

SYLLABUS OF SEMESTER SYSTEM
PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR
REVISED ORDINANCE NO. 170
ORDINANCE FOR SEMESTER SYSTEM

- 1 The Master of Arts/Science/Commerce courses shall be spread over four semesters. In each semester, there shall be theory courses and wherever required practical courses (Laboratory work, semester field work, project work etc.). Written and Practical Examinations shall be completed by the end of the each semester. There shall be numerical marking in evaluation.
 - 2
 - (i) A candidate who has obtained a Bachelor's Degree of this university or of a statutory university recognized by this University as equivalent to the Bachelor's Degree shall be eligible to seek admission in M.A. Courses of the University.
 - (ii) A candidate who has obtained Bachelor of Science (B.Sc.) Degree of this University or of statutory University as equivalent to Bachelor's Degree shall be eligible to seek admission in M.Sc. Courses of the University.
 - a) Provided that a candidate shall be eligible for admission in only those subjects which he/she has offered in B.Sc. degree.

Further provided that :

 - b) For admission in M.Sc. Anthropology and Rural Technology there shall be no barrier of subject at B.Sc. level,
 - c) For admission in M.Sc. Physics, a candidate must have offered Mathematics at B.Sc. level,
 - d) For admission in M.Sc. Electronics, a candidate must have offered Mathematics and Physics in B.Sc. level,
 - e) For admission in Bioscience, Biochemistry, Biotechnology and Herbal Science Technology, a candidate must have offered subjects of Biological Science at B.Sc. level. If any difficulty arises in this connection, the matter shall be referred to a committee consisting of Dean of the Faculty and Chairman Board of Studies and Head of subject concerned.
 - f) For admission in M.A./M.Sc. Statistics, a candidate must have offered Statistics or Mathematics at B.Sc./B.A. level.
 - (iii) A candidate who has obtained Bachelor of Commerce (B.Com.) Degree of this University or of statutory University as equivalent to Bachelor's Degree shall be eligible to seek admission in M.Com. Courses of the University.
- 3 Every candidate thus admitted shall pursue regularly the prescribed courses in each of the four semesters successively. The Masters Degree shall be awarded to those candidates who have obtained at least 36% marks in cumulative aggregate in each of four semesters in theory and practical courses separately and a minimum of 20% qualifying marks in each theory course. The successful candidate shall be placed in divisions on the following basis:
An aggregate of 60% or above - I Division

An aggregate of 48% or above - II Division

An aggregate of 36% or above - III Division

4. A student failing to appear or securing less than 36% aggregate or obtained less than 20% marks in any of the theory course of I, II & III semester examinations shall be allowed to pursue the courses for the next following semester. Such students shall have failed or failed in aggregate (with ATKT) or ATKT status in I, II, III or IV semesters and their scheme of examination shall be as follows :
 - (i) A student failing to qualify the examinations of any semester shall be permitted to appear in the ATKT/ reexamination along with the following semester examination.
 - (ii) A student who has failed in ATKT/ reexamination shall reappear as ex-student.
 - (iii) A student who has been admitted to any semester but fails to fill up examination form of that semester examination or debarred to take examination due to short attendance or any other reasons, then he/she shall have to take re-admission and appear at that examination.
 - (iv) ATKT provision shall be in three papers of one semester with maximum three attempts only (1 main + 2 ATKT).
 - (v) The provision of revaluation will not be available; however, a student may apply for re-totaling.
5.
 - a) There shall be 20% internal and 80% external evaluation in both theory and practical examinations.
 - b) The examination and evaluation shall be on internal/external basis. The theory papers may be examined externally up to 50% maximum. Practical examination shall be conducted jointly by internal and external examiners.
6. The examination for the first and the third semester shall ordinarily be completed by the end of December and examinations for the second and the fourth semesters shall ordinarily be completed by the end of May each year.
7. The examination shall be held in all subjects as approved by the University from time to time.
8. There shall be no provision for division improvement under the examinations of this ordinance
9. The matters not covered in Acts/Ordinance shall be governed by the Ordinance Nos. 5 and 6 and other provisions of the University rules.

USE OF CALCULATOR :

The students of M.A./M.Sc./M.Com. classes will be permitted to use calculator in the Examination hall on the following conditions:

- a) Student will bring their personal calculators.
- b) Calculators with memory and following variable be permitted, plus, minus, multiplication, division, square, reciprocal, exponential, log, square-root, trigonometric functions, viz., sine, cosine, tangent etc. However, under any circumstances programmable calculators shall not be permitted.

ANNUAL EXAM
REVISED ORDINANCE NO. - 22
MASTER OF SCIENCE EXAMINATION

1. The examination for the degree of Master of Science shall consist of two parts-
 - a) The Previous Examination; and
 - b) The Final Examination.
2. A candidate who after obtaining the degree of Bachelor of Science of the University or an examination of any Statutory University in India which has been recognised by the University as equivalent to the B.Sc. degree of the University and has completed a regular course of study for one academic year in a teaching department of the University or in a college affiliated to the University, shall be admitted to the Previous Examination for the degree of Master of Science. A candidate after passing a graduate Examination under 11+3 Scheme or any other examination recognised by the University as equivalent thereto shall be eligible for admission to a post graduate course of studies where graduation is minimum qualification only after passing One Year Bridge Course prescribed for the purpose. This shall apply to student graduating in 1991 examination.

Provided, however, every candidate shall offer for the Previous examination one of the subjects offered by him/her for his/her B.Sc. degree. However, a candidate passing B.Sc. with any of the subject prescribed for the examination, will be eligible to offer Anthropology as one of the subjects at the Previous Examination.

Provided further (i) for admission in M.Sc. Previous (Physics) a candidate must have offered Maths as one of the subjects in B.Sc., (ii) for admission in M.Sc. Previous (Chemistry) preference will be given to those who have offered Maths as one of their subjects in B.Sc.
3. A candidate who, after passing the M.Sc. Previous Examination of the University, has completed a regular course of study for one academic year in a teaching department of the University or in a college affiliated to the University shall be admitted to the Final Examination for the degree of Master of Science in the subjects in which he/she has passed the Previous Examination.

A candidate who has passed the Previous Examination for the degree of Master of Science of another University, may also be admitted to the Final Examination for the degree of Master of Science obtaining previous permission of the Kulpati, provided he offered for his Previous Examination a course of study of an equivalent standard with almost identical syllabus as is required for the Previous Examination of this University and has attended a regular course of study for one academic year in a teaching department of the University or in a college affiliated to the University.
4. The Examination shall be partly by means of papers and partly practical including sessionals, except in the case of Mathematics where the Examination shall be by means of papers only.
5. Besides regular students and subject to their compliance with this Ordinance, ex-students and non-collegiate candidate shall be eligible for admission to the Examination as per provision of Ordinance No. 6 relating to Examination (General). A candidate securing 60% or more marks in the M.Sc. Previous Examination will be

eligible to offer "dissertation" in lieu of one of optional papers for the Final. A regular candidate can offer dissertation with the permission of the Professor and Head of Department of his institution, while a private candidate will have to secure the prior permission in writing of any of the professors of the subject working in an institution within the jurisdiction of the University and will work under supervision of that professor after obtaining prior permission of the University to that effect. Provided that non-collegiate candidates shall be permitted to offer only such subject/papers as are taught to the regular students at any of the University teaching department or college.

6. The subject of Examination shall be one of the following :

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|---------------------|---------------------|
| Ⓐ Mathematics | (ii) Physics |
| (iii) Chemistry | (iv) Zoology |
| (v) Botany | (vi) Geology |
| (vii) Bio-Science | (viii) Statistics |
| (ix) Anthropology | (x) Defence Studies |
| (xi) Micro Biology. | (xii) Electronics |
| (xiii) Biochemistry | |

Any candidate who has passed the M.Sc. Examination of this University in any subject shall be allowed to present himself in Examination in any one or more of the optional papers in the subject not taken by him at the said Examination and if successful, will be given a certificate to that effect.

Provided that no candidate shall be allowed to offer more than two additional papers in any one year and in subjects other than Mathematics, a candidate shall undergo a practical test in respect of the paper concerned.

7. For both the Previous and Final Examinations a candidate will be declared successful if he/she obtains atleast 36% of the aggregate marks in the subject. A candidate is required to pass in the Practical Examination separately by obtaining not less than 36% marks.

8. The division in which a candidate is placed shall be determined on the basis of aggregate marks obtained in the total of the M.Sc. Previous and M.Sc. Final Examinations. No division will be assigned on the Previous Examination.

9. Successful candidates who obtain 60% or more of the aggregate marks shall be placed in the First Division : those obtaining less than 60% but not less than 48% in the Second Division; and all other successful candidate obtaining less than 48% in the Third Division.

10. Candidates who have passed in the M.Sc. Examination of the University in any subject in Third or Second Division and desire to appear at the M.Sc. Examination in the same Subject for improving Division may without attending a regular course of study in a college affiliated to the University or in a Teaching Department of the University shall be allowed to appear at the aforesaid Examination as non-collegiate students on the following conditions :

- Ⓐ There shall be only two Divisions for such candidates i. e. First Division and Second Division. The marks required for obtaining these division shall be the same as prescribed in the Ordinance i.e. examinees who are successful in Final of the Examination and have obtained 60% or more of the aggregate in total of

the marks in the Previous and Final of the Examination taken together shall be placed in the First Division and examinees who are successful in Final of the Examination and have obtained less than 60% but not less than 48% marks in the Previous and Final of the Examination taken together shall be placed in the Second Division.

- (ii) The results of the candidates obtaining less than 48% of the aggregate marks in the Previous and Final of the Examination taken together shall not be declared.
- (iii) Candidates shall have the option to appear at both the Previous and Final Examination in one and the same year and for being successful at the Examination, the candidate shall obtain 48% of the aggregate marks. Provided that such candidates who opt to appear in Previous and Final Examinations separately shall have to obtain minimum aggregate required for the Previous Examination but he will have to obtain atleast 48% in the aggregate of the Previous and Final Examination taken together or else his result will be cancelled.
- (iv) The syllabus for the Examination shall be same as prescribed for the year in which examination is held.
- (v) Not more than two attempts shall be allowed to such candidates, failure or non-appearance at the Examination after permission has been accorded by the University shall be counted as an attempt. Provided, however, such candidates who opt to appear at the Previous and Final Examinations separately will be allowed only one attempt at the Previous Examination and two attempts at the Final Examination.
- (vi) Candidates who wish to avail the opportunity given in the foregoing paras will have to apply for the permission as required in the Ordinance relating to admission of Non collegiate Students to the University Examination along with requisite Registration Fee.
- (vii) In case a student improves his division under the provisions of this para, the fresh degree will be issued after cancelling his first degree.

11. Transitory Provision - The repealed Ordinance relating to Master of Science Examination shall remain effective till the examinations of 1974 and this new Ordinance shall be applicable from the examination of 1975.

USE OF CALCULATORS

The students of Degree/P.G. classes will be permitted to use of Calculator in the examination-hall from annual 1986 examination on the following conditions as per decision of the standing Committee of the Academic Council at its meeting held on 31-1-1986.

1. Student will bring their own Calculators.
2. Calculators with memory and following variables be permitted : +, -, x, ÷ square, reciprocal, exponential log, square root, trigonometric functions viz sine, cosine, tangent ect. factorial summation, xy, yx and in the light of objective approval of merits and demerits of the viva only will be allowed.

SYLLABUS OF SEMESTER SYSTEM
SCHEME OF EXAMINATION 2010-2011
M.Sc. BOTANY

SEMESTER - I

A. THEORY

PAPER	TITLE	Ex.	In.
I	Cytology	80	20
I	Genetics	80	20
III	Microbiology, Phycology and Mycology	80	20
IV	Bryophyta, Pteridophyta and Gymnosperm	80	20

B. PRACTICAL

Practical-I	Based on paper I & III	80	20
Practical-II	Based on paper II & IV	80	20

* Seminar and Internal Assessment

Total Marks 600

SEMESTER - II

A. THEORY

PAPER	TITLE	Ex.	In.
I	Taxonomy and diversity of plants	80	20
I	Molecular biology	80	20
III	Plant physiology	80	20
IV	Plant metabolism	80	20

B. PRACTICAL

Practical-I	Based on paper I & III	80	20
Practical-II	Based on paper II & IV	80	20

* Seminar and Internal Assessment

Total Marks 600

Total marks of Semester I & II 1200

Note : Botanical excursion (within or outside Chhattisgarh) is compulsory for the students of M.Sc.

SEMESTER - III (SESSION - 2013-14)

A. THEORY

PAPER	TITLE	Ex.	In.
I	Plant development and Plant resources	80	20
PAPER	TITLE	Ex.	In.
I	Plant Ecology I (Basic Ecology and Plant resource conservation)	80	20
III	Biotechnology I (Genetic engineering of Plants and microbes)	80	20
IV	Elective I, Molecular plant pathology I	80	20

B. PRACTICAL

Lab Course - I - Based on paper I & II	80	20
Lab Course - II - Based on paper III & IV	80	20
* Seminar and Internal Assessment		
	Total Marks	600

SEMESTER - IV**A. THEORY**

PAPER	TITLE	Ex.	In.
I	Plant Reproduction and Plant resources utilization	80	20
I	Plant Ecology II (Vegetation Ecology and Biodiversity conservation)	80	20
III	Biotechnology Ii (Plant cell, tissue and organ culture)	80	20
IV	Elective II, Molecular plant pathology II	80	20

B. PRACTICAL

Lab Course - I - Based on paper I & II	80	20
Lab Course - II - Based on paper III & IV	80	20
* Seminar and Internal Assessment		
	Total Marks	600

Total marks of Semetster III & IV 1200

Note : In each semester, each theory paper there will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, where as rest questions will be unit wise.

SEMESTER - I**PAPER - I****CYTOLOGY****Max. Marks 80**

- UNIT-I**
- The dynamic cells Structural organization of the plant cell, specialized plant cell type chemical foundation, biochemical energetics.
 - Cell wall - Structure and functions, biogenesis growth.
 - Plasma membrane : structure, models and functions, site for ATPases, ion carriers channels and pumps, receptors.
- UNIT-II**
- Chloroplast - structure, genome organization, gene expression, RNA editing. Mitochondria; structure, Genome organization.
 - Plant Vacuoule - Tonoplast membrane, ATPases, transporters as an storage organelle.
- UNIT-III**
- Nucleus : Structure, nuclear pore, nuceosome organization.
 - Ribosome - Structure, and functional significance.
 - Cell cycle and Apoptosis : Control mechanisms, role of cyclins cycline dependent kinases.
 - Retinoblastoma and E2F proteins, cytokinesis and cell plate formation, mechanisms of programmed cell death.
- UNIT-IV**
- Other cell organelles : Structure and functions of microbodies microtubules, microfilaments. Golgi apparatus. Lysosome, endoplasmic reticulum.

- Techniques in cell biology : Immuno techniques in situ hybridization to locate transcripts in cell types FISH, GISH, Confocal microscopy.

List of Practicals -

Cell division -

1. Mitosis and meiosis.
2. Percentage frequency of mitosis and meiosis cell division.
3. Mitosis and Meiosis index.
4. Abnormal behaviour of chromosomes in cell division.
5. Use of Microtome for studying cytological material.

PAPER - II

GENETICS

Max. Marks 80

- UNIT-I** • **Chromatin Organization** : Chromosome structure and packaging of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA genes, euchromatin and heterochromatin, karyotype, banding pattern specialized types of chromosomes, polytene, lamp brush, B chromosomes and sex chromosomes.
- Molecular basis of chromosome pairing, chromosomal aberration and polyploidy.
- UNIT-II** • Mapping of Bacteriophage genome, Phage phenotype, recombination in phage genetic, transformation and transduction in bacteria.
- UNIT-III** • Genetic recombination & genetic mapping : Mechanism of crossing over, molecular mechanism of recombination, role of Rec-A and Rec-B,C,D enzyme, site specific recombination, linkage, linkage group, genetic marker.
- UNIT-IV** • Alien gene transfer through chromosome manipulation; Transfer of whole genome, Examples from wheat, arachis & Brassica. Transfer of individual chromosomes & chromosome segment, methods for detecting alien chromatin, production.

PAPER - III

MICROBIOLOGY, PHYCOLOGY AND MYCOLOGY

Max. Marks 80

- UNIT-I** • **Archaeobacteria and Eubacteria** : General account, ultra structure, nutrition and reproduction, biology and economic importance.
- **Cyanobacteria** : Salient feature and biological importance.
- UNIT-II** • **Viruses** : Characteristics and ultra structure of virions, isolation and purification of viruses. chemical nature, replication, transmission viruses, economic importance.
- **Phytoplasma** : General characteristic and role in causing plant diseases.
- UNIT-III** • **Phycology** : Algae in diversified habitats (terrestrial, freshwater, marine), thallus organization, cell ultra structure, reproduction (vegetative, asexual, sexual)
- Criteria for classification of Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.
 - Economic importance of algae.
- UNIT-IV** • **Mycology** : General characters of fungi, substrate relationship in fungi, cell structure, unicellular and multicellular organization, cell wall composition, nutrition (saprobic, biotrophic, symbiotic) reproduction, (vegetative, asexual, sexual) heterothallism heterokaryosis, Parasexuality, recent account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina,

Deuteromycotina, Mycorrhiza, fungi as biocontrol agent.

BOOKS SUGGESTED :

1. Alexopoulos, C.J. Mims, C.W. and Blalckwel, M. 1996. Introductory Mycology. John Wiley & Sons Inc.
2. Clifton, a. 1958. Introduction to the Bacteria. McGraw Hill Book Co., New York.
3. Kumar, H.D. 1988. Introductory Phycology. Affiliated East-West Press Ltd. New Delhi.
4. Mandahar, C.L. 1978. Introduction to Plant Viruses. Chand & Co. Ltd. Delhi.
5. Mehrotra, R.S. and Aneja, R.S. 1998. An Introduction to Mycology. New Age Intermediate Press.
6. Morris, I. 1986. An Introduction to the Algae. Cambridge University Press, U.K.

PRACTICAL-

Study of representative members with the help of available class work material permanent slides, sheets, specimens, plastic coated mounts etc.

PAPER - IV

BRYOPHYTA, PTERIDOPHYTA AND GYMNOSPERM

Max. Marks 80

- UNIT-I**
- **Bryophyta** : morphology, structure, reproduction, life history, distribution, classification.
 - General account of Marchantiales, Jungermanniales, Anthocerotales, Sphagnales. Funariales and Polytrichales. Economic and ecological importance.
- UNIT-II**
- **Pteridophyta** : morphology, anatomy and reproduction, classification, evolution of stele.
 - Heterospory and origin of seed habit, general account of fossil pteridophyta. Introduction.
 - To Psilopsida, Lycopsidea, Sphenopsida and Pteropsida.
- UNIT-III**
- **Gymnosperm** : General characters of gymnosperm mentioning diversity.
 - Classification of gymnosperm.
 - Resemblances and difference between gymnosperm, pteridophyta and angiosperm.
 - Gymnosperm distribution in India, Gymnosperm Biotechnology.
 - Economic importance of gymnosperm.
 - Origin and evolution of gymnosperm stele.
 - Structure and theories regarding origin of Paleozoic ovule.
- UNIT-IV**
- **Extinct gymnosperm** : general account of pteridospermales, Glossopteridales, Caytoniales Pentoxylales.
 - **Extant Gymnosperm** : Cycadales, Ginkgoales, Coniferales Ephedrales, Gnetales & Welwitschiales.

LIST OF PRACTICALS :

Study of representative members with the help of available classwork material specimen and permanent slides.

SUGGESTED READING :

1. Parihar, N.S. 1991. Bryophyta. Central Book Depot, Allahabad.
2. Parihar, N.S. 1996. Biology & Morphology of Pteridophytes. Central Book Depot, Allahabad.
3. Puri, P. 1980. Bryophytes. Atma Ram & Sons, Delhi.
4. Spome, K.K. 1991. The Morphology of Pteridophytes. B.I. Publishing Pvt. Ltd. Bombay.
5. Stewart, W.N. and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.

PRACTICAL - I

Time - 5 hours			Max. Marks 100
1	Practical based on Cytology	-	20
2	Exercise based on Phycology	-	20
3	Exercise based on Mycology	-	15
4	Spotting	-	15
5	Viva-Voce	-	10
6	Sessional	-	20
		Total	100

PRACTICAL - II

Time - 5 hours			Max. Marks 100
1	Practical based on Genetics	-	10
2	Exercise based on Bryophyta	-	15
3	Exercise based on Pteridophyta	-	15
4	Exercise based on Gymnosperm	-	15
5	Spotting	-	15
6	Viva-Voce	-	10
7	Sessional	-	20
		Total	100

SEMESTER - II

PAPER - I

TAXONOMY AND DIVERSITY OF PLANTS **Max. Marks 80**

- UNIT-I**
- **Plant nomenclature** : Binomial Nomenclature, International code of Botanical nomenclature.
 - **Plant identification** : Herbaria Botanical gardens, Taxonomic literature, Taxonomic keys.
 - **Taxonomic hierarchy** - Major categories, Minor categories, species concept.
 - **Taxonomic evidences** - Morphology, Anatomy, Palynology, Embryology, Cytology, Photochemistry, Genome analysis and Nucleic acid hybridization.
 - **Geographical information system (GIS)**.
- UNIT-II**
- **Pre Darwinian Classification** : Based on form relationship (Bentham and Hooker).
 - **Post Darwinian classification** : Engler and Prantl, Bessey's, Hutchinson, Takhtajan and Cronquist.
 - **Recent modification** : Dahlgren's system of classification.
 - **Fossil angiosperm**.
- UNIT-III**
- Study of following families with particular reference to systematic position, Phylogeny, evolutionary trends and economic importance. Dicot families; Ranunculaceae, Magnoliaceae, Nymphaeaceae, Sterculiaceae, Meliaceae, Fabaceae, Cucurbitaceae, Umbelliferae, Asteraceae, Sapotaceae, Bignoniaceae, Labiatae, Verbenaceae, Euphorbiaceae, Moraceae.
- UNIT-IV**
- Study of following families with particular reference to systematic position, phylogeny Evolutionary trends and economic importance. Monocot families- Orchidaceae, Zingiberaceae, Commelinaceae, Cyperaceae, Poaceae study on local available families.

PAPER - II

MOLECULAR BIOLOGY

Max. Marks 80

- UNIT-I • RNA and DNA structure. A, B and Z Forms replication, damage and repair, transcription, Translation.
- UNIT-II • **Molecular cytogenetics** : Nuclear DNA content, C- value paradox, Cot curve and its Significance, restriction mapping - concept and techniques, multigene families and their evolution in situ hybridization and techniques, chromosome, micro dissection and micro cloning flow cytometry, and confocal microscopy in karyotype analysis.
- UNIT-III • **Gene structure and expression** : Fine structure of gene, cis-trans test, fine structure analysis of eukaryotes introns and their significance. RNA splicing, regulation of gene expression in prokaryotes and eukaryotes.
 - **Protein sorting** : Targeting of proteins to organelles.
- UNIT-IV • **Mutation** : Spontaneous and induced mutation, physical and chemical mutagens, molecular basis of gene, transposable elements in prokaryotes and eukaryotes. mutation induced by transposones. site- directed mutagenesis, inherited human diseases and defects in DNA repair, translocation tester sets Robertsonian translocation, B-A translocation.

PAPER - III

PLANT PHYSIOLOGY

Max. Marks 80

- UNIT-I • **Membrane transport and translocation of water and solutes** : Plant - water relation mechanism of water transport through xylem root microbe interactions in facilitating nutrient uptake, Comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport membrane transport system.
- UNIT-II • **Signal transduction** : Overview, receptors, and G proteins, Phospholipids signaling, role of cyclic nucleotides, calcium- calmodulin cascade, diversity in protein kinases and phosphatases, specific signaling mechanism, two component sensor regulator system in bacteria.
- UNIT-III • **Stress physiology** : Plant response----- to biotic and abiotic stress, mechanism ---- biotic and abiotic stress tolerance HR Fundamental and SAR, water deficit and drought resistance, salinity stress, metal toxicity. freezing and heat stress, oxidative stress.
- UNIT-IV • **Fundamentals of enzymology** : General aspects, allosteric mechanism, regulatory and active sites, isozymes, kinetics of enzymatic catalysis, Michaelis-Menton equation and its significance.
 - **Sensory photobiology** : History of discovery of phytochromes and cryptochroms and their photochemical and biochemical properties, photophysiology of light induced----- responses, cellular localization, and molecular mechanism of action of

PAPER - IV

PLANT METABOLISM

Max. Marks 80

- UNIT-I • **Photosynthesis** : General concepts and historical background, evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting complexes, photooxidation of water mechanism of electron and proton transport, carbon assimilation- The Calvin cycle, photorespiration and its significance, the C₄ cycle, the CAM pathway, biosynthesis of starch and sucrose, physiological

and ecological consideration.

- UNIT-II** • **Respiration and Lipid Metabolism** : Overview of plant respiration, glycolysis, the TCA cycle, electron transport and ATP synthesis. Pentose phosphate pathway glyoxylate cycle, alternative oxidase system, structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids and their catabolism.
- UNIT-III** • **Nitrogen and sulphur metabolism** : Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation sulphur uptake, transport and assimilation.
- UNIT-IV** • **Plant growth regulators and elicitors** : Physiological effects and mechanism of action of auxins, gibberellins cytokinins ethylenes, abscisic acid, brassinosteroid, polyamines, jasmonic acid and salicylic acid hormone receptors.
- **The flowering process** : Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development - Genetic molecular analysis, role of vernalization.

PRACTICAL - I

Time - 5 hours		Max. Marks	100
1	Practical base on Molecular biology	-	20
2	Exercise based on Plant description (02 plants)	-	35
3	Spotting	-	15
4	Viva-voce	-	10
5	Sessional	-	20
	Total		100

PRACTICAL - II

Time - 5 hours		Max. Marks	100
1	Practical base on paper III	-	30
2	Exercise based on paper IV	-	25
3	Spotting	-	15
4	Viva-voce	-	10
5	Sessional	-	20
	Total		100

Suggested Laboratory Exercises for Lab Course-II

1. Simple Physiological experiments to understand the plant water relations, Photosynthesis and Respiration.
2. Effect of time and enzyme concentration on the rate of reaction of enzyme (e.g. acid phosphatase, nitrate reductase)
3. Effect of substrate concentration on activity of any enzyme and determination of its Km value.
4. Demonstration of the substrate inducibility of the enzyme and nitrate reductase.
5. Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum for chlorophylls and carotenoids.
6. To determine the chlorophyll a chlorophyll b ratio in C3 and C4 plants.
7. Isolation of intact chloroplast & estimation of chloroplast proteins by spot protein assay.
8. To demonstrate photophosphorylation in intact chloroplast resolve the phosphoproteins by SDS-PAGE & perform autoradiography.
9. Extraction of seed proteins depending upon the solubility and Preparation of standard curve of protein & estimation of protein content in extracts of plant material by Lowry's or Bradford's method.

10. Fractionation of proteins using gel filtration chromatography by Sephadex G 100 or sephadex G 200.
11. SDS-PAGE for soluble proteins extracted from given plant materials of their profile by staining with coomassie Brilliant Blue or AgNo.
12. Separation of isozymes of esterases, peroxidases by native polyacrylamide gel electrophoreses.
13. Radioisotope methodology, autoradiography, instrumentation (GM counter & scintillation Counter) & principles involved.
14. Principles of colorimetry, spectrophotometry & fluorimetry.
15. Determination of succinic dehydrogenase activity, its kinetics & sensitivity to inhibitors.
16. Desalting of proteins by gel chromatography.

The above listed Practicals are just guidelines many more on such lines may be framed accordingly.

SEMESTER - III

PAPER - I

PLANT DEVELOPMENT AND PLANT RESOURCES Max. Marks 80

- UNIT-I Introduction** : Unique features of plant development. Metabolism of nucleic acids, proteins and mobilization of food reserves tropisms; control of cell division, Programmed cell death in the life cycle of plants, seed germination, Hormonal control of Seedling growth, Seed dormancy, Over coming of seed dormancy, Bad dormancy.
- Root development** : Organization of root apical meristem (RAM), Cell fates and lineages, Vascular tissue differentiation of root, lateral roots, Root hairs, Root microbe-interaction.
- UNIT-II Shoot Development** : Organization of shoot apical meristem (SAM). Cytological and molecular analysis of SAM, Control of tissue differentiation; especially Xylem and Phloem, Vascular cambium.
Secretory ducts and laticifers, Wood development in relation to environmental factors.
- UNIT-III Leaf development** : Development, Phyllotaxy, Control of leaf form, Differentiation of epidermis (with special reference to Stomata and Trichome) and Mesophyll cell. Senescence, Influences of hormones and environmental factors on senescence.
- Flower development** : Floral characteristics, Flower development, Genetics of Floral organ differentiation : Homeotic mutant in Arabidopsis and Antirrhinum, sex determination.
- UNIT-IV Plant resources** : Origin, Evolution, Cultivation and Uses of (i) Food, Forage and Fodder crops, (ii) Fiber crops, (iii) Medicinal and Aromatic plants (iv) Vegetable Oil-yielding crops.
Important fire - wood, Timber- yielding plants and Non-wood forest products (NEFPs) such as bamboos, rattans, raw materials for paper making, gums, tannins, dyes, resins and tsuits.

SUGGESTED LABORATORY / FIELD EXERCISES

- Effect of gravity, unilateral light and plant growth regulators on the growth of young seedling.
- Role of dark and red light / far-red light on the expansion of cotyledons and epicotylar hook opening in pea.

- Study of living shoot apices by dissection using aquatic such as Ceratophyllum and Hydrilla.
- Study of monocot and dicot stem.
- Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides of a suitable plant such as Coleus, Kalanchoe and double-stained permanent slides of a suitable plant such as Coleus, Kalanchoe, and Tobacco. Examinations of shoot apices in monocotyledons in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
- Study of alternate and distichous, alternate and superposed, opposite and superposed, opposite and decussate leaf arrangement. Examination of rosette plants (Launaea, Mollugo, Raphanus, Hyoscyamus etc.) and induction of bolting under natural conditions as well as by GA treatment.
- Microscopic examination of vertical section of leaves such as Cannabis, Tobacco, Nerium, Maize and wheat to understand the internal structure of leaf tissues and trichomes, glands etc.
- Study the C₃ and C₄ leaf anatomy of plants.
- Study of epidermal peels of leaves such as Coccinia, Gailardia, Tradescantia, Notonea, etc. To study the development and final structure of stomata and stomatal index, Demonstration of the effect of ABA on stomatal closure.
- Study of whole roots in monocots and dicots.
- Examination of L.S. of root from a permanent preparation to understand the organization of root apical meristem and its derivatives. (Use Maize, aerial roots of Banyan, Pistia, Jussiaea etc.)
- Origin of lateral roots.
- Study of leguminous roots with different types of nodules.
- Food crops; Wheat, Rice, Maize, Chickpea, Potato, Tapioca, Sweet Potato, Sugar cane, Morphology, Anatomy, Micro chemical tests for stored food material.
- Forage/Fodder crops : Study of any five important crops of the locality (For example fodder sorghum, Bajra, Berseem, Clove, Guar bean, Gram, Ficus sp.)
- Plant fibers : (i) Textile fibers : Cotton, Jute, Linen, Sunn, hemp, Cannabis. (ii) Cordage fibers : Coir (iii) Fibers for stuffing : Silk, Cotton or Kapok.

SUGGESTED READINGS :

- Bewley, J.D. and Black. M. 1994. Seeds : Physiology of development and germination. Plenum press, New York.
- Bendre, A. and Kumar, 2004 A. Rastogi pub. Meerut, India.
- Crocker, W. and Barton V. 1953 Physiology of seeds. Waltham, Mass. U.S.A.
- Santra, S.C., Chatterjee, T.P. and Das. 2005 A.P. College Botany Practical Vol. II New central pub. India.
- Parihar, N.S. 1964. Hormonal control of plant growth, Asia pub. House, London.
- Wareing. P.F. and Phillips I.D.J. 1973, Pergamon press, Oxford.

PAPER - II

PLANT ECOLOGY - I

(ECOSYSTEM & VEGETATION ECOLOGY) Max. Marks 80

UNIT-I ECOSYSTEM ORGANISATION : Structure and functions, primary production (Methods of measurement, global pattern, controlling factors), Energy dynamics (trophic organization, energy flow pathways, ecological efficiencies), Litter fall and decomposition, (mechanism, substrate quality, and climatic factors), global biogeochemical cycles of C,N,P and S, mineral cycles (pathways, processes and

budgets) in terrestrial and aquatic systems.

UNIT-II ECOSYSTEM STABILITY AND MANAGEMENT : Concept (resistance and resilience), Ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems, ecology of plant invasion, environment impact assessment, ecosystem restorations. Concept of Sustainable development, sustainability indicators.

UNIT-III VEGETATION ORGANISATION : Concepts of community and continuum, analysis of communities (analytical and synthetic charactes), Community coefficients, inter specific associations, ordination, and concept of ecological niche.

UNIT-IV VEGETATION DEVELOPMENT : Temporal changes (cyclic and non cyclic) mechanism of ecological succession (relay floristic and initial floristic composition, facilitation, tolerance and inhibition models), change in ecosystem properties during succession.

REFERENCE BOOKS :

- Smith R.L., 1996. Ecology and field biology, Harper Collins, New York.
- Odum, E.P. 1971. Fundamentals of Ecology, Saunders, Philadelphia.
- Odum, E.P. 1983. Basic ecology, Saunders, Philadelphia.
- Kormondy, E.J. 1996. Concepts of Ecology, Prentice Hall of India Pvt. Ltd. New Delhi.
- Moldan, B. and Billharz, S. 1997. Sustainability indicators, John Wiley and Sons, New York.
- Muller- Dombosis, D and Ellenberg, H 1974 Aims and methods of vegetation ecology, Wiley, New York.
- Begon M, Harper, J.L. Townsend, C.R. 1996. Ecology, Blackwell science, Cambridge, USA.
- Ludwig, J. and Reynolds, J.F., 1988. Statistical ecology, John Wiley and Sons.
- Barbour, M.G., Burk, J.H. and Pitts, W.D. 1987. Terrestrial plant ecology.
- Benjamin cummings Publication Company, California.
- Chapman, J.L. and Reiss, M.J. 1988. Ecology principles and applications, Cambridge University press, Cambridge, U.K.

LIST OF PRACTICALS

1. To determine minimum size and number of quadrat required for reliable estimate of biomass in grassland.
2. To compare protected and unprotected grassland stands using community coefficients (similarity indices)
3. To analyze plant communities Bra Curtis ordination method.
4. To estimate IVI of the species in a woodland using point centered quarter method.
5. To calculate mean, variance, standard deviation, standard error, coefficient of variations and to use t test for comparing two means related to ecological data.
6. To find out the relationship between two ecological variables using correlation and regression analysis.
7. To find out important grassland species using chi square test.
8. Scientific visits to a protected area, a wet land, a mangrove, NBPGR, BSI, CSIR, ICAR labs and a recognized botanical gardens or a museum.

REFERENCE BOOKS :

- Ludwig, J.A. and Reynolds, J.F. 1988. Statistical Ecology, Wiley New York.
- Krebs, C.J. Ecological methodology, Harper and Row, New York.
- Pielou, E.C. 1984. The interpretation of ecological data, Wiley, New York.
- Moore, P.W. and Chapman, S.B. 1986. Methods in plant Ecology, Blackwell scientific publications.
- Misra, R. 1968. Ecology work book, Oxford & IBH, New Delhi.

- Smith, R.L. 1996. Ecology and Field Biology, Harpercollins, New York.
- Muller- Dombois, D and Ellenberg, H. 1974. Aims and methods of vegetation ecology, Wiley, New York.
- Sokal, R.R. and Rohlf, F.J. 1995. Biometry, W.H. Freeman & Co. San Francisco.

PAPER - III

BIOTECHNOLOGY AND GENETIC ENGINEERING OF PLANTS AND MICROBES

Max. Marks 80

UNIT-I BIOTECHNOLOGY- Basic concepts, principles and scope.

RECOMBINANT D.N.A. TECHNOLOGY: Gene cloning principles, Tools- Restriction Enconueleases. DNA modifying enzymes. Choice of Veetor. Plasmid. Cosmid, Bacteriophage vectors, phagmids, Artificial chromosomes. Shuttle veetors, Yeast veetors, Expression veetors and techniques, construction of genomic / cDNA libraties.

UNIT-II MICROBIAL GENETIC MANIPULATION : Bacterial transformation. selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

GENETIC ENGINEERING OF PLANTS : Aims, strategies for development of transgenics (with suitable examples), Gene transfer methods - Veetor mediated gene transfer- Agrobectgerium the natural genetic engineer, t-DNA mediated DNA transformation. Virus mediated gene tranfer, Vectorless or direct DNA transfer.

UNIT-III DNA SYNTHESIS AND SEQUENCING : Chemical synthesis of gene, Polymerase chain reaction, its variation, application, advantages and limitations, DNA sequencing - Sanger and dCoulson method, Maxam Gillbert method, High throughput DNA sequencing, DNA finger printing.

UNIT-IV GENOMICS AND PROTEOMICS : Genetic and physical mapping of genes, molecular markers for integression of useful traits, Transposon mediated gene tagging, genome projects, bioinformatics, Functional genomies, microarrays, protein profiling and its significance.

SUGGESTED READING :

1. Brown, T.A. 1999. Genomes, John Wiley and Sons (Asia) Pvt. Ltd. Singapore.
2. Callow, J.A., Fort-Lloyd, B.V. and Newbury, H.J. 1997.
3. Biotechnology and Plant Genetic Resources : Conservation and Use. CAB International. Oxon, UK.
4. Chrispeels, M.J. and Sadava, 1994. Plants, Genes and Agriculture, Jones & Ba..... P:ublishers, Boston, USA.
5. Glazer, A.N. and Nikaido, H. 1995. Microbial Biotechnology, W.H. Freeman & company, New York, USA.
6. Gustafson, J.P. 2000. Genomes, Kluwer Academic Plenum Publishers, New York, USA.
7. Henry, R.J. 1997. Practical Applications of Plant Molecular Biology, Chapman & Hall, London, UK.
8. Jolles, O. and Jomvall, H. (eds.) 2000. Proteomics in Functional Genomics, Birkhauser Verlag, Basel, Switzerland.
9. Old, R.W. and Primrose, S.B. 1989. Principal of Gene Manipulation. Blackwell Scientific Publication, Oxford, UK. Primrose, S.B. 1995. Principles of Genome Analysis. Blackwell Science ltd. Oxford, UK.
10. Reghava. V. 1997, Molecular Biology of Flowering Plants. Combridge University Press, New York, USA.
11. Shantharam, S. and Montgomery, J.F. 1999. Biosafety, and Biodiversity. Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi.

Suggested Laboratory Exercises :

1. Growth characteristics of E. coli using plating and turbidimetric methods.
2. Isolation of plasmid from E. coli by alkaline lysis method and its quantitation spectrophotometrically.
3. Restriction digestion of the plasmid and estimation of the size of various DNA fragment.
4. Cloning of DNA fragment in a plasmid vector, transformation of the given bacteria population and selection of recombinants.
Demonstration of DNA sequencing by Sanger's dideoxy method.

Suggested Reading (for laboratory exercise)

1. Plant molecular biology manual, 2nd edition, Kluwer Academic Publishers, Dordrecht, The Netherlands.
2. Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. CRS press, Boca Raton, Florida.
3. Glover, D.M. and Hames, B.D. (Eds.) 1995. DNA Cloning 1 : A Practical Approach; Core Techniques, 2nd edition. PAS, IRL Press at Oxford University Press, Oxford.
4. Hackett, P.B., Fuchs, J.W. 1988. An introduction to REcombinant DNA Techniques; Basic Experiments in Gene manipulation. The Benjamin Cummings/Publishing Co.; Inc Menlo, Calio Park, Callifomin.
5. Shaw, C.H. (Ed.) 1988. Plant Molecule Biology : A Practical Approach. IRL Press, Oxford.

PAPER - IV

MOLECULAR PLANT PATHOLOGY - I

Max. Marks 80

- UNIT-I**
1. Introduction and history of plant pathology.
 2. General Principles of plant pathology and classification of plant diseases.
 3. **Diseases inciting organisms** - Animate Pathogens- fungi, Bacteria, Mycoplasma, Viruses, Nematodes, their general characteristics, heterotrophic behavior with emphasis on parasitism ability and virulence.
- UNIT-II**
1. **Disease Syndrome and General Symptoms of plant disease** : Pathogenic and non pathogenic; Symptoms caused by fungi, Bacteria, Viruses, Mycoplasma and Nematodes.
 2. **Sources of infection** : Seeds, soil, water and airborne diseases of plants; Significance of phyllosphere and rhizosphere studies.
 3. **Pathogenesis** : Dissemination of plant pathogens; Mode of infection; Inoculum potential.
- UNIT-III**
1. **Effect of environment on disease development** : Predisposing factors; Survival of fungi; Germination of spores; Disease initiation and Epidemics.
 2. **Host Parasites relationship** : Mechanism and physiology of infection, Path of infection, Role of enzymes, growth regulators and toxins in pathogenesis.
 3. **Physiological specialization** : General account; Physiological specialization with special reference to smuts and rusts.
- UNIT-IV**
1. **Recurrence of disease** with special reference to recurrence of rust disease in India.
 2. **Methods of Studying Plant Diseases** : General account, Macroscopic study, Microscopic study, Koch postulates, Culture technique, Preparation of culture tubes, media preparation, Inoculation, Isolation, Pure Culture, Parasitism of obligate parasites, Methods in bacteriology, Techniques required in introductory bacteriology.

SUGGESTED READING :

1. Plant Pathology - J.C. Walkar.

2. Fungi and Plant diseases - B.B. Mundkar.
3. Plant Pathology - G.N. Agrios.
4. Plant Pathology - Wheeler.
5. Plant Pathology (Vol. 1-3) Horsfall & Dimon.
6. A text book of Modern Plant Pathology - K.S. Bilgrami & H.C. Dubey.
7. Plant Pathology - R.S. Singh.
8. An introduction to Principles of Plant Pathology - R.S. Singh.
9. Plant Diseases of Crop plants in India - N.G. Rangaswamy.
10. Plant Pathology problems and progress - Horsfall.
11. Essentials of Plant Pathology - V.N. Pathak.
12. Plant Pathology - Butter and Jones.
13. Plant Pathology - R.S. Mehrotra.
14. Crop plant Disease Colender - IARI-India.
15. Physiology of Fungus - K.S. Bilgrami & R.V. Verma.
16. Micro-organisms in the laboratory - G.P. Agrawal and S.K. Hassija.
17. Physiology of Fungi - V.G. Lilly & H.L. Barnett.
18. Illustrated Genera of Imperfect fungi - H.L. Barnett & B.B. Hunter.
19. Microbiology and Plant Pathology - P.D. Sharma.
20. Plant Pathology - P.D. Sharma.
21. Microbiology - P.D. Sharma.
22. The Gungi - G. Sumbali
23. Fungicides and Crop protection - H.G. Mewitt.
24. Fungus Diseases of Plants - B.M. Duggar.
25. Plant Pathology - P.C. Trivedi.
26. Plant Pathology - G.P. Gupta.
27. Virus and Plant Diseases - S.R. Mishra.
28. Bacterial Diseases - V. Kumar.
29. Biotechnology & Plant Pathology - V.K. Jain
30. Laboratory manual of Plant Pathology - D.K. Jha.
31. Modern Technology of Plant Pathology - V. Suri.

PRACTICAL - I

Time - 5 hours

Max. Marks 100

1	Practical base on Paper - I	30
2	Practical base on Paper - II	25
3	Spotting	15
4	Viva-Voce	10
5	Sessional	20
Total		100

PRACTICAL - II

Time - 5 hours

Max. Marks 100

1	Practical base on Paper - III	25
2	Practical base on Paper - IV	30
3	Spotting	15
4	Viva-Voce	10
5	Sessional	20
Total		100

SEMESTER - IV

PAPER - I

PLANT REPRODUCTION AND UTILIZATION OF RESOURCES

Max. Marks 80

- UNIT-I Reproduction :** Vegetative option. Methods of propagation. Pollination, P{ollination-mechanism and vector, Structure of pistil, Pollen stigma intgeraction, Sporophytic and gametophytic Self-incompatibility (Cytological, biochemical and molecular aspect). Fertilization double fertilizatgio, in-vitgro fertilization.
- UNIT-II Male gametophyte :** Stucdture of anther, Microsporogenesis, Role of tapetum, pollen development, male stgerility, sperm dimorphism and hybrid seed production. Pollen semination, Pollen tube growth and guidance, Pollen storage, Pollen allergy, Pollen embryo.
- Female gametophyte :** Ovule development, Organization of embryo sac and Structure of embryo sac cells.
- UNIT-III Seed and Fruit development :** Endosperm development during carly, maturation and desiccation stages, Embryo genesis, Storage proteins of endosperm, Ultra structure and unclear cytology, Cell lineage during late embryo develolpment, Polymbryony, Apomixes, Embryo culture, Endospermic and non-endospermic seeds, Dynamics of fruit growth, biochemistry and biology of fruit maturation.
- UNIT-IV Utilization of resources :** Plant used as avenue trees for shade. pollution control and aesthetics, Innovation for meeting world food demands. Origin of Atriculture, Green revolution : Benefits and adverse consequences. Ethanobotanically important plants of Chhattisgarh. World centers of primary diversity of domesticated plants : The Indo-Burmese center. Plant introduction and secondary centers.

SUGGESTED READING :

- Bhojwani. S.S. and Bhatnagar. S.P. 2000. The Embryology of Angiosperms (4 revised and enlarged edition). Vikas publication House, New Delhi.
- Fageri, K. and Vander Pijl. L. 1979. The Principles of Pollination Ecology. Pergamon Press, Oxford.
- Proctor. And Yeo, P. 1973. The Pollination of Flowers, William Collins, London.
- Raghavan V. 1997. Molecular Embryology of Flowering Plants. Cambridge University, Press, Cambridge.
- Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer Verlag, New York.
- Raven, P.H. Evert, R.F. and Eichhorn, and S.E. 1992. Biology of Plants (5 edition). Worth, New York.
- Sedgely, M. and Griffin, A.R. 1989. Sexual Reproduction of Tree Crops. Academic Press, London.
- Shivanna, K.R. and Sawhney, V.K. 1997. Pollen Biotechnology for crop Production and Improvement.
- Shivanna, K.R. and Rangaswamy, N.S. 1992. Pollen Biology : A Laboratory manual. Springer-Verlag, Berlin.
- Shivanna, K.R. and Johri, B.M. 1985. The Angiosperm Pollen : Structure and Function. Wiley Eastern Ltd. New York.
- Chandel, K.P.S. Shukla, G. and Sharma, N. 1996. Biodiversity in Medicinal and Aromatic Plants in India : Conservation and Utilization. National Bureau of Plant Genetic Resources. New Delhi.

- Chrispeels, M.J. and Sadava, D. 1977. Plants, Food and People. W.H. Freeman and Co., San Francisco.
- Council of Scientific and Industrial Research 1986. The Useful Plants of India. Publications and directorate, CSIR, New Delhi.
- Kochhar, S.L. 1998. Economic botany of the Tropics, 2nd edition. Macmillan India Ltd., Delhi.
- Thakur, R.S., Puri, H.S. and Hussain, A., 1989. Major Medicinal Plants of India. Central Institute of Medicinal and Aromatic Plants, CSIR, Lucknow.
- Swaminathan, M.S. and Kochhar, S.L. 1989. Plants and Society. Macmillan Pub. London.

SUGGESTED LABORATORY / FIELD EXERCISES :

- Study of microsporogenesis and gametogenesis in sections of anthers.
- Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (Maize, Grasses, Cannabis, sativa, Croton, Tradescantia, Petunia, Solanum melongena ect.)
- Tests for pollen viability using stains and in vitro germination. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
- Estimating percentage and average pollen tube length in vitro.
- Role of transcription translation inhibitors on pollen germination and pollen tube growth.
- Pollen storage. pollen-pistil interaction. self-incompatibility. *in vitro* pollination.
- Study of ovule in cleared preparations. study of monosporic, bisporic and tetrasporic types of embryo sac development through examination of permanent, stained serial section.
- Emasculation, bagging and hand pollination to study of pollen germination, seed set and fruit development using self compatible and obligate out crossing system. Study of ceistogamous flowers and Their adaptations.
- Study of nuclear and cellular endosperm through dissections and staining.
- Isolation of zygotic, globular, heart shaped, torpedo stage and mature embryo from suitable seeds and polyembryony in citrus. jamun (*Syzygium cumini*) etc. by dissections.
- Study of endospermic and non-endospermic seed.
- Study of seed dormancy and methods to break dormancy.
- Medicinal and Aromatic plants : Depending on the geographical location College/University select five medicinal and aromatic plants each from a garden. crop field or from the wild only if they are abundantly available. papaver somniferum, Atropa belladonna, Catharanthus roseus, Adhatoda ceylanica, Allium sativum, Rauwolfia serpentina, Withania somnifera, phyllanthus amarus, andrographis paniculata, Aloe barbadense, Mentha arvensis, Rosa sp. Pogostemon cablin, Origanum vulgare, Vetiveria zizanioides, jasminum grandiflorum, Cymbopogon sp., Pandanus odoratissimus.
- Study of live or herbarium specimens or other visual materials to become familiar with these resources.
- Vegetable oils : Mustard, Groundnut, Soya bean, Coconut, Sunflower and Castor.
- Gums, Resins, tannins and Dyes : Perform simple tests for gums and resins. Prepare a water extract of vegetable tannins (Acaia, Terminalia, Mangroves, Tea, Cassia sp. Myrobalans) and dyes (Turmeric, Bixa orellana, Indigo, Butea monosperma, Lawsonia inermis) and perform tests to understand their chemical nature.

SUGGESTED READINGS :

- Adriance, W. and Brison, R. Propagation of horticultural plants. Tata McGraw Hill pub. New Delhi.
- Sen. N. David, 1977. Environmental and seed germination of Indian plants. The chronica botanica co. New Delhi.
- Shivanna, K.R., Johri B.M. and Sastri, D.C. 1979. Development and physiology of angiosperm pollen. Today and tomorrows printers and pub. New Delhi.

- Vargheese, T.M. Experimental and applied embryology of angiosperms. Oxford & IBS pub. Co. New Delhi.

PAPER - II

PLANT ECOLOGY - II

(POLLUTION & BIODIVERSITY CONSERVATION) Max. Marks 80

- UNIT-I CLIMATE, SOIL AND VEGETATION PATTERNS OF THE WORLD :** Life zones, major biomes, major vegetation types and soil types of the world, barren land.
- UNIT-II POLLUTION, CLIMATE CHANGE AND ECOSYSTEMS :** Air, water and soil pollution :- kinds, sources, quality parameters, effects on plants and ecosystem. Green house gases (Carbon dioxide, methane, nitrous oxide, Chloro fluorocarbons : sources, trends and role). ozone layer, ozone hole, consequences of climate change, (Carbon dioxide fertilization, global warming, sea level rise, UV radiation)
- UNIT-III BIOLOGICAL DIVERSITY :** Concepts and levels, status in India, Utilization and concerns, role of biodiversity in ecosystem functions and stability, speciation and extinction, IUCN categories of threat, distribution and global patterns, terrestrial biodiversity hot spots, inventory. World centers of primary diversity of domesticated plants : The Indo Burmese center, plant introductions and secondary centers.
- UNIT-IV CONSERVATION STRATEGIES :** Principles of conservation, extinctions, environmental status of plants based on International union for conservation of Nature. In situ conservation, International efforts and Indian initiatives, protected areas in India - sanctuaries national parks, biosphere reserves, Wetlands, Mangroves and coral reefs for conservation of wild biodiversity. Ex situ conservation : Principles and practices, botanical gardens, field gene bank, seed banks, in vitro repositories, cryo banks, general account of the activities of Botanical survey of India (BSI), National Bureau of plant genetic resources (NBPGR), Indian council of Agriculture research (ICAR), Council of scientific and Industrial research (CSIR), and the department of Biotechnology (DBT) for conservation and non formal conservation efforts.

REFERENCE BOOK :

- Treshow, M. 1985. Air pollution and plant life, Wiley interscience.
- Mason C.F. 1991. Biology of fresh water pollution, Longman.
- Hill, M.K. 1997. Understanding Environmental pollution, Cambridge university press.
- Anonymous, 1987. National gene bank, Indian heritage on plant genetic resources, National bureau of plant genetic resources.
- Directory of Indian wet lands, 1993, WWF Idnia and AWB, Kualalumpur.
- Frankel, O.H., Brown, A.H.D. and Burdon, J.J. 1995. The conservation of plant biodiversity Cambridge university press, Cambridge, U.K.
- Kothari, A. 1997. Understanding Biodiversity : Life sustainability and Equity, Orient Longman.
- Nair, M.N.B. 1998. Sustainable management of non wood forest products, Faculty of forestry, University Putra Malaysia.
- Paroda, R.S. and Arora R.K. 1991. Plant resources conservation and management, IPGRIP usa campus, New Delhi.
- Heywood, V.H. and Watson, R.T. 1995. Global biodiversity assessment, Cambridge University press, Cambridge, U.K.
- Brady, N.C. 1990. The nature and properties of soils, MacMilan.

- Chandel, K.P.S., Shukla G. and Sharma, N., 1996. Biodiversity in medicinal and aromatic plants in India, conservation and utilization. National bureau of plant genetic resources New Dehli.
- Falk, D.A., Olwell, M Millan, C. 1996. Restoring biodiversity, Island press, Columbia, USA.
- Gaston, K.J. Biodiversity : A biology of numbers and differences, Blackwell science Ltd. Oxford, U.K.
- Heywood, V. 1995. Global biodiversity assessment. United nations environment programme, Cambridge university press, Cambridge, U.K.
- Heywood V.H. and Wyse Jackson, P.S. 1991. Tropical botanical gardens, their role in conservation and development, Academic press San Diego.
- Walter, K.S. and Gillett H.J. 1998. 1997 IUCN Red list of threatened plants.
- IUCN The world conservation union, IUCN Gland, Switzerland and Cambridge U.K.

LIST OF PRACTICALS :

1. To prepare ombrothermic diagram for different sites on the basis of given data set and to comment on climate.
2. To determine soil moisture content, porosity and bulk density of soil collected from varying depths at different locations.
3. To determine the water holding capacity of soils collected from different locations.
4. To determine percent organic carbon and organic matter in the soils of cropland, grassland and forest.
5. To estimate rate of carbon dioxide evolution from different soils using soda lime or alkali absorption method.
6. To determine gross and net phytoplankton productivity by light and dark bottle method.
7. To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples by azide modification method.
8. To estimate chlorophyll content in sulphur dioxide fumigated and unfumigated plant leaves.
9. To study environmental impact of a given developmental activity using checklist as a EIA method.
10. To determine diversity indices (Shannon Wiener, concentration of dominance, species richness, equability and Beta diversity).
11. Field survey of a part of town or city to make the students aware of the diversity of plants in urban ecosystems.

REFERENCE BOOKS :

- Magurran, A.E. 1988. Ecological diversity and its measurement, Chapman and Hall. London.
- APHA-AWWA-WPCF Standard methods for the examination of water and waste water, American public health association, Washington, D.C.
- Krebs, C.J. Ecological methodology, Harper and Row, New York, USA.
- Pielou, E.C. 1984. The interpretation of ecological data, Wiley, New York.
- Moore, P.W. and Chapman, S.B. 1986. Methods in plant Ecology, Blackwell scientific publications.

PAPER - III

BIOTECHNOLOGY - II

PLANT CELL, TISSUE AND ORGAN CULTURE Max. Marks 80

UNIT-I PLANTS CELL AND TISSUE CULTURE : General introduction, history, scope, concept of cellular differentiation, cellular totipotency.

TISSUE CULTURE MEDIA : Introduction, Media constituents, Media selection, Media preparation.

CELL CULTURE : Introduction isolation of single cells, Suspension cultures, Culture of Single cell, Plant cell reactors. Applications of cell culture.

CLONAL PROPAGATION : Auxillary bud proliferation, Meristem and shoot tip culture. bud culture.

ORGANOGENESIS AND ADVENTIVE EMBRYOGENESIS : Fundamental aspects of morphogenesis; organogenesis via callus formation, direct adventitive organ formation.

UNIT-II SOMATIC EMBRYOGENESIS AND ANDROGENESIS : Mechanisms, techniques and utility.

SOMATIC HYBRIDIZATION : Methods of Protoplast isolation, Spontaneous and induced methods of protoplasm fusion, Identification and selection of hybrid cells, REgeneration of hybrid plants. VERification and Characterization of somatic hybrids. Cybrids, possibilities achievements and limitations of protoplast research.

UNIT-III CRYOPRESERVATION AND GERMLASM STORAGE : Raising sterile tissue cultures, addition of cryoprotectants and pretreatment, freezing, storage, thawing, determination of survival viability, Plant growth and generation, vetrification, encapsulation and dehydration. Slow growth method. Applications.

INTELLECTUAL PROPERTY RIGHTS : Possible ecological risks and ethical concerns.

UNIT-IV APPLICATION OF PLANT TISSUE CULTURE : Artificial seeds, Production of hybrids and somaclones.

PRODUCTION OF SECONDARY METABOLITIES / NATURAL PRODUCTS : Morphological and chemical differentiation, Medium composition for secondary product formation. Growth production patterns, Environmental factors. Selection of cell lines producing high amounts of a useful metabolite. Problems associated with secondary metabolite production. Immobilized cell system.

TRANSGENICS IN CROP IMPROVEMENT : Transgenics for Resistance to biotic and abiotic stresses, Transgenics for quality modification, Terminator seed technology. Chloroplast transformation and its utility.

SUGGESTED READING :

1. Bhojwani, S.S. and Razdan, M.K. 1996. Plant Tissue Culture : Theory and Practice (revised edition). Elsevier Science Publishars, New York. USA.
2. Bhojwani S.S. 1990. Plant Tissue Culture : Application and Limitations. Elsevier Science Publishers, New York. USA.
3. Collins, H.A. and Edwards, S. 1998. Plants cell culture, Bros Scientific Publishers, Oxford UK.
4. Jain S.M. Sopory, S.K. and Veilleux, R.E. 1996. In vitro Haplod Production in Higher Plants. Vois. Fundamental Aspects and Methods Kluwer Academic Publishers, Dordreeth, The Netherlands.
5. Kartha K.K. 1985. Cryopreservation of Plants Cells and Organs. CRC Press, Boca Raton, Florida. USA.
6. Raghavan, V. 1986. Embryogenesis, in Angiosperms : A Development and Experimental study. Combridge university Press, New York, USA.
7. Vasil, lksshorpe, T.A. 1994. Plant Cell and Tissue Cuoture, Kluwer A CADEMIC publishers, The Netherlands.

SUGGESTED LABORATORY EXERCISE :

1. Isolation of protoplast from various plant tissues and testing viability.
2. Effect of physical (e.g. temperature) and chemical (e.g. osmoticum) factors on protoplast yield.

5. Demonstration of protoplast fusion employing PEG.
6. Organogenesis and somatic embryogenesis using appropriate explants and preparations of artificial seed.
7. Demonstration of androgenesis in *Datura*.
8. Electroporation of protoplasts and checking of transient expression of the reporter gene.
9. Co-cultivation of the plant material (e.g. leaf discs) with *Agrobacterium* and study GUS activity histochemically.

SUGGESTED READING (FOR LABORATORY EXERCISE)

1. Butenko, R.G. 2000. Plant Cell Culture. University Press of Pacific.
2. Collier, H.A. and Edwards, S. 1998. Plant Cell Culture. Bios Scientific Published. Oxford UK.
3. Dixon, R.A. (Ed.) 1987. Plant Cell Culture : A Practical Approach. IRL Press, Oxford.
4. George, E.F., 1993. Plant propagation by tissue Culture. Part 2. The Technology, 2nd Exegetics Ltd. Edington, UK.
5. Hall, R.D., (E.D.) 1999. Plant Cell Culture Protocols. Humana Press, Inc., New Jersey. USA.
6. Smith R.H. 2000. Plant Tissue Culture : Techniques and Experiments. Academic Press. New York.

PAPER - IV

MOLECULAR PLANT PATHOLOGY

Max. Marks 80

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|-----------------|--|
| UNIT-I | <ol style="list-style-type: none"> 1. Epidemiology and disease forecasting : Form of epidemics, factors responsible for the establishment of an epidemic, disease forecasting. 2. General principles of plant disease control : General account; Prophylactic, chemical (including fungicides, systemic fungicides, fumigants, antibiotics, growth regulators etc.) and biological control; Breeding for disease resistance varieties of host plants, Plant quarantine. |
| UNIT-II | <ol style="list-style-type: none"> 1. Defense Mechanism : Defense of host against pathogen, Structural defense; Physiological defense, Biochemical defense-role of phenolic compounds; Phytoalexins Defense through hyper-sensitive reactions. 2. Resistance and susceptibility : General account, types of resistance, vertical and horizontal resistance; breeding for disease resistance. |
| UNIT-III | <ol style="list-style-type: none"> 1. Wilt diseases : General account symptoms of diseases, Mechanism of wilting. 2. Diseases due to fungi : Rusts, smuts, Downy mildews powdery mildew diseases, Wilts. Leaf blight, Ergots, Tikka, necrosis, Rust-red rot of sugarcane. Damping off and warts diseases of economically important plants. 3. Diseases due to Bacteria : Bacterial blight of Rice, Tungro disease, citrus canker, Crown galls of stone fruits, Angular leaf spots. |
| UNIT-IV | <ol style="list-style-type: none"> 1. Diseases due to Viruses : Mosaic of tobacco, potato and tomato, Leaf curl of tomato & papaya, Yellow vein mosaic of Bhindi, Bunchy top of banana, Grass shoot disease of sugarcane. 2. Diseases due to Mycoplasma : Sandal spike. Little leaf of Brinjal, Grassy shoot disease, Sesamum, phyllody, Citrus greening. 3. Diseases due to Nematodes : General characteristics of plants nematodes, Rott knot, Malaya disease of Barley, wheat, Citrus nematodes, Ear cockle of wheat. |

SUGGESTED READING :

1. Plant Pathology - J.C. Walkar.
2. Fungi and Plant diseases - B.B. Mundkar.
3. Plant Pathology - G.N. Agris.

4. Plant Pathology - Wheeler.
5. Plant Pathology (Vol. 1-3) Horsfall & Dimon.
6. A text book of Modern Plant Pathology - K.S. Bilgrami & H.C. Dubey.
7. Plant Pathology - R.S. Singh.
8. An introduction to Principles of Plant Pathology - R.S. Singh.
9. Plant Diseases of Crop plants in India - N.G. Rangaswamy.
10. Plant Pathology problems and progress - Horsfall.
11. Essentials of Plant Pathology - V.N. Pathak.
12. Plant Pathology - Butter and Jones.
13. Plant Pathology - R.S. Mehrotra.
14. Crop plant Disease Colender - IARI-India.
15. Physiology of Fungus - K.S. Bilgrami & R.V. Verma.
16. Micro-organisms in the laboratory - G.P. Agrawal and S.K. Hassija.
17. Physiology of Fungi - V.G. Lilly & H.L. Barnett.
18. Illustrated Genera of Imperfect fungi - H.L. Barnett & B.B. Hunter.
19. Microbiology and Plant Pathology - P.D. Sharma.
20. Plant Pathology - P.D. Sharma.
21. Microbiology - P.D. Sharma.
22. The Gungi - G. Sumbali
23. Fungicides and Crop protection - H.G. Mewitt.
24. Fungus Diseases of Plants - B.M. Duggar.
25. Plant Pathology - P.C. Trivedi.
26. Plant Pathology - G.P. Gupta.
27. Virus and Plant Diseases - S.R. Mishra.
28. Bacterial Diseases - V. Kumar.
29. Biotechnology & Plant Pathology - V.K. Jain
30. Laboratory manual of Plant Pathology - D.K. Jha.
31. Modern Technology of Plant Pathology - V. Suri.

PRACTICAL - I

Time - 5 hours

Max. Marks 100

1	Practical base on Paper - I	30
2	Practical base on Paper - II	25
3	Spotting	15
4	Viva-Voce	10
5	Sessional	20
Total		100

PRACTICAL - II

Time - 5 hours

Max. Marks 100

1	Practical base on Paper - III	30
2	Practical base on Paper - IV	25
3	Spotting	15
4	Viva-Voce	10
5	Sessional	20
Total		100
