman.
13) Rachna sagar, Together with Computer Applications
14) Raghavarao, D.(1983) Statistical methods in agricultural and biological research. Oxford and IBH Publishing co., PVT.,LTD., New Delhi.
15) Rangaswamy,R.(1995) A Textbook of agricultural statistics. New Age International Publishers Limited, New Delhi.
16) Vanholdem K.E. and W.C.Johnson, 1998. Principles of Physical Biochemistry
17) Wilson & Walker 1986. Practical biochemistry: Principles & Techniques. Cambridge Univ.Press.
18) Alfonso Valencia & Blascheke. L. 2005. Developing Bioinformatics Skills. Orille's Publication.
19) Fundamentals of computers 2014, by Reema Thareja, Oxford University Press.
20) MS-Office 2007 Training Guide by S. Jain

SEMESTER-I

PRACTICAL SYLLABUS

PAPER-I: BIOLOGY AND DIVERSITY OF ALGAE, FUNGI, BACTERIA AND VIRUSES (AND) BIOLOGY AND DIVERSITY OF, BRYOPHYTA, PTERIDOPHYTA AND CYCADOPHYTA

PHYCOLOGY (Identification of algae):

1) Chlorophyceae: *Pandorina, Hydrodictyon, Zygnema, Oedogonium, Cladophora*
2) Bacillariophyceae: *Cyclotella, Navicula, Pinnularia, Cymbella*
3) Phaeophyceae: *Laminaria*
4) Rhodophyceae: *Batrachospermum, Gracilaria*
5) Cyanophyceae: *Nostoc, Anabaena, Oscilatoria, Tolypothrix, Scytonema*
6) Cultivation of Algae in four (4) different media
7) At least 25 Algal samples to be submitted in the practical examination by each student

MYCOLOGY:

Section cutting of the following infected materials.

1) *Phytophthora* infected leaf material
2) Rust infected leaves of Jowar/Wheat/Barberry
3) Smut infected leaf of Jowar/Wheat
4) *Cercospora* infected groundnut leaf
5) *Alternaria* infected Mango leaf
6) Permanent Slides: Observation and identification.
   Phytophthora, Mucor, Rhizopus, Yeast, *Puccinia* (All stages), *Ustilago* (2 stages), *Colletotrichum, Alternaria.*
7) Fungal Specimens: Observation and identification.
   Agaricus, Puccinia infected leaf (Wheat, Barberry), Smut of *Sorghum, Polyporus*, Powdery Mildew, *Peziza*.

MICROBIOLOGY:

1) Differential staining of Bacteria.
2) Viral infected plants (specimens).
3) Little leaf of Brinjal.
4) Yellowing of *Acalypha.*
5) Leaf curl of *Papaya.*
6) Yellowing and vein clearing of Bhendi.
7) Leaf curl of Chilly.
8) Lichenology: All types of Lichens.

BRYOPHYTA:

1) Hepaticopsida: *Marchantia, Sphagnum*
2) Anthoceratopsida: *Notothylas, Anthoceros*
3) Bryopsida: *Polytrichum*

PTERIDOPHYTA:

1) Psilophyta: *Psilotum*
2) Lycophyta: *Selaginella, Isoetes*
3) Sphenophyta: *Equisetum*
4) Pteropsida: *Ophioglossum, Adiantum*

CYCADOPHYTA(GYMNOSPERMS):

1) Cycadales: *Cycas*
2) Coniferales: *Taxus*
3) Ginkgoales: *Ginkgo*
4) Ephedrales: *Ephedra*
5) Gnetales: *Gnetum*

PALEOBOTANY: *Leginopteris, Glossopteris, Pentaxylon*

SEMESTER-I

MODEL QUESTION PAPER (PRACTICAL)

PAPER-I: BIOLOGY AND DIVERSITY OF ALGAE, FUNGI, BACTERIA AND VIRUSES (AND) BIOLOGY AND DIVERSITY OF, BRYOPHYTA, PTERIDOPHYTA, CYCADOPHYTA AND PALEOBOTANY.

Time: **4 hours** *Max.Marks*: **100**

1) Identify and describe the structure with well labeled diagram of the given Algal/Cyanobacterial mixture (A, B, C & D). 16
   A = Chlorophyceae
   B = Bacillariophyceae
   C = Phaeophyceae / Rhodophyceae
   D = Cyanophyceae (Cyanobateria)

2) Identify and describe the given plant material (E) by making temporary Mount/identify the given bacterium by Gram staining. 12

3) Take a thin section and describe the structure with well labeled diagram of the given plant material Bryophyta / Pteridophyta (F) by making a temporary slide. 12

4) Describe the structure and draw a well labeled diagram of the given Gymnosperm material by preparing double stained permanent slide. 16

5) Identify the following slides by suitable reasons (G, H, I, J). 12
   G = Fungal
   H = Bryophyta
   I = Pteridophyta
   J = Cycadophyta

6) Identify the following specimens by suitable reasons (K, L, M, N). 12
   K = Viral/Fungal infected material
   L = Specimen of Lichens
   M = Specimen of Bryophyta/Pteridophyta
   N = Specimen of Cycadophyta/Fossils

7) Algal collections/Fungal infected herbaria. 05

8) Record and Slides. 10

9) Viva-Voce/ Assignment. 05

SEMESTER-I

PRACTICAL SYLLABUS

PAPER-II: SYSTEMATICS OF MAGNOLIOPHYTA AND ETHNOBOTANY (AND) BIOSTATISTICS, TECHNIQUES IN PLANT BIOLOGY AND BIOINFORMATICS

TAXONOMY:

Study of about 15 wild taxa representing different families and identification to species level

Plants of Magnoliophyta to be worked out for technical description and identification up to the species using Gamble and Fischer's Flora of the Madras Presidency as per Bentham and Hooker's Classification

MAGNOLIOPHYTA (Dicotyledonae):

POLYPETALAE: Annonaceae: *Annona squamosa, Polyalthia longifolia*
Menispermaceae: *Tinospora cordifolia*
Nymphaeaceae: *Nelumbo nucifera* or *Nymphaea pubescens*
Capparaceae: *Cleome viscosa*
Malvaceae: *Abutilon indicum* or *Sida acuta*
Rutaceae: *Murraya koenigii* or *Murraya paniculata* (*M. exotica*)
Meliaceae: *Azadirachta indica* or *Melia azadirachta*
Leguminosae: Papilionoideae: *Butea monosperma* or *Tephrosia* spp.
Caesalpinioideae: *Senna* spp. or *Bauhinia* spp.
Mimosoideae: *Acacia nilotica*
Combretaceae: *Combretum indicum*(*Quisqualis indica)* or *Terminalia* spp.
Cucurbitaceae: *Coccinia indica* or *Diplocyclos pamatus.*

GAMOPETALAE: Rubiaceae: *Oldenlandia umbellata*
Compositae/Asteraceae: *Blumia* spp. or *Eclipta prostata*
Apocynaceae: *Catharanthus pusillus*
Convalvulaceae: *Evolvulus alisinoides* or *Ipomoea aquatica*
Solanaceae: *Datura* spp. or *Solanum* spp.
Acanthaceae: *Barleria prionotis, B. cristata*
Verbenaceae: *Vitex negundo* or *Lantana camara*
Lamiaceae: *Ocimum* spp.

MONOCHLAMYDAE: Amaranthaceae: *Achyranthus aspera* or *Amaranthus* spp.
Euphorbiaceae/Phyllanthaceae: *Phyllanthus amarus* or *Jatropha* spp.

LILIOPSIDA (Monocotyledonae)
Scitamineae: Cannaceae: *Canna indica*

- Study of flora of University/College campus
- Students should submit 75 herbarium specimens of common wild plant taxa along with field visit note book
- Construction of taxonomic keys
- Nomenclatural exercise

ETHNOBOTANY:

Ethnobotanical specimens: a) Ethnic food crops (Jowar,Yam,Sweet potato)
b) Ethnomedicine (Nelavemu, Sarpagandhi, Tani)
c) Ethnoveterinary medicine (Narra Mamidi, Chinna Palathiga, Tella Vavili)

PROBLEMS ON BIOSTATISTICS:

1) Measures of central tendencies: Mean, Median and Mode
2) Standard deviation (SD) and variance, coefficient variance (CV)
3) Tests of significance: 't' test and Chi-square test
4) Correlation of variance (ANOVA)

For Major questions:

The student has to generate data from the given plant material and apply measures of central tendencies, SD & CV to the solve the problem and interpret the results.

For Minor questions:

Problem-1: Calculate the mean, the variance, the standard deviation and the coefficient of variation from the recorded on the number of pods per plant in *Cymopsis tetragonoloba*

No of pods:

Sample A	40	46	47	39	42	54	50	49	40	41
Sample B	46	51	49	40	41	49	60	61	55	49

Problem-2: Calculate the mean, the variance, the standard deviation and the coefficient of variation of the following distribution

X	2	4	6	9	11	6	5	3
F	21	24	27	31	35	20	17	11

Problem-3: The following data were recorded on a number of fertile branches per plant and a number of pods per plants in one of the variance of lentil. Calculate the correlation coefficient and test its significance

No of fertile branches	8	10	15	11	12	9	13	14	10	9
No of pods	45	55	70	80	65	70	90	90	76	67

Problem-4: Data recorded on the length of panicle and the number of grains per panicle in a variety of rice. Calculate the correlation coefficient and find out its level of significance

Length of panicle	10.5	12.0	15.5	12.5	15.0	11.0	16.0	14.0	16.5	13.5
No. of grains	75	80	85	108	110	85	105	110	112	107

Problem-5: In a Jojoba (*Simmondsia chinensis*) population, there are 525 female plants and 475 male plants. Calculate the χ^2 and interpret your results.

Problem-6: In F_2 generation, Mendel obtained 621 tall plants and 187 dwarf plants out of the total of 808. Text whether these two types of plants are in accordance with the Mendelian mono hybrid ratio of 3:1 or that they deviate from this ratio.

Problem-7: In an experiment on breeding of flowers of a species; a researcher obtained 107 magenta flowers with a green stigma, 42 magenta flowers with a red stigma, 38 red flowers with a green stigma and 13 red flowers with a red stigma. According to Mendel's laws the theory predicts that these types be obtained in the ratio 9:3:3:1. Draw your conclusions based on the calculated X^2 value.

Problem-8: The following results obtained in a dihybrid cross, involving shape of the seeds and the colour of the pods. Round yellow = 317; Round green = 109; Wrinkled yellow = 102 and Wrinkled green = 32.If the dihybrid ratio is 9:3:3:1, the plants should have been: 315 round yellow,105 round green, 105 wrinkled yellow and 35 wrinkled green, Calculate X^2 value

Problem-9: The following data relate to the days to flowering in two varieties of mungbean,G-65 and PS-16. Determine whether the two means are significantly different.

Items	G-65	PS-16
n	30	35
mean	32	38
variance	9.62	14.23

Problem-10: In a mutation breeding experiment, gamma-irradiation effect was evaluated on 100-seed weight in grams per plant of a Mung bean variety in M_2 generation. The experimenter obtained the following results. Analyze the data using the t-test and give your inference as regards the effect of gamma-irradiation.

Control	2.9	3.1	3.5	3.4	3.0	4.0	3.7	3.0	4.0	4.0
Treated	2.7	2.8	3.0	3.5	3.7	3.2	3.0	3.1	2.9	2.8

Problem-11: Number of tubers per plant was recorded in two strains of potato. Compare the results of two strains and give your conclusions.

Strain-1: 13 10 18 11 17 12 16 13 15 14 17 16 10 11 12 15 14 13 13 11 17 12 15 13 14 12 15 14 14 14 15 13 14 14

Strain-2: 21 16 15 24 16 23 22 17 19 18 21 20 16 17 23 21 20 15 19 20 18 22 17 24 19 19 20 20 19 19 22 22

Problem- 12: Following in the data recorded on nitrate content of water (mg/1) from two lakes. Analyze the data and show whether the two lakes are significantly different in nitrate content

Samples	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Lake 1	0.62	0.87	0.54	1.36	0.87	0.62	1.24	1.36	1.10	1.24
Lake 2	0.79	1.68	1.59	0.99	1.61	1.49	1.39	1.24	1.24	1.86

TECHNIQUES IN PLANT BIOLOGY

1) Separation and identification of amino acids by paper chromatography
2) Separation of pigments by paper chromatography
3) Separation and identification of sugars by TLC
4) Isolation and spectrophotometric characterization of plant pigments

BIOINFORMATICS:

1) Familiarization with Windows, UNIX
2) Database searching of given gene sequence or protein sequence
3) Blast analysis of given protein

SPOTTERS:

1) pH meter
2) Electron microscope (SEM / TEM)
3) High Performance Liquid Chromatography(HPLC)
4) Fluorescent Microscope
5) Spectrophotometer
6) Polyacrylamide gel (PAGE)
7) Compact Disc (CD)
8) Internet Connectivity
9) Central Processing Unit (CPU)
10) Keyboard
11) Monitor
12) Familiarization with Windows, UNIX
13) Database searching of given gene sequence or protein sequence
14) Blast analysis of given protein

SEMESTER-I

MODEL QUESTION PAPER (PRACTICAL)

PAPER-II: SYSTEMATICS OF MAGNOLIOPHYTA AND ETHNOBOTANY (AND) EVOLUTION, BIOSTATISTICS, TECHNIQUES IN PLANT BIOLOGY AND BIOINFORMATICS.

Time: **4 hours** *Max.Marks*: **100**

1) Describe the technical terms, draw the floral diagram and write floral formula of the given plant material (A)	12
2) Construct a key for the given 4 twigs (B)	06
3) Identify to the level of species using the flora for the given plant material (C) and (D)	10
4) 4) Write critical note on Ethnobotanical specimens of the following (E, F, G, H, I) 5) E = Herbarium skills 6) F = Herbarium specimens 7) G = Ethnic food crops 8) H = Ethnomedicine 9) I = Ethnoveterinary medicine	10
5) Calculate the Mean, Median, Mode and SD of the given plant material (J) OR Solve the given biostatics problem (from question bank)	15
6) Perform the given experiment (K) and interpret the results (from techniques in plant biology)	10
7) Identify and write critical notes on (L, M, N, O) (Spotters from techniques in Plant biology and Computer applications)	12
8) Herbarium and Field note book	10
9) Record	10
10) Viva-Voce/ Assignment	05

SEMESTER-II

Paper-I (BOT-201): CYTOLOGY, GENETICS AND CYTOGENETICS

Unit-I – CYTOLOGY

1) Chromosomes-Physico-Chemical nature of Chromosomes of Prokaryotes and Eukaryotes
2) Theories and Models of Chromosome Morphology and Structure; Types of Chromosomes- Lampbrush and Polytene
3) Chromosome Banding: Q, C, G & R Banding
4) Cytological Techniques: Flow Cytometry, FISH & GISH

Unit-II – GENETICS

1) Mendelian Laws of Inheritance -An Overview, Linkage & Crossing-Over, Chromosomal Mapping (Two-Point and Three-Point Mapping)
2) Multiple Allelism, Intergenic Interactions and failure of dominance
   (i) Codominance, (ii) Incomplete dominance, (iii) Lethal genes
3) Genetic Transformation, Conjugation and Transduction in Bacteria
4) Population Genetics – Hardy Weinberg Law

Unit-III – CYTOGENETICS-I

1) Mutagens- Physical and Chemical Mutagens, Molecular Basis of Gene Mutations
2) Transposable Elements- AC-DS System in Maize
3) DNA Damage and Repair Mechanisms – Direct Repair, Excision Repair, Mismatch Repair and SOS Repair, C-Value paradox
4) Mutagenicity Tests-Ames Test

Unit-IV – CYTOGENETICS-II

1) Structural Alterations in Chromosomes – Deletions, Duplications, Inversion and Translocation (Robertsonian Translocations)
2) Numerical Changes in Chromosomes – Aneuploids and Euploids; Cytogenetics of Aneuploids, Autopolyploids and Allopolyploids
3) Genome study in Rice
4) Chloroplast and Mitochondrial Genomes

Suggested Readings:

1) Lewin. B. 2000. Genes VII. Oxford University Press, New York.
2) Gupta. P.K. 1995. Cytogenetics. Rastogi & Co., Meerut.
3) Glick. B.R. & Thompson. J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boc Raton, Florida.
4) Sybenga. J. 1973. General Cytogenetics. American Elsevier Pub. Co., New York.
5) Swanson, Merz & Young. 1967. Cytogenetics. Prentice Hall India.
6) Lewis. K.R. & John. B. 1963. Chromosome Marker. J & A Churchill Co., London.
7) Alberts. B., Breyer. D., Hopkin. K., Johnson. A.D., Lewis. J., Raff M., Roberts. K. & Watter. P. 2014. Essential Cell Biology. 4th Edition. Garland Publishers, New York.
8) Karp. G. 2013. Cell and Molecular Biology – Concepts and Experiments. 7th Edition. Wiley Global Education, USA.
9) Alberts. B., Johnson. A., Lewis. J., Raff. M., Roberts. K., & Walker. P. 2007. Molecular Biology of the Cell. 5th Edition. Garland Publishers, New York.
10) Schaffer. S.W. 2007. Mitochondria: The Dynamic Organelle. 1st Edition. Springer Verlag.
11) Wilson. J., & Hunt. T. 2007. Molecular Biology of the Cell. 5th Edition. The Problems Book. 2nd Edition. Garland Publisher, New York.

12) Celis. J.E. (Ed.). 2006. Cell Biology: A Laboratory Hand Book. 3rd Edition. Elsevier, USA.
13) Lodish. H., Berk. A., Kaiser. C.A., Kreiger. M., Scott. P.M., Bretcher. A., Ploegh. H., & Matsudaira. P. 2004. Molecular Cell Biology. 5th Edition. W.H. Freeman and Co., New York.
14) Kleinsmith. L.J. & Kish. V.M. 1995. Principles of Cell and Molecular Biology. 2nd Edition. Harper Collins College Publishes., New York, USA.
15) Powar. C.B. Cell Biology.
16) Singh. R.J. 2014. Plant Cytogenetics. 2nd Edition. CRC Press, India.
17) William. K., Cummings. S., Spencer. M.R., & Charlotte. A. 2013. Essentials of Genetics. Pearson Books, Delhi.
18) Hartwell L. 2011. Genetics: From Genes to Genomes, Study Guide and Solution Manual. 4th Edition. Nero.
19) Bass. H. & Birchler. J. 2011. Plant Cytogenetics: Genome Structure and Chrmosome Function. Springer, New York.
20) Russel. P.J. 2009. Genetics – A Molecular Approach. 3rd Edition. Pearson Benjamin Cummings, San Francisco, USA.
21) Roy. D. 2009. Cytogenetics. Alfa Science International Ltd., UK.
22) Gupta. P.K. 1995. Cytogenetics. Rastogi & Co., Meerut.
23) Sybenga. J. 1992. Cytogenetics in Plant Breeding. Springer London Ltd.
24) Swanon. M. & Young. 1982. Cytogenetics. Prentice Hall, India

SEMESTER-II

Paper-II (BOT-202): ECOLOGY, EVOLUTION AND PHYTOGEOGRAPHY

Unit-I – ECOSYSTEM ORGANISATION

1) Structure and Function – Primary Production (Methods of Measurement, Global pattern controlling factors); Energy Dynamics (Trophic Organization, Energy flow, Ecological Efficiencies)
2) Global Biogeochemical Cycles of Carbon, Nitrogen, Phosphorus and Sulphur
3) Ecological succession: Mechanisms of Ecological Succession- Sub-Climax and Climax theories, Stability of ecosystem; Homeostasis and Self-regulation, Margalef's model of Ecological succession
4) Strategy of Ecosystem development, Migration, Ecesis, Aggregation and Colonization

Unit-II – POLLUTION ECOLOGY

1) Kinds, Sources, Quality Parameters; Effects of Pollution on Plants and Ecosystems
2) Ozone Depletion, Acid rains, UV radiation and their Effects; Green House effect
3) Global Climate Change; National Carbon Pool and Carbon Sequestration
4) Eutrophication and Biomagnifications; Bioremediation and Activated sludge

Unit-III – EVOLUTION

1) Origin of life, Theories of organic evolution- Lamarckism, Darwinism, Concept of Variation, Adaptation, Fitness and Natural Selection
2) Mechanisms of Speciation, Genetic Polymorphism and Selection
3) Molecular Evolution: Molecular Divergency-Protein & Nucleotide Sequence Analysis, Molecular Clocks
4) Origin and Evolution of Cultivated Plants – Wheat and Rice

Unit-IV – PHYTOGEOGRAPHY

1) Introduction, Principles, Theory of Tolerance; Theory of Continental Drift and Plate Tectonics
2) Endemism – Endemic Plants of India
3) Biogeography – Major Terrestrial Biomes – Theories of Island Biogeography
4) Phytogeographical Zones of India.

Suggested Readings:

1) Alan Beebay & Anne-Maria Brennan. 2008. First Ecology. 3rd Ed. Oxford University Press.
2) Ambasht. R.S. & Ambasht. N.K. A Textbook of Plant Ecology. CBS Publishers & Distributers, New Delhi.
3) Begon Michael, Colin Townsend & John. L. Harper. 2005. Ecology, From Individuals to Ecosystems. 4th Ed. Black Well Publishing, Oxford.
4) Cain, S.A. 1944. Foundations of Plant Geography. Harper & Bros, NY. 4. Good, R.D. 1974. The Geography of flowering Plants. 3rd edition, Long Mans, London.
5) Dash. M.C. 2009. Fundamentals of Ecology. Tata McGraw Hill Pub., New Delhi.
6) Eddy Van Der Maarel & Janet Franklin. 2012. Vegetation Ecology. 2nd Ed. Wiley-Blackwell.
7) Ernst-Detlef Schulze, Erwin Beck, Klaus Muller-Hohenstein. 2010. Plant Ecology. Springer, Berlin.
8) Freeman Dyson 1999,Origin of Life, Cambridge University Press
9) Girard, James. 2014. Principles of Environmental Chemistry. 3rd Ed. Jones & Bartlett.
10) Magurran. A.E. 1988. Ecological Diversity and its Measurement. Croom Helm, UK.
11) Manuel. C. Molles Jr. 2013. Ecology – Concepts and Applications. 6th Ed. McGraw Hill.
12) Moore P.D. & Chapman. S.B. 1986. Methods in Plant Ecology. Blackwell Scientific, Oxford, UK.
13) Odum. E.P. & Gary W. Barrett. 2005. Ecology. Thomson Brooks / Cole, Singapore.

14) Odum. E.P. 1971. Fundamentals of Ecology. W.B.Saunders, Philadelphia.
15) Paul Davies , 2003 Origin of life, Penguin Publishers, UK
16) Richard T. Wight & Boorse. D.F. 2013. Environmental Science: Towards a Sustainable Future. 12th Ed. Benjamin-Cummings.
17) Ricklefs. R.E. & Gary L. Miller. 2000. Ecology. 4th Ed. W.H.Freeman & Co., New York.
18) Sharma. P.D. 2015. Ecology and Environment. Rastogi Publications, Meerut.
19) Smith. R.L. 1996. Ecology and Field Biology. Harper Collins, New York.
20) Stiling. P. 2002. Ecology, Theory and Applications. Prentice-Hall of India, New Delhi.
21) Symposium on Origin and Phytogeography of Angiosperms 1974. BSIP Publication
22) Teresa Andesirk, Gerald Audesirk and Bruce, E. Byers. 2003. Biology-Life on Earth. 6th edition. Prentice Hall University of Massachusetts, Amherst.
23) Tom Hennigan & Jean Lightner. 2013. The Ecology Book. Master Books.
24) Valentine, D.H. 1972. Taxonomy, Phytogeography and Evolution. Academic Press, London. New York.
25) Webber, P and Punnett, N. 1999. Physical geography and people Stanley. Thomas (Pub) Ltd. England.

SEMESTER-II

Paper-III (BOT-203): PLANT DEVELOPMENTAND REPRODUCTIVE BIOLOGY

Unit-I – MERISTEMS, TISSUE SYSTEM AND ANATOMY:

1) Meristems, Classification and Types; Organization of Shoot Apical Meristem
2) Simple and Complex tissues: Ultrastructure of Xylem and Phloem
3) Epidermal, Ground and Vascular Tissue Systems – Cambium, Laticifers, Periderm and Lenticels
4) Stem-Anatomy of Node, Primary Structure and Secondary Growth, Annual Rings, Heart wood and Sap wood, Hard and Soft wood, Reaction wood, Anomalous Secondary Growth

Unit-II – PLANT GROWTH AND DEVELOPMENT:

1) Introduction to Plant Growth and Development.
2) Seed Germination and Seedling growth: Metabolic activities during Seed Germination and Seedling Development, Hormonal control of Seedling Growth
3) Vascular Tissue Differentiation: Wood development in relation to Environmental Factors
4) Symmetry and Polarity – General Account

Unit-III – EMBRYOLOGY-I

1) Male Gametophyte: Anther wall, Microsporogenesis and Pollen development: Pollen Morphology (incl. SEM and TEM), NPC system
2) Pollen Storage, Viability, Pollen in Air; Pollen Allergy
3) Female Gametophyte: Ovule development, Types of Ovules, Megasporogenesis, Development and Ultra-structure of Female Gametophyte
4) Pollination: Biotic and Abiotic systems

Unit-IV – EMBRYOLOGY-II

1) Fertilization, Endosperm development: Nutrition of embryo; Embryogeny, Apomixis and Experimental Embryology
2) Anther and Embryo culture
3) Pollen-Pistil Interaction – Seed and Fruit development
4) Applications of Palynology

Suggested Readings:

1) Carlquist, S. 1961. Comparative plant Anatomy, Holt, Rinehart & Winston, New York.
2) Faegri, K.A. & Vander Pijl, L. 1971. The Principles of Pollination ecology, Pergamon Press, Oxford, London.
3) Fahn, A. 1990. Plant Anatomy.
4) Iwanami *et.al.,* 1988. Pollen: Illustrations and Scanning Electromicrographs, Spinger-Verlag, Berlin.
5) Johri, B.M. 1984. Embryology of Angiosperms, Springer-Verlag, Berlin.
6) Mauseth, J.D. 1988. Plant Anatomy. The Benjamin Cumminds Publication Co., Inc, Reading.Reading.
7) Raghavan, V. 1976. Experimental embryogenesis in Vascular Plants, Academic Press, London.
8) Shivanna, K.R. & Johri B.M. 1989. The Angiosperm Pollen: Structure and Function, Wiley Eastern Ltd., New Delhi.
9) Shukla, A.K., Vijayaraghavan, M.R. & Chaudhary, B. 1998. Biology of Pollen, APH Publication Company, New Delhi.
10) Wardlaw, C.W. 1968, Morphogenesis in Plants, Methuen & Co., London.

SEMESTER-II

Paper-IV (BOT-204): PLANT RESOURCES AND UTILIZATION

Unit-I– PLANT RESOURCES

1) Edible Plant Resources – Cereals-Rice, Wheat, Maize, Jowar, and Pulses- Red gram, Bengal gram, Black gram.
2) Spices and Condiments-Black pepper, Clove & Cinnamon – Oil yielding plant-Groundnut, Sunflower, Castor
3) Fruits – Mango, Banana, Grapes; Nuts-Beetlenut, Cashewnut, Vegetables- Brinjal, Tomato, Potato, Chilli, Spinach, Cluster bean
4) Plants yielding Fibers-Jute, Sun hemp, Rubber (*Hevea*); Timber -Teak, Rose wood; Biofuels -*Pongamia*, Wild castor.

Unit-II– PLANTS AND MEDICINE-I

1) Introduction, History, Scope and Importance of Indigenous Systems of Medicine (Ethno medicine)
2) Traditional medicine (AYUSH) Ayurveda, Siddha, Unani) and Homeopathy
3) Different types of Crude Drugs – Based on Origin, Application and Use
4) Central Institutes-CIMAP, NBRI

Unit-III- PLANTS AND MEDICINE-II

1. Wild and Potential Drug Yielding Plants and their Therapeutic Values with Reference to Sarpagandha, Ashwagandha, Datura, Periwinkle.
2. Endangered medicinal plants- conservation
3. Phytomedicine and Applications – Importance of Phytopharmaceuticals, Principles of Pharmacognosy
4. Patent laws of medicinal plants

Unit-IV – PLANTS AS MODEL ORGANISMS

1) Introduction to Model Organisms and use of model organisms
2) Major types of model organisms
   a) Genetic model organisms
   b) Experimental model organisms
   c) Genomic model organisms
3) Important model organisms – *Escherichia coli*, Yeast, *Neurospora, Chlamydomonas reinhardtii, Arabidopsis thaliana, Zea mays, Nicotiana benthamiana*
4) Plant as bioreactors, Plantibodies and Transgenic plants.

Suggested Readings:

1) Cotton. C.M. 1996. Ethnobotany: Principles and Applications.
2) Hill, Albert. F. 1952. A Textbook of Useful plants and Plant Products. McGraw Hill.
3) Kokate, C.K., Purohit. A.P., & Gokhale. S.B. 2000. Pharmacognosy. Nirali Prakashan Publ.
4) Lincol Taiz & Eduardo Zeiger. 2010. Chapter-1 – Model Organism in Plant Physiology. 5th Edition. Sinauer.
5) Pooja. 2010. Economic Botany. Discovery Publishing House.
6) Rao, Ravi Prasad. B. 2005. Biodiversity. In Pullaiah. T (Ed.) Taxonomy of Angiosperms. Regency Pub. , New Delhi. Pp.287-317.
7) Rao, Ravi Prasad. B. 2009. Plant Name Directory. ABCD-Kalanjali, Hyderabad.
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9) Trease. G.E. & Evans W.C. 2002. Pharmacognosy. Saunders, New York.
10) Economic Botany. Chand Publications.

SEMESTER-II

PRACTICAL SYLLABUS

Paper-I: CYTOLOGY, GENETICS AND CYTOGENETICS (and) ECOLOGY, EVOLUTION AND PHYTOGEOGRAPHY

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I) PROBLEMS ON CYTOGENETICS:

1) Problems on Inversions
2) Problems on Translocations
3) Problems on Polyploids
4) Problems on Hardy Weinberg law (Population Genetics)

II) CYTOLOGY:

1) Effect of chemical mutagens on dividing cells (Mitosis)
2) Meiotic stages in Onion / Maize flower buds
3) Mitotic Index (MI)
4) Induction of Tetraploidy by using Colchicine

III) Spotters:

1) Chromosomal aberrations
   (a) Chromosomal bridges; (b) Laggards and fragments; (c) Chromosomal breakages; (d) Precocious moments of chromosomes; (e) Unequal separation of chromosomes.
2) Cp-DNA
3) Mt-DNA
4) Karyotype
5) AC-DS system
6) Chromosome models
7) Ames's Test
8) Conjugation
9) Polyploids
10) Molecular Evolution
11) Gene- chips
12) Protein modeling
13) Computer
14) Protein chips
15) DNA data bank

PROBLEMS IN CYTOGENETICS:

Problem-1: Consider an organism with four pairs of chromosomes in standard order, the ends of which we shall label 1-2, 3-4, 5-6, 7-8. Strain-A crossed to the standard strain gives a ring of four plus two bivalents during meiotic prophase. Strain-B crossed to the standard strain also gives a ring of four plus two bivalents. In each of the four situations which follow, explain how a cross of strain A x strain B could produce (a) four bivalent. (b) ring of four two bivalents, (c) two ring of four, (d) ring of six plus one bivalent.

Problem-2: An inversion heterozygote possesses one chromosome in the normal order a b c d e f g h and one in the invented order a b f e d c g h
A four stand double crossover occurs in the f-e and d-c. Diagram and label the first anaphase

Problem-3: Eight regions of a dipteran chromosome are easily recognized cytologically and labeled a through h. Four different races within this species have the chromosomal orders as listed. (1) a h b d c f e g, (2) a e d c f b h g, (3) a h b d g e f c, (4) a e f c d b h g
Assuming that each race evolved by a single inversion from another race, show how the four races could have originated.

Problem-4: The European raspberry (*Rubus idaeus*) has 14 chromosomes. The dewberry (*Rubus caesius*) is a tetraploid with 28 chromosomes. Hybrids between these two species are sterile F1 individuals. Some unreduced gametes of the F1 are functional in backcrosses. Determine the chromosome number and level of ploidy for each of the following: (a) F1, (b) F1 backcrossed to *R. idaeus*, (c) F1 backcrossed to *R. Caesius*, (d) chromosome doubling of F1 (*R. maximus*).

Problem-5: The diploid number of the garden pea is 2n=14. (a) How many different trisomics coiled be formed, (b) How many different double trisomics could be for formed.

Problem-6: The diploid number of an organism is 12. How many chromosomes would be expected in (a) a monosomic (b) a trisomic (c) a tetrasomic (d) a double trisomic (e) a nullisomic (f) a monoploid (g) a triploid and (h) an autotetraploid.

Problem-7: Given a pericentric inversion heterozygote with one chromosome in normal order (1 2 3 4 5 6 7) and the other in the inverted order (1 5 4 3 2 6 7 8), diagram the first anaphase figure when a 4-strand double crossover occurs involving the regions between 4 and the centromere ( ) and between the centromere and 5.

Problem-8: A four-strand double crossover occurs in an inversion heterozygote. The normal chromosome order is (0 1 2 7 6 5 4 3 8). One crossover is between 1 and 2 the other is 5 and 6. Diagram and label the first anaphase figures.

Problem-9: Diagram and label the first anaphase produced by an inversion heterozygote whose normal chromosome is (o a b c d e f g h) and with the inverted order (o a b f e d c g h), assume that a two-strand double crossover occurs in the regions c-d and e-f.

Problem-10: Prove the Hardy-Weinberg law by finding the frequency of all possible kinds of mating the progeny using the symbols below.

	Alleles		Genotypes		
Frequency	A	a	AA	Aa	aa
	p	q	p^2	2pq	q^2

Problem-11: The MN blood group has three phenotypes M, MN and N with the genotypes L^M, L^M, L^M, L^N and L^N, L^N, respectively. In sample of 100 individuals the following members in the M, MN and N groups were obtained.

Phenotype (Blood group)	**M**	**MN**	**N**	**Total**
Genotype	L^M, L^M	L^M, L^N	L^N, L^N	
No. of individuals	60	30	10	100

Estimate the frequency of L^M and L^N alleles of the gene producing MN blood group in man.

V) ECOLOGY AND PHYTOGEOGRAPHY

a) Major experiments:

1) Estimation of Gross and Net Primary Productivity and Respiratory consumption in aquatic ecosystems.
2) Air Pollution Tolerance Index (APTI) in tree species.
3) Determination of Biochemical oxygen demand (BOD) in sewage water.
4) Study of plant community by determining the frequency, density and abundance of different species, based on the collected data construct frequency diagram and compare it with normal frequency diagram

b) Minor experiments:

1. Determination of accumulated soil enzymes (protease and urease) and soil fertility
2. Estimation of organic matter in agriculture soils.
3. Determination of Chemical Oxygen Demand (COD) in industrial effluents
4. Estimation of eutrophication factors; phosphates and sulphates in degraded and fertile soils.
5. TDS (Estimation of Total Dissolved Solids in a given sample of water)

VI) SPOTTERS:

1. Petrol or Coal (Non-renewable energy)
2. Alcohol (Bioenergy)
3. Hydrophytes
4. Xerophytes
5. Epiphytes
6. Continental drift
7. Phytogeographic region of Telangana

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SEMESTER-II

PRACTICAL SYLLABUS

Paper-II: PLANT DEVELOPMENT AND REPRODUCTIVE BIOLOGY (and) PLANTS RESOURCES UTILIZATION

I) MAJOR EXPERIMENTS:

a) Plant Development

1) Micrometry for standardization of Microscope.
2) Stomatal Index (SI) for abaxial and adaxial surface of leaf material.
3) *In vitro* pollen germination and tube growth in BK medium at different time periods.

b) Anatomy:

1) Plant fixation, Sectioning and staining including microtome sections.
2) Awareness on SEM.
3) Section cutting:
   a) Structure of Node
   b) 3D structure of wood (TS, RLS, TLS) in Teak and Neem.
4) Anomalous growth (primary): *Boerhaavia*, *Amaranthus*, *Casurina* or *Nyctanthes*.
5) Anomalous Secondary growth: *Aristolochia*, *Leptodenia*, *Strychnos*, *Dracaena*.
6) Vessel less angiosperm, eg. *Michaelia*.

II) MINOR EXPERIMENTS:

1) Histochemical studies of**:**
   (a) Proteins
   (b) Cellulose
   (c) Lignin
   (d) Starch
   (e) Pectins
2) Determination of pollen viability
3) Measurement of Microscopic structure by using Ocular micro meter.
4) Pollen germination by using Hanging drop technique.
5) Dissection of endosperm haustorium

III) SPOTTERS

1. Dimorphism in flowers (Pin & Thrum forms)
2. Callose deposition in Pollen tube
3. Polarity in a single cell
4. Group effects
5. Secretary Tapetum
6. Plasmodia Tapetum
7. Endothecia Thickenings
8. Hypogeal germination
9. Epigeal germination
10. Apical meristem / shoot apex.
11. Bilateral symmetry. Eg; *Opuntia, Laminaria*.
12. Dorsi-ventral symmetry .Eg: *Thuja*
13. Ovules slides (whole mounts)
14. Embryo (Heart and Globular)

PALYNOLOGY:

1) Slides of Pollen grains (permanent): *Acacia*, *Hibiscus*, *Ipomea*, *Datura* and Grass

PLANT RESOURCES AND UTILIZATION

1) Fibers: Jute, Sun-hemp, Flax-Morphology , anatomy, microscopic study of whole fibers appropriate staining procedure
2) Oil seeds: Groundnut, Sunflower, Castor –morphology, microscopic structure of oil yielding tissues, test for oil and iodine number.
3) Medicinal Plants: Sarpagandha, Ashwagandha, Datura, Periwinkle (Study of atleast two from each category)
4) Cereals: Rice, Wheat, Maize, Jowar
5) Pulses: Red gram, Bengal gram, Black gram
6) Fruits: Mango, Banana, Grapes
7) Nuts: Beetle-nut, Cashew-nut
8) Vegetables: Brinjal, Tomato, Potato, Chilli, Spinach, Cluster-bean
9) Rubber: Hevea
10) Timber: Teak, Rose-wood
11) Biofuels: *Pongamia*, Castor

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SEMESTER-II

PRACTICAL MODEL PAPER

Paper-I: CYTOLOGY, GENETICS AND CYTOGENETICS (and) ECOLOGY AND PHYTOGEOGRAPHY

Time: **4 hours** *Max.Marks*: **100**

1) Cytological preparations / Calculate of mitotic index (A) (Cytological preparation include showing different mitotic stages)	15
2) Cytogenetics problem on Inversions / Translocations (B)	12
3) Cytogenetics problem on Polyploidy / Hardy-Weinberg Law (C)	08
4) Major experiments from Ecology (D)	20
5) Minor experiments from Ecology (E)	15
6) Identify the given spotters (F, G, H & I) F = Spotter from Cytology G = Spotter from Cytology H = Spotter from Ecology I = Spotter from Ecology	12
7) Record	05
8) Viva-Voce/ Assignment	05

SEMESTER-II

PRACTICAL MODEL PAPER

Paper-II: PLANT DEVELOPMENT, REPRODUCTIVE BIOLOGY AND PALYNOLOGY (and) PLANTS IN HUMAN WELFARE

Time: **4 hours** *Max.Marks*: **100**

1)	Conduct the given experiment and interpret the results (Major experiments from Plant development) – (A)	20
2)	Conduct the given experiment and present the results- (B)	15
3)	Take the section of given plant material, stain and describe it (Section cutting from Anatomy) – (C)	20
4)	Write notes on the following crops (Plant Resource and Utilization) – (D & E)	12
5)	Identify and write critical notes on the following (F, G, H, I, J) F = Spotters from Plant development G = Spotters from Embryology H = Slides from Palynology I & J = Spotters from Plant Resource and Utilization	18
6)	Record	05
7)	Viva-Voce/ Assignment	05

SEMESTER-III

THEORY SYLLABUS

PAPER-I (BOT-301): PLANT PHYSIOLOGY AND BIOCHEMISTRY

Unit-I: WATER RELATIONS, MINERALNUTRITION, TRANSLOCATION OF PHOTOASSIMILATES AND PHOTOSYNTHESIS

1) Importance of Water in Plants Life, Absorption of Water, Ascent of Sap, Transpiration: Stomatal Structure and Movement, Anti-Transpirants and their importance.
2) Mineral Nutrition: Macro and Micro essential elements; Ion uptake mechanism; Translocation and Distribution of Photo-assimilates: Structure of Phloem tissue; Sources and Sinks; Mechanism of Translocation in the Phloem; Phloem loading and unloading.
3) Photochemistry and Photosynthesis: General Concepts and Historical background, Evaluation of Photosynthetic–Apparatus, Photosynthetic Pigments and Light Harvesting Complexes.
4) Photo-oxidation of Water, Mechanism of Electron Transport, Carbon Assimilation, the Calvin Cycle, Photorespiration and its Significance, the C_4 cycle; CAM pathway, Biosynthesis of Starch and Sucrose.

Unit-II: RESPIRATION AND NITROGEN METABOLISM

1) Respiration: Overview of Plant Respiration, Glycolysis, the TCA Cycle, electron transport and ATP synthesis.
2) Pentose Phosphate Pathway (PPP), Glyoxylate Cycle, Alternative Oxidase System.
3) Nitrogen Fixation, Nitrogen and Sulphur metabolism: Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, sulphate uptake, transport and assimilation.
4) Organization and regulation of *nif* genes; Transfer of *nif* genes into higher plants.

Unit-III: PLANT GROWTH REGULATORS, PHYSIOLOGY AND FLOWERING AND STRESS PHYSIOLOGY

1) Plant Growth Regulators: Physiological effects and Mechanism of action of Auxins, Gibberellins, Cytokinins, Ethylene, Abscisc acid, Brassinosteroids, Polyamines, Jasmonic acid and Salicylic acid; Physiological roles in Agri-horticulture; Hormone receptors.
2) The Flowering process: Photoperiodism and its Significance, Endogenous Clock and its Regulation.
3) Floral Induction and Development: Genetic and Molecular analysis, Role of Vernalization
4) Photomorphogenesis: Phytochrome, distribution, chemical nature and Physiological roles Physiology of Seeds: Seed germination, dormancy, Morphological, biochemical and metabolic events during seed germination.
5) Stress Physiology: Plant response to Biotic and Abiotic stress; Mechanism of Biotic and Abiotic Stress tolerance.

Unit-IV: PLANT BIOCHEMISTRY

1) Classification and Properties of Carbohydrates.
2) Lipid metabolism: Structure and Function of Lipids, Fatty acid biosyntheses, Synthesis of Membrane Lipids, Structure and Storage of Lipids and their Catabolism.
3) Fundamentals of Enzymology: General aspects, Allosteric mechanism, Regulation and active sites, Isozymes.
4) Kinetics of Enzymatic Catalysis: Michaelis-Menten Equation and its Significance.

Suggested Readings:

1) Delvin. R.M. 1969. Plant Physiology. Affiliated East West, New York.
2) Dennis. D.T., Layzell. D.B., Lefebvre. D.D. & Turpin. D. 1997. Plant Metabolism. 2nd Ed. Addison-Wesley Pub. Co., New York.
3) Hopkins. W. 1998. Introduction to Plant Physiology. ELBS & Longman, Essex., England.
4) Salisbury. F.B. & Ross. C.W. 1992. Plant Physiology. 4th Ed. Wadsworth Publishing Co., Belmont, California.
5) Taiz & Zeiger. E. 1998. Plant Physiology. 2nd Ed. Sinauer Associates Inc. Publishers, Massachusetts, USA.
6) Thomas. C. Moore. 1992. Biochemistry and Physiology of Hormones. Narosa.
7) Purohit. Plant Physiology – Fundamentals and Approach.
8) Dey & Harborne. 1998. Plant Biochemistry. Academic Press.
9) Heldt. H.W. 1997. Plant Biochemistry and Molecular Biology. OUP.
10) Lehninger. A.L. 2001. Biochemistry. Kalyani Publishers, Ludhiana.
11) Matthews. C.K., Van Holde. K.E. & Ahem. K.G. 2000. Biochemistry. 3rd Ed. Benjamin Cummings, Sanfrancisco.
12) Wilkins. M.B. (Ed.). 1987. Advanced Plant Physiology. ELBS & Longman, Essex., England.

SEMESTER-III

THEORY SYLLABUS

PAPER-II (BOT-302): MOLECULAR BIOLOGY AND BIOENGINEERING

Unit-I: CELL BIOLOGY

1) Ultra-Structure of Prokaryotic and Eukaryotic cells: Cytoskeleton.
2) Chromatin; Euchromatin, Heterochromatin, DNA condensation and Nucleosome
3) Cell Cycle: Molecular events and Model systems.
4) Biology of Cancer, Carcinogenesis , tumorigenesis, Oncogenes and their expression: Apoptosis.

Unit-II: MOLECULAR BIOLOGY

1) Molecular Biology/Introduction and Scope, Basic Organization of Nuclear Genes; Promoters and Other regulatory sequences, Prokaryotic and Eukaryotic gene expression.
2) Transcription: Prokaryotic and Eukaryotic Transcription, RNA Polymerase, Transcription factors, Mechanism of Transcription.
3) Post-Transcriptional modification, Modifications in RNA, 5-Cap formation, Transcription, termination, 3'end processing and Polyadenylation, Splicing and editing, Nuclear export of m- RNA Stability.
4) Translation: Prokaryotic and Eukaryotic Translation, the Translational machinery, Initiation, Elongation and Termination, Post-Translation modification of Proteins.

Unit–III: MOLECULAR ENGINEERING

1) Restriction Enzymes: Discovery, Types, Nomenclature and Role in Genetic Engineering.
2) Cloning vectors: Plasmids, Cosmids, Phagemids and Other Viral Vectors.
3) Process of Cloning: Selection of recombinant DNA molecule, Blue and white selection, Blotting Techniques (Southern, Northern, Western). Synthesis of cDNA, Construction of Genomic and cDNA Libraries: YAC, BAC, Packaging, Transfection and Recovery of Clones.
4) Molecular Markers in Genome Analysis.

Unit-IV: APPLIED MOLECULAR BIOLOGY

1. Applications of RFLP, RAPD and AFLP Analysis in crop improvement.
2. Applications of r-DNA technology.
3. Applications of genetic engineering in crops.
4. Application of RFLP in Forensic and Disease Prognosis.

Suggested Readings:

1) Alberts. B., Bray. D., Lewis. J., Raff. M., Roberts. K. & Watson. J.D. 2004. Molecular Biology of the Cell. Garland Publishing, New York & London.
2) Alfonso Valencia & Blascheke. L. 2005. Developing Bioinformatics Skills. Orille's Publication.
3) Ayala. A.J. & Castra. W. 1984. Modern Genetics. 2nd Ed. Goom Helns, London.
4) Benjamin Lewin. 2006. Genes VIII. Oxford University Press.
5) Des Higgins Willie. 2006. Bioinformatics Sequence, Structure and Data Banks.
6) Fritsch. E.F. & Sambrook. J. 1992. Molecular Cloning: Laboratory Manual. Maniatis, Cold Spring Laboratory, New York.
7) George. M. Malacinski & Freifeilder. D. 2005. Essentials of Molecular Biology.
8) Schecleif. R.F. & Wensik. P.C. 1991. Practical Methods in Molecular Biology. Springer, Verlag.
9) Walker. J. & Castra. W. 1992. Techniques in Molecular Biology. Goom Helns. London.
10) Snustad. P & Simmons. M.J. 2003. Principles of Genetics. 3rd Ed. John Wiley & Sons Inc., USA.
11) Weaver. R.F. 1999. Plant Molecular Biology. WCB / McGraw Hill.
12) Lewin. B. 2004. Genes VIII. Pearson Prentice Hall, New Jersey.

SEMESTER-III

THEORY SYLLABUS

PAPER –III (BOT 303): Elective I (a): PLANT BIOSYSTEMATICS

Unit-I: PLANT BIOSYSTEMATICS: INTRODUCTION

1) Introduction: Biosystematics; Scope, objectives and relevance of Biosystematics; International Organization of Plant Biosystematics (IOPB).
2) Biosystematics categories: Ecotype, Ecospecies, Coenospecies and Comparium ; Deme Concept and Terminology.
3) Variability: Patterns of Phenotypic and Genetic Variability due to Environment; Concept of Species.

Unit-II: PLANT BREEDING SYSTEMS

1) Breeding Systems in Magnoliophyta: Reproductive isolation mechanism; Hermaphrodity, Dicliny, Dichogamy and Sex ratios.
2) Pollination Biology and Gene Flow. Pollen/ovule ratios.
3) Incompatibility: Diallelic Self-incompatibility and Heteromorphy; Multiallelic Self-incompatibility; Sporophytic and Gametophytic Self-incompatibility.

Unit-III: HYBRIDIZATION AND SYSTEMATIC EVIDENCE

1) Hybridization: Hybridization, Speciation; Cytotaxonomy.
2) Systematic Anatomy: Evidence from Foliar Epidermis (Stomata, Trichomes and Idioblasts), Venation patterns, Wood and Floral Anatomy.
3) Systematic Embryology: Embryological traits and Pollen in relation to Systematics.

Unit-IV: CHEMOSYSTEMATICS, CLADISTICS AND TAXIMETRICS

1) Numerical Taxonomy: Concept, Adansonian Taxonomy; Merits and Demerits of Numerical Taxonomy.
2) Chemosystematics: Cell and Molecular Biological Approaches to Biosystematics.
3) Cladistics: Molecular Markers to Identify and Resolve Taxonomic disputes at Species level.

Suggested Readings:

1) Crawford, DJ 1990. *Plant molecular Systematics: Macromolecular approach*, John Wiley, New York
2) Davis, PH & VM Heywood.1963. *Principles of Angiosperm Taxonomy* Oliver & Boyd. Edinburgh.
3) Donoghue. 2007. *Plant Systematics: A Phylogenetic Approach*, 3rd ed. Sinauer.
4) Judd, WS, Christopher S. Campbell, Elizabeth A. Kellogg, Peter F. Stevens, and Michael J.
5) Lawrence, GHM.1951. *Taxonomy of Vascular Plants*. McMillan, New York.
6) Naik, VN. 1992. *Taxnomy of Angiosperms*. 2nd Edn. Tata Mc. Graw Hill
7) Radford. AE et al., 1974. *Vascular Plant systematics.* Harper & Row. New York.
8) Radhakrishnaiah, M. 1996. *Essentials of Plant Taxonomy*. Hyderabad
9) Ratnam, S.V. 2009. *Plant Biosystematics.* MD Publications Pvt. Limited, New Delhi.
10) Sneath, PHA & RR Sokal, 1973. *Numerical Taxonomy.* WH Freeman & Co.
11) Solbrig, OT.1970. Priciples and Methods of Plant Biosystematics. Macmillan Series, London.
12) Stace, CA. 1980. *Plant Taxonomy and Biosystematics*. Edward Arnold, London.

SEMESTER-III

THEORY SYLLABUS

PAPER-III (BOT-303): Elective-I (b): MICROBIAL ECOLOGY

Unit-I: ECOLOGICAL GROUPS AND MICROBIAL INTERACTIONS

1) Scope of Microbial Ecology: Historical Overview–Microbial Diversity (Bacterial, Archaeal, Eucaryal). Ecological groups of Microorganisms.
2) Microbial interactions: Neutralism, Commensalisms, Synergism (Proto-Cooperation, Mutualism, Symbiosis), Competition, Amensalism, Parasitism and Predation.
3) Plant Microbe Interaction (With Plant Roots), Rhizosphere-Mycorrhizae and Nitrogen Fixation in Nodules.

Unit-II: MICROBIAL COMMUNITIES AND ECOSYSTEM

1) Microbial Community Dynamics: Population Selection within Communities-Alpha and Kappa Strategies, Succession within Communities.
2) Ecosystem: Microbial Communities in Nature-Microbes within Macro Communities' Structure and Function of Some Microbial Communities.
3) Physiological Ecology of Microorganisms: Adaptations to Environmental Conditions, Leibig law of Minimum, Shelfords Law of Tolerance.

Unit-III: AIR, WATER AND SOIL MICROBIOLOGY

1) Aeromicrobiology: Introduction , Aeromycoflora constituents, Important Airborne Pathogens–Dispersal of Airborne Microorganisms in the Air (Launching, Transport and Deposition). Air Sampling Techniques (Impingers and Impacters).
2) Aquatic Microbiology: Introduction, Microbial Habitats in the Aquatic Environment (Planktonic Environment, Benthic Habitat, Microbial Mats, Biofilms); Water Pollution-Standards and Criteria of Indicator Organisms, Total Coliform; The Most Probable Number (MPN) Test; The Membrane Filter (MF) Test; The Presence-Absence (P-A) Test; Standards of potable water.
3) Soil Microbiology: Soil Profile-Distribution of Microorganisms in Soil, Microbes in Nutrient Cycles (Carbon, Nitrogen, Phosphorous and Sulphur), Composition of Litter, Dynamics of Litter Decomposition, Carbon Assimilation and Immobilization, Humus.

Unit-IV: BIOTECHNOLOGICAL ASPECTS OF MICROBIAL ECOLOGY

1) Microbial Treatment of Solid and Liquid Wastes: Landfills, Composting, Biological Oxygen Demand (BOD)-Primary , Secondary and Tertiary treatment of sewage, Potable Water and Disinfections.
2) Biomagnifications of Pesticides: Biodegradation of Pesticides (DDT), Hydrocarbons.
3) Microbial Leaching and Biomining (Copper and Uranium): Microbial Approaches in the Remediation of Metal contaminated Aquatic Systems.

Suggested Readings:

1) APHA.(1995) " Standard methods for Water and Wastewater" American Public Health Association, Washington, DC.
2) Atlas and Bartha. (1993) "Microbial Ecology." Benjamin Cummings, Redwood City, CA.
3) Block ,S.S (1991) "Disinfection ,Sterilization and Preservation ,"4th ed. Lea & Febiger, Philadelphia.
4) Britton, L.N.(1984)Microbial Degradation of Aliphatic Hydrocarbons. In" Microbial Degradation of Organic Compounds"(D.T.Gibson,ed.)Marcel Dekker Inc.,New York ,NY pp.89-129.
5) Craun ,G.F.(1993) "Safety of water Disinfection: Balancing Chemical and Microbial Risks" ILSI Press, Washington, DC.
6) Geldreich,E.E.(1996) "Microbial Quality of Water Supply in Distribution Systems ."Lewis ,Boca Raton, FL.
7) Gleeson, c., and Gray,N.(1997) "The Coliform index and waterborne Disease." E and FN spon ,London.
8) Gottardi, W.(1991)Iodine and Iodine compounds .In "Disinfection ,Sterilization and Preservation," 4th ed. Lea&Febiger, Philadelphia,pp.152-166.
9) Gregory, P .H. (1973) "The Microbiology of the Atmosphere."Leonard Hill Books, Aylesbury, Bucks.
10) Haug,R.T.(1993) "The Practical Handbook Of Compost Engineering" Lewis,Chelsea, MI.
11) Konopka, A. E. (1993) Distribution and activity of microorganisms in lakes: Effects of physical processes. In "Aquatic Microbiology: An Ecological Approach" (T.E. Ford, ed.)Blackwell Scientific Publications, Cambridge, MA pp47-68.
12) Montgomery ,J.M.(1985) "Water Treatment Principles and Design."John wiley & sons, New York.
13) Paul, E.A.,and Clark, F.E.(1989) "Soil Microbiology and Biochemistry." Academic Press, New York.
14) Raina M.Maier ,Ian L.Pepper, Charles P.Gerba (2000) "Environmental microbiology" California 92101-4495, ,Elsevier(USA)
15) Reddy,S.M, Reddy, S.R and Narendra Babu G (2012) Basic Industrial Biotechnology, New Age International Publishers, New Delhi.
16) Tilak S. T (2010) Aerobiology to Astrobiology. Bharati vidhyapeeth scientific Monograph No-1. P-192
17) Tilak S.T (1996) Plant disease forecasting in IPM System in agriculture Eds. R.K. Upadhyaya, K.E. Mukhaerjee and R.K. Rajak, Aditya Books (Pvt) Ltd., New Delhi. P 235-263
18) Wagner,G.H., and Wolf, D. C.(1998) Carbon transformations and soil organic matter formations.In "Principles and applications of Soil Microbiology" D.M.Sylvia, J.J.Fuhrmann, P.G. Hartel, and D.A. Zuberer,eds.) Prentice-Hall,Upper Sadle River,NJ,pp.259-294

SEMESTER-III

THEORY SYLLABUS

PAPER–III (BOT-303): Elective I (c): MEDICINAL PLANT CHEMISTRY AND PHARMACOGNOSY

Unit – I: INTRODUCTION

1) Phytochemistry: Introduction, Phytochemistry and Human welfare.
2) Phytochemistry and Medicinal plants.
3) Phytochemical techniques: **C**hromatography, Electrophoresis and NMR spectra.

Unit – II: MEDICINAL PLANTS AND CHEMICAL CONSTITUENTS

1) Indian Medicinal plants: Cultivation of rare Indian medicinal plants.
2) Phytochemical analysis: Methods of extraction, isolation and identification.
3) Active Principles: Secondary metabolites-Alkaloids, flavonoids, steroids, terpenoids and phenolic constituents.

Unit –III: **PHARMACOGNOSY: INTRODUCTION**

1) Pharmacognosy: Introduction, scope and interdisciplinary nature.
2) Therapeutic classes of plant drugs.
3) Organized and unorganized crude drugs. Indian pharmacopoeia.

Unit – IV: **CRUDE DRUGS EVALUATION**

1) Evaluation of crude drugs.
2) Powder analysis of following plant drugs.
   a). Root : *Rauvolfia serpentina* (Sarpagandhi)
   b). Rhizome: *Curcuma longa* (Turmeric)
   c). Bark : *Cinnamon verum (C. zeylanicum*)
   d). Wood : *Santalum album* (Sandal)
   e). Leaf : *Senna alexandrina* (*S. aungustifolia*)
   f). Flower: *Eugenia caryophyllata* (Cloves)
   g).Fruit : *Carum curvi* (Caraway)
   h).Seed : *Strychnos nux-vomica* (Nux vomica)
   i). Herb : *Cannabis sativa* (Cannabis/Hemp)
3) Drug adulteration and contamination. Pharmacognosy and Forensic Science.

Suggested Readings:

1) Ashuthosh Kar 2013, Pharmacognosy and Phytochemistry IInd Ed. New Age International Publishers, New Delhi
2) Biren Shah and Seth AK 2014, Text book of Pharmacognosy & Phytochemistry, Elsevier Health Sciences, India
3) Jarald EE 2010, text book of Pharmacognosy and Phytochemistry a, CBS Publishers and Distributors, New Delhi
4) Khadabadi KH, Bavisker BA & Deere SL, 2014, Pharmacognosy & Phytochemistry a comprehensive approach, Pharmamed Press
5) Kumar GS and Jayveera KN, 2013, A text book of Pharmacognosy and Phytochemistry 1st ed. S .Chand Publishing, Delhi
6) Ruby KM, Rajani Chouhan and Jaya Dwivedi 2014,Phytochemisytry and pharmacology of some Indian medicinal plants ,LAP Lambert, Academic Publishing
7) Trease, G.E. and W.C. Evans, 2002. Pharmacognosy, Saunders, New York.

SEMESTER-III

THEORY SYLLABUS

PAPER-IV (BOT-304): Elective-II (a): PLANT CELL, TISSUE & ORGAN CULTURE

Unit-I: INTRODUCTION TO PLANT TISSUE CULTURE AND TECHNIQUES

1) History, Scope and Perspectives of Plant Cell, Tissue and Organ Culture.
2) Various Plant Tissue Culture Media: Role of Macro and Micronutrients on the Growth of Cultured Cells; Role of Vitamins, Carbohydrates and Nitrogen source on Growth and Differentiation.
3) Techniques–Instrumentation in Tissue Culture; Cytodifferentiation *In Vitro*.

Unit-II: *IN VITRO* PROPAGATION

1) Morphogenesis, Differentiation, Dedifferentiation, Redifferentiation and Cytodifferentiation.
2) Micropropagation and Its Applications: Organogenesis, Somatic Embryogenesis and Synthetic Seeds, Clonal Propagation.
3) Somaclonal and Gametoclonal Variation and Crop Improvement.

Unit-III: APPLICATIONS OF PLANT TISSUE CULUTRE-I

1) Androgenic Haploids and its Applications.
2) Embryo Rescue, Embryo Culture and Wide Hybridization.
3) Protoplast Isolation, Culture and Somatic Hybridization, Types and their Importance in Agriculture.

Unit-IV: APPLICATIONS OF PLANT TISSUE CULUTRE-II

1) Secondary Metabolites production through Tissue Culture and Hairy Root Culture.
2) Induction and Selection of Mutant Cell Lines for Drought, Salt Tolerance and Disease Resistance.
3) Cryopreservation (Meristems, Somatic Embryos, Callus) in Germplasm Storage.

Suggested Readings:

1) Bhojwani. S.S. & Razdan. M.K. 1996. Plant Tissue Culture: Theory and Practice (Rev.Ed.). Elsevier Science Publishers, New York.
2) Chawla. H.S. Introduction to Plant Biotechnology. Oxford & IBH.
3) Collin. H.A & Edwards. S. 1998. Plant Cell Culture. Bioscientific Publishers, Oxford, UK.
4) Gamborg & Phillips. Plant Cell, Tissue and Organ Culture. Narosa Publications.
5) Jain. S.M., Sopory. S.K. & Valleux. R.E. 1996. In Vitro Haploid Production in Higher Plants. Volumes 1 to 5. Fundamental Aspects and Methods. Kluwer Academic Publishers, Dordrecth, Netherlands.
6) Kalyan Kumar De. 1997. Plant Tissue Culture. NCB Agency, Kolkata.
7) Ramawat. K.G. & Merillon. J.M. 2007. Biotechnology: Secondary Metabolites. 2nd Ed. Science Pub., Netherlands.
8) Razdan. M.K. 2003. An Introduction to Plant Tissue Culture. Oxford & IBH, New Delhi.
9) Shukla YM,Patel NJ,Jithendra JD,Bhatnagar R,Talati JG ,Kathiria KB 2009, Plant Secondary Metabolites, New India Publishing Agency, Gujarat.
10) Vasil. I.K. & Thorpe. T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, Dordrecth, Netherlands.

SEMESTER-III

THEORY SYLLABUS

PAPER-IV (BOT-304): Elective II (b) : ADVANCED PLANT PHYSIOLOGY

Unit-I: INTRODUCTION TO ADVANCED PLANT PHYSIOLOGY

1) Transpiration: Molecular mechanism of stomatal movement.
2) Molecular organization of photosynthetic systems.
3) Protein transport into chloroplast; signal transduction.

Unit-II: ADVANCED PLANT BIOCHEMISTRY

1) Biochemistry and Molecular Biology of Seed Storage Proteins and their Importance through Biotechnological Tools.
2) Calcium Modulation Proteins Targets of Intra -Cellular Ca^{++} Signals, Signal perception and Transduction–Overview of Receptors and G-Proteins, Phospholipids, Fundamentals of Signaling, Role of Cyclic Nucleotides.
3) Chloroplast Genetic System in Higher Plants, Plastome Organization and Evolution. Regulation of Chloroplast Gene expression; Elements of the Transcriptional Apparatus.

Unit-III: PHOTOBIOLOGY

1) Sensory Photobiology: History and Discovery of Phytohormones and Cryptochromes and their Photochemical and Biochemical Properties.
2) Physiology of Light Induced Response Cellular Localization.
3) Molecular mechanism of Action of Photomorphogenic Receptors, Signaling and Gene Expression.

Unit-IV: STRESS PHYSIOLOGY

1) Plant Growth regulators: Brassionosteroids, Polyamines, Jasmonic acid and salicylic acid, hormone receptors, signal transduction and gene expression.
2) Stress Physiology: Water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress.
3) Molecular biology aspects of plant stress response. Engineering of biotic stress tolerance in crop plants.

Suggested Readings:

1) Buchanan, B.B. Gruissem, W. and Jones, R.L. 2004. Biochemistry and Molecular Biology of plants. I.K. International PVT., New Delhi.
2) Conn, E.E. Stumpf. Bruenning, G. and Doi, R.H. 1987. Outlines of Biochemistry. John Wiley and Sons, New York.
3) Hall, D.O. and Rao, K.K. 1999. Photosynthesis. 6th edition, Published in association with the Institute of Biology, Cambridge University Press, Cambridge, U.K.
4) Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons. Inc., New York, USA.
5) Moore, T.C. 1989. Biochemistry and physiology of Plant Hormones. 2nd edition. Springer – Verlag, New York, USA.
6) Stumpf, P.K. and Conn, E.E. (eds.) 1988. The Biochemistry of Plants- A Comprehensive treatise. Academic Press, New York.
7) Taiz, L. and Zeiger, E. 1998. Plant Physiology. 2nd edition. Sinauer Associates, Inc., Publishers, Massachusetts, USA.
8) Taiz, L. and Zeiger, E. 2003. Plant Physiology. 3rd edition. Panima Publishing Corporation, New Delhi/Bangalore.
9) Wilkins, M.B. 1989. Advanced Plant Physiology. Pitman publishing Ltd., London.

SEMESTER-III

THEORY SYLLABUS

PAPER-III (BOT-303): Elective-II (c): PLANT BREEDING

Unit-I: GENETICS -I

1) Gene interactions: Epistatic Gene Interactions and Multiple Allelism, Blood Groups in Human Beings, Multiple Alleles in Maize, Incompatibility Allele in Plants.
2) Quantitative or Polygenic Inheritance: Multiple Gene Hypothesis, Confirmation of Multiple Gene Hypothesis, Ear Length Study in Maize.
3) Sex Determination: Sex Determination in *Drosophila*, *Melandrum.*

Unit-II: GENETICS -II

1) Linkage and Crossing Over: Linkage, Crossing Over, Cytological Proof of Crossing Over, Genetic Map or Linkages Maps of Chromosomes, Two Point and Three Point Tests Crosses, Interference and Coefficient of Coincidence.
2) Extra-Chromosomal or Extra Nuclear Inheritance: Plastid Inheritance in *Mirabilis*, Maternal Inheritance by *Iojap* Gene in Maize, Cytoplasmic Male Sterility in Maize, Mitochondrial Inheritance in Yeast.
3) Chemical Basis of Heredity: DNA as the Genetic Material, Chemical Composition of DNA, Double Helix Model of DNA, Replication of DNA; RNA as the Genetic Material Chemical Composition of RNA, Types of RNA.

Unit-III: METHODS OF PLANT BREEDING-I

1) Type of Reproduction in Crop Plants: Structure of Androecium and Gynoecium, Cross and Self Pollination.
2) Breeding Techniques: Introduction, Hybridization, selection and mutation breeding.
3) Hybridization Techniques in Self-Pollinated Crops and Methods of Breeding for Vegetatively Propagated Crops.

Unit-IV: METHODS OF PLANT BREEDING -II

1) In-Breeding, Out-Breeding and Heterosis and Incompatibility Systems in Plants: Incompatibility in Heteromorphic Species-Dystyly & Tristyly.
2) Male Sterility: Genetic Male Sterility, Cytoplasmic Male Sterility, Cytoplasmic- Genetic Male Sterility, Induction and Application and Overcoming of Male Sterility.
3) Biotechnological Approaches and Application in Crop Improvement: Plant Tissue Culture; Haploid Breeding, Wide Hybridization, Protoplast Culture and Fusion, Somatic Hybridization and Plant Genetic Engineering.

Suggested Readings:

1) Singh. B.D. 2012. Plant Breeding: Principles and Methods. Kalyani Publishers, Delhi.
2) Frey. K.J. 1981. Plant Breeding II. Iowa State University Press, Oxford.
3) Jones. D.A. & Wilkins. D.A. 1971. Variation and Adaptation in Plant Species. Heinemann Educational Books Ltd., London.
4) Stebbins. G.L. 1971. Chromosomal Evolution in Higher Plants. Edward Arnold Publishers Ltd., London.
5) Poehlman. J.M. & Borthakur. D. 1969. Breeding Asian Field Crops: With Special Reference to Crops of India. Oxford & IBH Pub. Co., Delhi.
6) Brewbaker. J.L. 1964. Agricultural Genetics. Prentice-Hall, New Jersey, USA.
7) Allard. R.W. 1961. Principles of Plant Breeding. 2nd Ed. John Wiley & Sons Inc., New York.

SEMESTER-III

PRACTICAL SYLLABUS

PAPER-I: PLANT PHYSIOLOGY AND BIOCHEMISTRY (AND) PLANT BIOSYSTEMATICS/ MICROBIAL ECOLOGY / MEDICINAL PLANT CHEMISTRY AND PHARMACOGNOSY

I) PLANT PHYSIOLOGY AND BIOCHEMISTRY

A) MAJOR EXPERIMENTS:

1. Estimation of Chlorophyll.
2. Determination of Iodine number of fats.
3. Separation of proteins by Poly Acrylamide-Gel Electrophoresis.
4. Peroxidase enzyme activity.
5. Estimation of Ascorbic acid by volumetric method.
6. Estimation of hemoglobin.

B) MINOR EXPERIMENTS:

1) Estimation of IAA.
2) Estimation of proline.
3) C_3 Plants.
4) C_4 Plants.
5) CAM Plants.

C) SPOTTERS:

1) Plasma membrane
2) ATP
3) Root nodules
4) Nitrogenase
5) Rubisco
6) C_3 plant
7) C_4 plant
8) CAM plant
9) IAA
10) IBA
11) GA_3
12) Phytochrome
13) Kranz Anatomy
14) Florigen

Elective-I (a): BIOSYSTEMATICS

A) MAJOR EXPERIMENTS:

1) Biosystematic study of any two of the genera (comparision) with 4-5 locally available species**:** *Crotalaria, Senna, Cassia, Jatropha* and *Phyllanthus.*
2) Identification of Biosystematic categories (Ecads, Ecotypes, Cenospecies and Comparium) based on Morphological, Anatomical and Chemical data.
3) Construction of traditional taxonomic keys.
4) Construct the Phenogram using the *t x n* table provided.

B) MINOR EXPERIMENTS:

1) Draw the polygonal graphs for the OTUs based on the similarity matrix data provided.
2) Chemical tests for alkaloids, flavonoids, iridoids, steroids, anthroquinones, and tannins.
3) Study of pollen of the distylous and homostylous plants.
4) Study of foliar epidermis in ecotypes.

C) SPOTTERS:

1. Speciation: Sympatry and Allopatry.
2. Natural selection: Stabilizing, Disruptive and Directional.
3. Incompatibility: Distylous and Tristylous.
4. Incompatibility: Sporophytic and Gametophytic.
5. Karyotypes and Idiograms.
6. Hybridization and Speciation.
7. Polyploidy and Evolution.
8. Paper Chromatography/Electrophoresis.
9. Phenograms and Cladograms.
10. Common Molecular Markers employed for cereals.

D) HERBARIUM: of ecotypes of species studies (10 sheets).

Elective-I (b): MICROBIAL ECOLOGY

MAJOR EXPERIMENTS:

1) Determination of the organic matter content in the soil and water samples.
2) Determination of microbial activity in soil.
3) Estimation of Phosphates in soil/water samples.
4) Estimation of Sulphates in soil/water samples.
5) Isolation of microorganisms from soil/water/air (Agar plate method).

MINOR EXPERIMENTS:

1) Perform VAM (Vascular Arbuscular Mycorrhizae) staining and calculate the percentage of infection.
2) Using Winogradsky Column isolate diversified bacteria from water sediments.
3) Calculate the Most Probable Number (MPN) of Coliform bacteria in sewage water samples.
4) Estimate the following accumulates soil enzymes from humus: Peroxidase and urease
5) Isolation of *Rhizobium* from root nodules.

B) SPOTTERS:

1) Diseases of plants: Viral (2)
2) Diseases of Plants: Bacterial (2)
3) Diseases of Plants: Fungal (2)
4) Root nodules
5) Compost
6) Sludge
7) Bio-fertilizers (*Nostoc* and *Anabaena*).
8) Coralloid roots
9) Antagonism (Agar plate)
10) Mushrooms
11) Yeast cake
12) Leaf litter
13) *Brassica nigra* (Phytoremidiation)
14) Pollution indicators.

Elective-I (c): MEDICINAL PLANT CHEMISTRY AND PHARMACOGNOSY

1. **Micromolecules or Secondary metabolites:**
   Alkaloids, Flavonoids, Polysaccharides, Steroids and Terpenoids.

2. **Phytochemical Methods:**
   a) Extraction method (with Soxhlet).
   b) Paper Chromatography: Amino acids and Phenolic constituents.
   c) Electrophoresis: Leaf and Seed Proteins.

3. **Organoleptic study of powder drugs:**
   Cannabis sativa, Cinnamomum zeylanicum, Carum curvi, Senna angustifolia, Curcuma longa, Eugenia caryophyllata, Strychnos Nux-vomica, Rauwlfia serpentina, Santalum album.

4. **Crude phytodrugs and their therapeutic uses:**
   a) *Rauwlfia serpentina* (Drug acting on cardio-vascular system)
   b) *Strychnos Nux-vomica* and *Cannabis sativa* (Drug acting on Central Nervous System (CNS).
   c) *Senna angustifolia* (Drug acting on gastro-intestinal tract)
   d) *Carum curvi* and *Cinnamomum zeylanicum***:** Aromatic, stimulant and carminative culinary purposes and flavoring.
   e) *Curcuma longa*, *Eugenia caryophyllus*, *Santalum album***:** Analgesic, antiseptic perfumery, condiment or spice.

SEMESTER-III

MODEL QUESTION PAPER (PRACTICALS)

PAPER-I: PLANT PHYSIOLOGY AND BIOCHEMISTRY (AND) PLANT BIOSYSTEMATICS / MICROBIAL ECOLOGY / MEDICINAL PLANT CHEMISTRY AND PHARMACOGNOSY

Time: **4 hours** *Max.Marks*: **100**

1)	Conduct the given experiment and interpret the results (Major experiments from Plant Physiology) – (A)	20
2)	Conduct the given experiment and present the results (Minor experiments from Plant Physiology) – (B)	15
3)	Major experiment from Elective-I – (C)	20
4)	Minor experiment from Elective-I – (D)	15
5)	Identify and write critical notes on the following (E, F, G, H, I) E, F & G = Spotters from Physiology and Biochemistry H & I = Spotters from Elective-I	15
6)	Record	10
7)	Viva-Voce/ Assignment	05

SEMESTER-III

PRACTICAL SYLLABUS

PAPER-II: MOLECULAR BIOLOGY AND BIOENGINEERING (AND) PLANT CELL TISSUE AND ORGAN CULTURE / ADVANCED PLANT PHYSIOLOGY/PLANT BREEDING

I) MOLECULAR BIOLOGY:

A) MAJOR EXPERIMENTS:

1) Isolation of plasmid-DNA.
2) Isolation of plant-DNA.
3) Electrophoretic separation of DNA (Agarose-gel electrophoresis–AGE)
4) PCR amplification of plant genomic DNA.

MINOR EXPERIMENTS:

1) Quantitative estimation of DNA.
2) Quantitative estimation of RNA.
3) Designing of cloning vectors–pBR^{322}, PUC series.
4) Study of polypeptide analysis.

SPOTTERS:

1. Autoradiography
2. Plasmid (pBR-322)
3. Cosmid
4. Phagemid
5. Restriction endonuclease ((blunt / cohesive ends)
6. Apoptosis
7. C-DNA libraries
8. YAC / BAC library
9. RELP analysis
10. RAPD analysis
11. Southern blotting
12. Northern blotting
13. Western blotting

Elective-II (a) : PLANT CELL, TISSUE AND ORGAN CULTURE

MAJOR EXPERIMENTS:

1. Preparation of tissue culture media (MS and B5 media).
2. Sterilization and inoculation of varies explants.
3. Induction of callus from different explants.
4. Micropropagation through induction of multiple shoots by using shoot tips and auxiliary buds.
5. Organogenesis and somatic embryogenesis using appropriate explants.
6. Enzymatic isolation of protoplasts and their fusion employing PEG.

MINOR EXPERIMENTS:

7. Demonstration of Anther culture experiments in *Datura*.
8. Encapsulation of somatic embryos (Synthetic seeds).
9. Embryo rescue technique.
10. Suspension cultures.
11. Variations (Chromosomal and phenotypic) in tissue culture.

C) SPOTTERS:

1. Callus
2. Organogenesis-Rhizogenesis and Caulogenesis
3. Somatic embryogenesis
4. Multiple shoots
5. Somatic embryos
6. Isolated protoplasts
7. Artificial seeds
8. Growth regulations-IAA,IBA and BAP, Kn
9. Fused protoplast
10. Cybrids
11. Somaclones
12. Microdroplet technique

Elective-II (b) : ADVANCED PLANT PHYSIOLOGY

MAJOR EXPERIMENTS:

1) Chloroplast isolation.
2) Separation of seed Storage proteins using PAGE.
3) Estimation of polyamines.

MINOR EXPERIMENTS:

1) Calculation of Stomatal index on adaxial and abaxial surface of the given material.
2) Estimation of IAA.
3) Estimation of chlorophyll pigments.

B) SPOTTERS:

1) PS-I
2) PS-II
3) ATP-synthetase
4) Chloroplast genome
5) Calmodulin
6) G-protein
7) Phytochrome
8) Hormone receptors
9) Brassionosteroids
10) Polyamines
11) Jasmonic acid
12) Salicylic acid.

Elective-II (c) : PLANT BREEDING

A) MAJOR AND MINOR EXPERIMENTS:

1) Line diagrams showing the plan of different methods of breeding of self pollinated crops– Mass selection, Pure line selection, Pedigree method.
2) Line diagram showing the plant of different methods of breeding cross pollinated crops– Bulk selection, Recurrent selection.
3) Methods of hybridization in rice, sorghum, bajra, cotton in starveling crop in field.
4) Problems on Epistatic gene interactions.
5) Problems on two point and three point test cross.

B) SPOTTTERS:

1) Multiple alleles in maize
2) Ear length study in maize
3) Sex determination of *Melandrum*
4) Pachytene stage for crossing over
5) Plastid inheritance in *Mirabilis*
6) Double helix model of DNA
7) t-DNA
8) m-DNA
9) Distyly
10) Tristyly
11) Protoplast fusion
12) Somatic hybrids

SEMESTER-III

MODEL QUESTION PAPER (PRACTICALS)

PAPER-II: MOLECULAR BIOLOGY AND BIOENGINEERING (AND) PLANT CELL TISSUE AND ORGAN CULTURE /ADVANCED PLANT PHYSIOLOGY /PLANT BREEDING

Time: **4 hours** *Max.Marks*: **100**

1)	Conduct the given experiment and interpret the results (Major experiments from Molecular Biology) – (A)	20
2)	Conduct the given experiment and present the results (Minor experiments from Molecular Biology) – (B)	15
3)	Major experiment from Elective-II – (C)	20
4)	Minor experiment from Elective-II – (D)	15
5)	Identify and write critical notes on the following (E, F, G, H, I) E, F & G = Spotters from Molecular Biology H & I = Spotters from Elective-II	15
6)	Record	10
7)	Viva-Voce/ Assignment	05

SEMESTER-IV

THEORY SYLLABUS

PAPER –I (BOT-401): BIODIVERSITY CONSERVATION AND MANAGEMENT

Unit-I: PRINCIPLES OF BIODIVERSITY

1) Biodiversity: Definition, Concepts, Levels of Biodiversity-Species, Ecosystem and Genetic Diversities, Measurements of Biodiversity-Species Richness, Species Evenness, Diversity Indices- Shannon–Weiner Index and Simpson's Index.
2) Global Distribution of Biodiversity: Distribution patterns, Factors affecting diversity, Endemism, Biodiversity hotspots.
3) Monitoring of Biodiversity: Assessment and Inventorying; Biodiversity indicators; Biodiversity assessment–Species, Population, Ecosystem levels; Remote Sensing; Inventorying– ingle Taxon and Multi-taxon.
4) Benefits of Biodiversity: Value assessments –Use and Non-Use values; Benefits–Provisioning, regulating cultural and supporting services.

Unit-II: BIODIVERSITY LOSS AND CONSERVATION

1) Trends in Biodiversity Loss: Threats to Biodiversity –Root causes, Direct and Indirect Threats.
2) Principles of Biodiversity: Conservation, IUCN Red List, Categories of Threatened Species, Criteria to differentiate Threatened Taxa.
3) *In situ* Conservation methods: Natural Protected Areas, Biosphere Reserves, Sanctuaries, National Parks, Sacred Grooves, Marine Protected Areas, Community protected areas, Private protected areas, Advantages and Disadvantages of *In Situ* Conservation.
4) *Ex situ* Conservation Methods: Botanical Gardens, Gene Banks, Seed Banks, Field Gene Banks, *In vitro* Gene Banks. Pollen and Ovule Conservation; Biotechnological approaches; Advantages and Disadvantages of *Ex Situ* Conservation.

Unit-III: PHYTODIVERSITY OF INDIA- CONSERVATION

1) Biogeographic Zones, Forest Diversity, Biodiversity Hotspots, Floral diversity of Wild and Domesticated plants.
2) Endemic and Threatened plant species of India: Importance of Biodiversity in Indian context
3) Conservation methods–*In situ*, *Ex situ* methods.
4) National Legislations: Policies relevant to Biodiversity- Biological Diversity Act-2002; National Biodiversity Authority (NBA). State Biodiversity Boards, Biodiversity Management Committees, Peoples Biodiversity Registers; National Biodiversity Action Plan (NBAP); National Biodiversity Targets.

Unit-IV: CONSERVATION ORGANIZATIONS AND THEIR ACTIVITIES

1) Brief account of the Conservation Organizations and their activities–CI, WWF, UNEP, FAO, IUCN.
2) International Agreements on Biodiversity Conservation–CBD, CITES, IPCC, UNFCC, RAMSAR.
3) Biodiversity related Traditional knowledge, Biopiracy, Nagoya Protocol.
4) Intellectual Property Rights (IPR) and Patents, TRIPs and Patents laws.

Unit-I: PLANT RESOURCES

5) Edible Plant Resources – Cereals-Rice, Wheat, Maize, Jowar, and Pulses- Red gram, Bengal gram, Black gram.
6) Spices and Condiments-Black pepper, Clove & Cinnamon – Oil yielding plant-Groundnut, Sunflower, Castor
7) Fruits – Mango, Banana, Grapes; Nuts-Beetle nut, Cashew nut, Vegetables- Brinjal, Tomato, Potato, Chilli, Spinach, Cluster bean
8) Plants yielding Fibers-Jute, Sun hemp, Rubber (*Hevea*); Timber -Teak, Rose wood; Biofuels -*Pongamia*, Wild castor.

Suggested Readings:

1) Chauhan, S.S (2014). Status of Biodiversity in India. Issues and Challenges. Indian Journal of Plant Sciences 3(1) :35-42.
2) Gaston,K. J and Spicer,J.I.(2004). Biodiversity: An Introduction (2nd Ed.) Blackwell Publishing Company.
3) Gaston,K.J.(2010). Biodiversity. In Conservation Biology for all (Eds. Sodhi and Ehrlich) Oxford University Press.
4) Hamilton, C.(2006) Biodiversity, Biopiracy and Benefits: What allegations of Biopiracy tell us about intellectual property. Blackwell publishing Ltd., Oxford.
5) Heink, U and Kowarik,I. (2010) What criteria should be used to select biodiversity indicators . Biodiversity Conservation 19:3769-3797.
6) IUCN Red List of threatened species Version 2012.2.
7) Kasso Mahammed and Balakrishnan,M.(2013).Ex situ conservation of biodiversity with particular emphasis to Ethiopia. ISRN Biodiversity. Hindawi Publishing Corporation.doi.org/10.1155/2013/985037.
8) Marchese,C.(2014). Biodiversity hot spots : A shortcut for more complicated concept. Global Ecology and conservation. http://dx.doi.org/10.10.16/j.gecco.2014.12.008
9) Nayar, M.P. (1996). Hotspots of endemic plants of India, Nepal and Bhutan (Thiruvananthapuram): Tropical Botanic Garden and Research Institute.
10) Ram Reddy,S. Surekha ,M. and Krishna Reddy,V (2016). Biodiversity Traditional Knowledge Intellectual Property Rights .Scientific Publishers.
11) Unnikrishna,P and Suneetha,M. (2012). Biodiversity ,traditional knowledge and community health : strengthening linkages .Institute for Advanced Studies, United Nations University ,Tokyo.
12) Wood ,A., Pamela, S.E.and Johanna, M.(2000). The root causes of biodiversity loss. United Kingdom: Early –Scan Publications.

SEMESTER-IV

THEORY SYLLABUS

PAPER-II (BOT-402): PLANT BIOTECHNOLOGY

Unit-I: R-DNA TECHNOLOGY

1) Plant Biotechnology: Introduction, History & Scope of Plant Biotechnology.
2) Recombinant DNA Technology: Gene Cloning, Principles and Techniques, Choice of Vectors, Constructions of Genomic and DNA Libraries.
3) Blotting Techniques – Southern, Northern and Western Blotting.
4) Polymerase Chain Reaction (PCR) and its Applications and DNA Fingerprinting.

Unit-II: GENETIC ENGINEERING

1) Genetic Engineering–Basic concepts, Aims and Strategies for development of transgenics.
2) Methods of gene transfers: Direct and indirect methods-, *Agrobacterium*, micro- projectile bombardment, agroinfection, virus mediated and chemical mediated gene transfer.
3) Different types of vectors used for transformation, Selectable markers and reporter genes.
4) Transgenics with improved shelf life, functional foods and phytoceuticals–Golden rice.

Unit-III: PLASTID TRANSFORMATION

1) Chloroplast transformation–Engineering the plastid genome of higher plants.
2) Protein expression in plastids.
3) Development of transplastomic plants.
4) Elimination of selection markers from transgenic plants.

Unit-IV: APPLICATIONS OF PLANT BIOTECHNOLOGY

1) Strategies for engineering biotic resistant plants- Insect and fungal.
2) Strategies for engineering abiotic tolerance plants-Drought and salinity.
3) Plants as Bioreactors–Molecular farming.
4) Transgenic-Possible risks and benefits.

Suggested Readings:

1) Balasubramanian, D. 2005. Concepts of Biotechnology New edition.
2) Chawla, H.S. 2008. Plant Biotechnology 3rd ed. Oxford & IBH. 2008.
3) Glick and Pasternak 2002. Molecular Biotechnology, Panima
4) Halford, N. 2006. Plant Biotechnology; Current and future applications of genetically modified crops. JW Pub.
5) Lindsey, K. and MGK Jones. 1989. Plant Biotechnology in Agriculture. Open University Press.
6) Oksman, K.M.-Caldentey & W.H. Barz. 2002. Plant Biotechnology and Transgenic plants. CRC Pub.
7) Old and S.B. Primrose. 2002. Principles of Gene Manipulation by Blackwell, Oxford.
8) Pandian, T.T. & D. Kandavel. 2008. Text book of Biotechnology. IK International.
9) Primrose, S.B. 1994. Molecular Biotechnology (2nd Edn.), Blackwell Scientific Pub. Oxford.
10) Satyanarayana U. 2005 Biotechnology.

SEMESTER-IV

THEORY SYLLABUS

PAPER - III – (BOT 403): Elective I (a): ETHNOBOTANY

Unit – I: INTRODUCTION

1) Ethnobotany: A brief Historic Introduction. The Concept, Scope, and Interdisciplinary Nature.
2) The Pathways and Approaches to the Study of Ethnobotany.
3) The Methods of Ethnobotanical Data Documentation.

Unit – II: PLANTS AND PEOPLE

1. The Major Ethnic Groups of India. A succinct account of the life styles of three major Ethnic Groups of Telangana and the extent of their dependence on Local forests.
2. The Centers of Ethnobotanical studies in the world. Ethnobotanical research in Telangana.
3. The History of Plant-Human interactions: Paleo- and Archaeo-ethnobotany. Plants in Magico-religious beliefs, Social customs and Taboos.

Unit-III: ETHNIC FOODS AND ETHNOMEDICINE

1. Ethnomedicine and Ethnoveterinary medicine. Role of Ethnobotany in modern medicine.
2. Ethnomedicinal Plants and important Indian Ethnobotanical Drugs.
3. Ethnic Foods, Vegetables, Beverages and Psychoactive plants.

Unit- IV: ENVIRONMENT

1. Ethnoagriculture: *Podu/Jhum/Shifting* cultivation and its impact on the Environment.
2. Role of Ethnobotany in the Conservation of Native Plant Genetic Resources and Biodiversity.
3. Non-timber Forest products (NTFPs) gathered by Gonds, Koyas and Chenchus for their subsistence.

Suggested Readings:

1) Anonymous, 1948 – 1964. The Tribes of Andhra Pradesh, TCRTI, Hyderabad.
2) Anonymous, 1966. The Koyas of Andhra Pradesh, TCRTI, Hyderabad.
3) Anonymous, 1978. The Scheduled Tribes of Andhra Pradesh. TCRTI, Hyderabad.
4) Farooq A. Lone, Maqsooda Khan, G.M. Buth 1993. Palaeoethnobotany: Plants and Ancient Man in Kashmir. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
5) Hemendorf, C.V.F. Tribes of India. Struggle for Survival. University of California Press.
6) Hemendorf. C.V.F. 1943. The Chenchus. MacMillan & Co. London.
7) Rama Rao, N and Henry, A.N. 1996. The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India.
8) S.K. Jain 1993. A Manual of Ethnobotany, Scientific Publishers, Jodhpur.
9) S.K. Jain, 1980. Glimpses of Indian Ethnobotany, Oxford & IBH Publishing Co. New Delhi.

SEMESTER-IV

THEORY SYLLABUS

PAPER-III (BOT-403): Elective-I (b) CROP IMPROVEMENT

Unit-I: INTRODUCTION TO MUTATION BREEDING

1) Introduction and Scope of Mutation Breeding Crop improvement.
2) Physical and Chemical Mutagenesis: Induction, Screening and selection of Mutants.
3) Molecular Basis of Mutations.

Unit-II: HYBRIDIZATION TECHNIQUES

1) Self-incompatibility in Plant Breeding.
2) Genetic basis of Plant Breeding.
3) Techniques of Artificial Hybridization and Distant Hybridization: Intergeneric and Interspecific Hybridization.

Unit-III: BREEDING FOR RESISTANCE

1) Induced Polyploidy and Breeding.
2) Breeding for Disease Resistance.
3) Breeding for Specific Traits.

Unit-IV: *IN VITRO* MUTATION BREEDING

1) Dihaploidization and Crop Improvement.
2) *In vitro* Mutation Breeding and Crop Improvement.
3) Genetic Engineering in Crop Improvement.

Suggested Readings:

1. Singh, B. D. 2000. Plant breeding- Principles and methods. Kalyani Publishers, Ludhiana.
2. Sharma, J. R. 2000. Principles and practice of plant breeding. Tata McGraw Hill Publ. Co. Ltd., New Delhi.
3. Siddiqui B. A. and Khan S. 1999. Breeding in crop plants. Mutation and *in vitro* mutation breeding. Kalyani Publishers New Delhi
4. IAEA, 1995. Induced mutations and Molecular techniques for crop improvement. Proc FAO/IAEA Symposium Vienna
5. IAEA, 1991. Plant Mutation Breeding crop improvement Proc. FAO/IAEA Symposium (Vol. 1 & 2)Vienna
6. Micke A, 1991. Induced Mutation for crop improvement. Gamma Field Symposia No.30 Institute of Radiation Breeding Pullman USA.
7. Vijendra Das L. D, 2000. Problems Facing Plant Breeding CBS Publishers New Delhi
8. Roselle A. A. and Hamblin J. 1981 Theoretical aspects of selection for yield in stress and non- stress environments Crop Sci, 21: 932-946.
9. Levitt J, 1980. Response of Plants to Environmental Stress: Water, Salt and Other stresses. Academic Press, New York.
10. Blum A. 1988. Plant Breeding for stress Environments. CRC Press Florida.
11. Chopra V. L, 1989. Plant Breeding. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
12. Roy Darbeshwar 2000, Plant breeding analysis and exploitation of variance. Narosa Publishers New Delhi.

SEMESTER-IV

THEORY SYLLABUS

PAPER-III (BOT-403): Elective-I (c): AGRICULTURAL BIOTECHNOLOGY

Unit-I: DEFINITION AND PERSPECTIVES OF BIOTECHNOLOGY

1) New Technologies: Scope, Potential and Achievements; Introduction to Agriculture.
2) Impact of Biotechnology on Agro-biodiversity; Biotechnology for Agriculture; Micropropagation Technology and its use in Agriculture.
3) Genetic manipulation in Plant Breeding of Crop Plants; Dangers of Genetic uniformity; Preservation and exchange of Genetic resources; Use of Transgenic Plants in industry, Agriculture and Medicine.

Unit-II: ORIGIN OF AGRICULTURE

1) Conventional Plant Breeding approaches (Introduction, Selection, Hybridization, Mutation breeding and Polyploidy breeding) for Crop improvement.
2) Exploiting Natural Variability; Inbreeding Depression and Heterosis.
3) Self-Incompatibility and methods of its overcoming; Male Sterility–Types and its Applications in Agriculture.

Unit-III: MUTATION BREEDING FOR CROP IMPROVEMENT

1) Mutagens: Mode of action of chemical mutagens at the molecular level–transitions, transversions and frame shifts.
2) Molecular theories of radiation induced chromosomal aberrations.
3) Radiation sterilized foods.

Unit-IV: BIOFERTILIZERS AND BIOCONTROL

1) Biofertilizers: Types (*Rhizobium*, *Azotobacter*, *Azospirillum*), Blue Green Algae and Vesicular Arbuscular Mycorrhizae (VAM fungus), Production, Utility and Limitations.
2) Biological Control of Pests; Pathogens and Weeds; Biopesticides; Entomopathogens; Formulations use in Pest management.
3) Role of national and international organizations in crop improvement-ICAR, IARI, ICRISAT and IRRI.

Suggested Reading:

1) Bajaj YPS. **Biotechnology in Agriculture and Forestry**.Vol.22. Springer-Verlag.
2) Chadwick.,K and Leenhouts HP.2012. **The Molecular theory of radiation Biology**. Springer Berlin Heidelberg, Berlin.
3) Dhaliwal GS and Arora R.1994. **Trends in Agriculture insect pest management**. Common wealth Publishers, New Delhi.
4) Mukherji KG and Chincholkar SB.2006. **Biological control of plant diseases.** Heaworth Food and Agricultural Products Press, New Delhi.
5) Obe G and Natarajan AT.1994. Chromosomal Alterations: Origin and Significance. Springer-Verlag, Berlin.
6) Sharma R.1992. Biotechnology in Agriculture. Biotech Books, New Delhi.
7) Singh BD .1983.Plant Breeding. Kalyani Publishers.

SEMESTER-IV

THEORY SYLLABUS

PAPER-IV (BOT-403): Elective-II (a) BIO-CONTROL OF PLANT DISEASES AND INSECT PESTS

Unit-I: BIOCONTROL AGENTS

1) Introduction to various approaches to the control of Pests and Diseases of Plants.
2) Biological Control of Fungal, Bacterial and Viral Diseases of Plants.
3) Pheromones and Semi-chemicals.
4) Botanical Insecticides.

Unit-II: NEMATODE RESISTANCE

1) Plant Parasitic Nematodes: Introduction, Susceptible response of Plants to Nematodes.
2) Mechanism of Nematode infestation and induction of feeding structures in Plants Nematode Secretions.
3) Molecular Biology of Nematode resistance (Structure, Mapping and Localization of Mi-gene).
4) Genetic Engineering for Nematode resistance in Crop plants.

Unit-III: BIOCONTROL AGENTS-II

1) Biology of Fungi and Bacteria for the control of insects.
2) Progress towards commercialization of Baculovirus Insecticides.
3) Biology of Bacteria and Fungi used for control of Weeds.
4) Genetic Engineering approaches for Weed Resistance.

Unit-IV: MANAGEMENT STRATEGIES

1) Integrated Pest management Strategies.
2) Insect Growth Regulators
3) Regulatory aspects of Biological Control Agents.
4) Monitoring of Bio-control Agents and Genetically Engineered Microorganisms in the Environment.

Suggested Readings:

1) Campbell R. 1989. Biological Control of Microbial Plant Pathogens. Cambridge Univ. Press, Cambridge.
2) Cook RJ & Baker KF. 1983. Nature and Practice of Biological Control of Plant Pathogens. APS, St. Paul, Minnesota.
3) Dhaliwal GS and Arora R.1994. Trends in Agriculture insect pest management. Common wealth Publishers, New Delhi.
4) Fokkemma MJ. 1986. Microbiology of the Phyllosphere. Cambridge Univ. Press, Cambridge.
5) Gnanamanickam SS (Eds). 2002. Biological Control of Crop Diseases. CRC Press, Florida.
6) Heikki MT & Hokkanen James M (Eds.). 1996. Biological Control - Benefits and Risks. Cambridge Univ. Press, Cambridge.
7) Mukerji KG, Tewari JP, Arora DK & Saxena G. 1992. Recent Developments in Biocontrol of Plant Diseases. Aditya Books, New Delhi.
8) Mukherji KG and Chincholkar SB.2006. Biological control of plant diseases. Heaworth Food and Agricultural Products Press, New Delhi.
9) Sharma PD.1993.Environmental Biology and Toxicology. Rastogi and company

SEMESTER-IV

THEORY SYLLABUS

PAPER-IV (BOT-404): Elective-II (b) : INDUSTRIAL MICROBIOLOGY

Unit-I: PRINCIPLES OF FERMENTATION TECHNOLOGY

1) Fermentation Technology**:** History of Fermentation Technology, Scope and Prospects, Range of fermentation products, Components of fermentation process.
2) Types of Fermentation**:** Batch, Continuous, Fed batch, Solid state, Submerged dual and Multiple fermentation, Isolation, Preservation and Strain improvement of industrial Microorganisms.
3) Microbial fermenter design, Aseptic operation, Body construction and Types of fermentation vessels.

Unit-II: FERMENTATION PROCESS AND PRODUCTS

1) Fermentation processes: Primary and secondary metabolites.
2) Fermentations media formulation, carbon, nitrogen, mineral sources, buffers, anti-foam agents, starter culture & scale up process.
3) Downstream process: Recovery and purification of fermentation products, fermentation economics, patent concept, IPR.

Unit-III: INDUSTRIAL PRODUCTION OF MICROBIAL METABOLITES

a) Antimicrobials : Penicillin
b) Organic acids : Citric acid
c) Alcohols : Ethanol
d) Amino Acids : Glutamic acid
e) Beverages : Beer
f) Vitamins : B_{12}
g) Enzymes : Amylases

Unit-IV: MICROBIAL TECHNOLOGY

1) Immobilization of Enzymes and Cells (Adsorption, Covalent and Ionic bonding, Cross-linking and Entrapment).
2) Biotechnology process for Microbial production of Foods: Cheese, Mushroom cultivation (Oyster and Button), Single Cell Proteins (*Spirulina*).
3) Microbial Technology in Agriculture: Biofertilizers and Biopesticides-Detailed account of *Rhizobium* and *Trichoderma*.

Suggested readings:

1) Crueger W and Crueger A (2000). Biotechnology: A Text Book of Industrial Microbiology, Panima Publishing Corporation, New Delhi.
2) Glazer, AN and Nikaida, H (1995).Microbial Biotechnology, W.H.Freeman, New York.
3) Jay JM (1996).Modern Food Microbiology, Chapman& Hall, Inc., New York.
4) Patel AH (2001) Industrial Microbiology, MacMillan India Ltd.
5) Prescott and Dunn's: Industrial Microbiology,4th Edition.
6) Ram Reddy, S and Singaracharya MA (2008) A text Book Of Applied Microbiology, Himalaya Publishers, Hyderabad.
7) Reed, G. Industrial Microbiology, CBS Publishers
8) Ram Reddy S and K.Rajeshwar Reddy.2007 Microbiology-vi (Immunology, Medical Microbiology, Industrial Microbiology, Microbial Technology) Paper vii & viii, Sixth Semester,, B.SC. Himalaya Publishing Housing
9) Stanbury PF, Whitaker A and Hall SJ(1995).Principles of Fermentation Technology, 2nd edition ,Butterworth-Heineman, Oxford.
10) Waites MJ, Morgam NL, Rockey JS and Higton G (2001). Industrial Microbiology. Blackwell science Ltd.
11) Reddy SM,Reddy SR, Narendra Babu G (2013) Basic industrial microbiology, New Age International Publishers , New Delhi

SEMESTER-IV

THEORY SYLLABUS

PAPER-IV (BOT-404): Elective-II (c): APPLIED PHYCOLOGY

Unit-I: ECONOMIC IMPORTANCE OF ALGAE

1) Historical Perspectives and Scope of Algae.
2) Algae as source of Food, Feed and Biofertilizers.
3) Industrial uses of Algae (Cosmetic, Pharmaceutical, Agriculture and Biofuel).

Unit-II: ALGAL BIOTECHNOLOGY

1) Single Cell Protein studies with reference to *Spirulina*, *Chlorella* and *Scenedesmus*.
2) Mass Cultivation and Commercial value of Sea weeds.
3) Algal Biotechnology.

Unit-III: ALGAE AND POLLUTION

1) Aquatic Pollution, Causes and Consequences, Eutrophication and its impact on Water quality.
2) Algae as Indicators in assessing Water quality and Pollution.
3) Algae in environmental health, Sewage treatment and treatment in Industrial Water quality, Algal Blooms, Nuisance of algae and its control.

Unit-IV: GENETICS AND CULTURE OF ALGAE

1) Algal cultures and their ability, Source of Algal cultures.
2) Mutation and Genetics of Algae.
3) Extracellular products and Toxicity of Algae.

Suggested Readings:

1) Dawson E.Y. 1966. Marine Botany, Holt, Reinhart & Winston including New York;
2) Round F.E.1970. The Biology of the Algae. Edward Arnold Limited;
3) Fritsch F.E.1935. The Structure and reproduction of Algae. Cambridge University Press;
4) Chapman V.J.1970. The Sea weeds and their uses. Methena & Company Limited;
5) Levin R. 1964. Physiology and Biochemistry of Algae. Academic Press. Oxford;
6) Aymount J.E.E.1963. Plankton and productivity in Oceans, Pergamon Press. Oxford;
7) Smith G.M. (Ed.) 1951. Manual of Phycology. Cronica Botanica, Company U.S.A.;
8) Lewis J.R.1964. The ecology of rocky shores. The English University Press Limited. London;
9) Trait R.V.1968. Elements of Marine Ecology. Butter Worths. London;
10) Fogg G.E. Stewart, W.D.P., Fay P., and Walsby A.E. 1973. The blue green algae. Academic Press. London;
11) Kumar H.D. 1985. Algal Cell Biology. Affiliated East-West Press, New Delhi;
12) Kumar H.D. 1990. Introductory Phycology. Affiliated East-West Press, New Delhi;
13) Venkata Raman G.S. 1972. Algal Biofertilizers and Rice cultivation. Today and Tomorrow printers and publishers, New Delhi;
14) Singh R.N. 1961. Role of Blue green algae in Nitrogen economy of Indian Agriculture, ICAR, New Delhi;
15) Subba Rao N.S. 1988. Biofertilizers in Agriculture. Oxford publishing Company Private Limited. New Delhi

SEMESTER-IV

PRACTICAL SYLLABUS

PAPER-I: BIODIVERSITY MANAGEMENT AND CONSERVATION (AND) ETHNOBOTANY/ CROP IMPROVEMENT / AGRICULTURAL BIOTECHNOLOGY

I) BIODIVERSITY MANAGEMENT AND CONSERVATION

MAJOR EXPERIMENTS

1. Determination the Importance Value Index (IVI) for a species.
2. Estimation of Total Importance Value (TIV) of an economic species.
3. Determination of minimum size of quadrates.
4. Determination of minimum number of quadrates.
5. Determination of quantitative character of plant community.
6. Determination of species–wise IVI in plant community.
7. Determination of Simpson index of dominance of a plant community.
8. Determination of Shannon Weiner diversity for plant community.

MINOR EXPERIMENTS

1. Mapping of Biogeographic zone of India.
2. Remote Sensing of Natural Resources: Forest ecosystem nearby (Google Earth).
3. Energy crops: *Pongamia* (Indigenous), *Jatropha* (Exotic).
4. IUCN threatened categories: Rare, Endangered and Vulnerable categories of plant species from Telangana.
5. Mapping of *in situ* plant conservation in India.
6. *Ex situ* conservation: Seeds of crop plants.

SPOTTERS:

1. INSAT maps
2. Quadrates
3. Aquarium
4. Seeds (Crop plant, Energy plants)
5. Non-Timber forest products: Gums, Resins, Nuts / Fruits from local forests,
6. Timber products: Teak, Neem, Red sanders, *Dalbergia sisso*

Elective-I (a): ETHNOBOTANY

A) MAJOR AND MINOR EXPERIMENTS:

1) Collection of ethnobotanical data**:** From a local forest area and from a local forest tribes ethnobotanical data are to be collected. The details of resource persons are documented (Photography, Video, Tape recording etc.).
2) Analysis of ethnobotanical data**:** disease–wise, plant wise, habit –wise, tribe-wise and pictorial presentation of these data.
3) Calculation of *total importance value* (**TIV***) Index* of a species based on ethnobotanical uses: demonstrate the evaluation of two ethnobotanical sites for prioritization or disposal.
4) Submission of Ethnomedicinal herbarium/Museum specimens like leaves barks, tubers, nuts, *etc*. of economic/medicinal use.

B) SPOTTERS:

1) **Ethnic food plants:**
   a) *Cajanus cajan* (Kandi)
   b) *Sorghum bicolor* (Jonnalu)
   c) *Dioscoria* spp. (Nalla gadda, Kasi teega)
2) **Ethnomedicinal Plants:**
   a) *Androghaphis paniculata* (Nelavemu)
   b) *Rauwolfia serpentina* (Sarpagandhi)
   c) *Terminalia bellarica* (Tani)
3) **Ethnoveterinary Plants:**
   a) *Listea glutinosa* (Narra mamidi)
   b) *Gymnema sylvestris* (China Pala Teega)
   c) *Vitex nigundo* (Tella vavili)
4) **Magico-religious ornamental plants:**
   a) *Abrus precatorius* (Gurija)
   b) *Achyranthus aspera* (Uttareni)
   c) *Cassia glauca* (Bhuthan kush, nerdi)

Elective-I (b): CROP IMPROVEMENT

A) MAJOR AND MINOR EXPERIMENTS:

1. Effect of EMS/Colchicine on chromosomes of Garlic/Onion).
2. Demonstration of Hydoxylamine (HA)/Pesticide (DDT) effect on gram seeds and evaluation of seed germination percentage.
3. Karyotype and ideogram preparation.
4. Protoplast fusion.
5. Particle gun mediated gene transfer.
6. *In vitro* pollen germination.

C) SPOTTERS:

1) Mutagens
2) Allium chromosomes
3) Somatic hybridization
4) Chromosomal aberrations
   a) Chromosome bridges
   b) Chromosome fragments
   c) Spindle abnormalities
   d) Precocious movement of chromosomes.
5) Cybrid
6) Bt-cotton
7) Somaclonal variations
8) Variation in sizes of pollen grains.

Elective-I (c): AGRICULTURAL BIOTECHNOLOGY

A) MAJOR AND MINOR EXPERIMENTS:

1) Callus cultures.
2) Micro propagation.
3) Isolation of plant genomic DNA from leaf tissue.
4) Separation of seed proteins using SDS-PAGE.
5) Separation of isozymes using PAGE.
6) Isolation of protoplast.
7) Demonstration of protoplast fusion.
8) Culture of entamopathogens.
9) Formulation of biopesticides.

B) SPOTTERS:

1) Biopesticide
2) Protoplast fusion
3) Entamopathogen
4) Callus
5) Biofertilizers
6) PAGE
7) Chemical mutagens
8) Transgenic plants
9) Frame shift mutations
10) VAM fungi
11) Chromosomal aberrations:
    (a) Fragments (b) Bridges (c) Laggards, (d) Multinucleate condition

SEMESTER-IV

MODEL QUESTION PAPER (PRACTICALS)

PAPER-I: BIODIVERSITY MANAGEMENT AND CONSERVATION (AND) ETHNOBOTANY/ MUTATION BREEDING /CROP IMPROVEMENT/ AGRICULTURAL BIOTECHNOLOGY

Time: **4 hours** *Max.Marks*: **100**

1)	Conduct the given experiment and interpret your results (Major experiments from Biodiversity Management and Conservation) – (A)	20
2)	Conduct the given experiment and present your results (Minor experiments from Biodiversity Management and Conservation) – (B)	15
3)	Major experiment from Elective-I – (C)	20
4)	Minor experiment from Elective-I – (D)	15
5)	Identify and write critical notes on the following (E, F, G, H, I) E, F & G = Spotters from Biodiversity Management and Conservation H & I = Spotters from Elective-I	15
6)	Record	10
7)	Viva-Voce/ Assignment	05

SEMESTER-IV

PRACTICAL SYLLABUS

PAPER-II: PLANT BIOTECHNOLOGY (AND) BIO-CONTROL OF PLANT DISEASES AND INSECT PESTS /INDUSTRIAL MICROBIOLOGY/APPLIED PHYCOLOGY

I) PLANT BIOTECHNOLOGY

A) MAJOR EXPERIMENTS:

1) Isolation of DNA.
2) Isolation of Plasmid DNA.
3) Agarose Gel Electrophoresis (AGE).
4) *In vitro* amplification of DNA by PCR.
5) *Agrobacterium tumefaciens* mediated genetic transformation.

B) MINOR EXPERIMENTS:

1. *Agrobacterium rhizogenes mediated* hairy roots culture.
2. Gene cloning experiment.

C) SPOTTERS:

1. *r*DNA
2. pBR 322
3. Ti-plasmid
4. Gus expression
5. Hairy roots
6. Golden rice
7. Edible vaccine
8. pBlue script
9. Polymerase Chain Reaction (PCR)
10. Green Fluorescent Protein (GFP)
11. Electroporation
12. Bt Cotton
13. Transplastomes
14. Bacterial Artificial Chromosomes (BAC)
15. *E.co*RI
16. Thermocycler

Elective-II (a): BIOCONTROL OF PLANT DISEASES AND PESTS

A) MAJOR AND MINOR EXPERIMENTS:

1. Extraction of Biopesticide from Neem/*Annona.*
2. Extraction of Biopesticide from *Tagetus*/*Chrysanthemum*.
3. Formulation of Biopesticide from fungal organism (*Trichoderma* spp.).
4. Formulation of Biopesticide from Bacteria (*Bacillus thuringiensis*/*Pseudomonas* spp.)
5. An improved technique and staining of plant tissues for detection of plant nematodes.
6. Identification of disease based on the histo-pathogenesis.
7. Giant cell and its development stages.
8. Formulation of viral Biopesticide (*Nuclear Polyhedrosis Virus*).

B) SPOTTERS:

1. *Trichoderma viridae*
2. *Bacillus thuringiensis*
3. *Pseudomonas* spp.
4. Mi-gene
5. Neem
6. *Annona*
7. *Tagetus*
8. *Chrysanthemum*
9. Nuclear polyhydrosis virus
10. *Meloidogyne* spp.
11. Pheromones

Elective-II (b): INDUSTRIAL MICROBIOLOGY

A) MAJOR AND MINOR EXPERIMENTS:

1) Design of industrial fermenter.
2) Uses of logarithms in Microbial growth.
3) Estimation of alcohol.
4) Estimation of penicillin.
5) Estimation of citric acid.
6) Estimation of Vitamin B_{12} (Riboflavin).
7) Wine production.
8) Assay of a-amylase.
9) Immobilization of enzymes.
10) Formulation of bio-pesticide (*Trichoderma* spp.).

B) SPOTTERS:

1. *Asperigillus*
2. Yeast
3. Bread
4. *Penicillium*
5. Penicillin
6. Alcohol
7. Lysine
8. Riboflavin
9. Cheese
10. Mushrooms
11. Fermenter
12. Single Cell Protein.

Elective-II (c): APPLIED PHYCOLOGY

A) MAJOR AND MINOR EXPERIMENTS:

1. Algae as bio-indicator of the assessment of water quality.
2. Preparation of algal beads (sodium alginate).
3. Phycobiliproteins of Cyanobacteria.
4. Algal biofertilizers.
5. Algal cytology (Cholorophyceae) by Aceto-carmine squash method.
6. Cultivation of soil algae by using general media.

B) SPOTTERS:

1. Biofertilizers
2. Agar-Agar media
3. *Spirulina*
4. Commercial sea-weeds (*Gracilaria*, *Gelidium* and *Laminaria*)
5. Toxic algae (*Gymnodinium*, *Anabaena* and *Oscillatoria*)
6. Algal culture
7. Algal pigments
8. Phycocolloids
9. Bioremediation
10. Single Cell Protein(SCP)
11. Nitrogen fixation (Nitrogenase)

SEMESTER-IV

MODEL QUESTION PAPER (PRACTICALS)

PAPER-II: PLANT BIOTECHNOLOGY (AND) BIO-CONTROL OF DISEASES AND INSECT PESTS / INDUSTRIAL MICROBIOLOGY /APPLIED PHYCOLOGY

Time: **4 hours** *Max.Marks*: **100**

1)	Conduct the given experiment and interpret the results (Major experiments from Plant Biotechnology) – (A)	20
2)	Conduct the given experiment and present the results (Minor experiments from Plant Biotechnology) – (B)	15
3)	Major experiment from Elective-II – (C)	20
4)	Minor experiment from Elective-II – (D)	15
5)	Identify and write critical notes on the following (E, F, G, H, I) E, F & G = Spotters from Plant Biotechnology H & I = Spotters from Elective-II	15
6)	Record	10
7)	Viva-Voce/ Assignment	05