SHIVAJI UNIVERSITY, KOLHAPUR

SYLLABUS

For

M.Sc. Botany

(Semester Pattern)
Sem. III to IV

Estd. 1962
NAAC 'A' Grade

Choice Based Credit System
(CBCS)

To be implemented From

June, 2020 onwards

A) Syllabus for the Semester System Examination (Choice Based Credit System) w.e.f. June 2019 for M.Sc. Part-I (Semester I & II) R. No. ……dated …. …….and for M. Sc. Part-II (Semester III & IV) R. No…….. dated…… from June 2020.

B) Shivaji University Kolhapur, New Revised syllabus for Master of Science in Botany.

1.Title : M. Sc. BOTANY REVISED SYLLABUS (Choice Based Credit System)

2.Faculty of Science and Technology

3. Year of Implementation –

M.Sc.I- June 2019

M.Sc.II- June 2020

4. Preamble :

5. General objectives of course:

a: Programme outcomes:

1. Rational thinking: To check assumptions for their accuracy and validity
2. Biodiversity awareness: Understand the local and global issues of environment and its sustainable development.
3. Continuous learning: ability to engage independently on context of human society and technological changes.
4. Solving problems related to food scarcity.

b: Course outcomes

Working knowledge of the basic concepts of Botany i.e. cellular, ecological, molecular, physiological, ecological organizations and evolutionary biology of algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms.

Students will learn several biophysical techniques such as electrophoresis, microscopy, biostatistics, bioinformatics, centrifugation, chromatography, spectroscopy, radioisotope, culture techniques.

Identification and understanding of basic concepts related diseases and several processes related to physiology, ecology, cell and molecular biology, biochemistry of plants under stress conditions.

Identification of classification of algae, fungi, bryophytes, Pteridophytes, gymnosperms, angiosperms, evolution of reproductive structures, phylogeny and interrelationship of the selected genus.

Understanding of basic concepts of population and how individuals of a population interact with the ecosystem.

Knowledge of plant pathology, identification of disease, their causal organisms, symptomology, defense mechanism of the selected diseases.

Study of organs, their development, experimental embryology, apomixes and its types, poly-embryony, experimental induction of poly-embryology, palynology and its role in horticulture, agriculture and oil exploration programs.

Understanding the processes of natural selection, migration, mutation, genetic drift and variation and application of this knowledge in crop improvement.

Acquisition of skills required for the production of disease free plants, development of hybrids, development of plants with novel traits. Intellectual property rights their importance, ecological risks and ethical concerns.
Commercial storage products, knowledge and value added structural components, information about active components.

6 : The entire course of M. Sc. (Botany) will be of **four Semesters** spread over two years .
7 : Pattern- M.Sc.I & M.Sc. II Theory semester and practical is Annual examination

8 : Fee structure : As per university norms

a. Statutory University recognized as equivalent, and has kept four semester terms in the University as a post-graduate student be admitted to the degree of Master of Science in any of these subjects mentioned in R. M. Sc. No. 3.
b. A student shall be held eligible for admission to the M. Sc. Course provided he/she has passed the B. Sc. examination either with a principal subject or with a subsidiary/interdisciplinary/applied/ allied subjects and has passed the entrance examination conducted by the University.
c. The students with B. Sc. from other universities shall be eligible if they qualify through Entrance Examination and they score minimum 55 per cent B+ marks in the subject at the B. Sc.
d. While preparing the merit list for M. Sc. admission, the performance at B. Sc. III , B. Sc. II/ B.A. II, as the case may be, and the performance at the entrance examination will be given equal weight age (50.50).

10: Medium of Instruction –English
11: Structure of course:
There shall be **four theory courses** and **four practical courses** in every semester.
Each theory course shall have four units and each practical course shall have two units (based on the theory).
Department of Botany shall offer **one Generic elective paper** each of 50 marks for the students of other PG departments of the University. Generic Elective paper shall consist of two units having 30 lectures and will be available to PG Part-II students during Semester IV. **The decision regarding the admission to such other departmental students will be made by the Departmental Committee**
The Department offers following specializations[#] at M. Sc. II (Semester III and IV).

- Plant Physiology
- Mycology and Plant Pathology
- Cytogenetics and Plant Breeding
- Energy, Ecology and Environment
- Angiosperm Taxonomy
- Marine Botany
- Plant Biotechnology
- Palaeobotany (Presently suspended)

12. **Scheme of teaching and Examination**

Each unit in theory course shall comprise 15 lectures each of 60 minutes duration and there shall be four lectures per theory course per week. There shall be one practical (not less than three hours duration) for each theory course per week. Library/Reference-work/ Excursion/Field work/Seminar/Group Discussion/Project work shall also be organized in every week.

13. **Standards of Passing**: Passing of each theory papers and internal examination is separately. It required 32 marks for theory paper and 8 marks for internal examination and for practical exam 20 marks are necessary out of 50.

14. Nature of Question paper and scheme of marking:

Entire course of M. Sc. Botany will be of **2400** marks. The Ist and IIIrd Semester will be of 800 marks and Sem. II and IV will be 1600 marks (800 marks for theory papers and 400 marks for practical for Sem. II and 400 marks for sem. IV).

Examination of each **theory course** shall be of **100 marks** [80 (university examination) + 20 (internal examination)]. University examination of 80 marks (03 hours duration) will be conducted at the end of each Semester. Internal examination of 20 marks (comprising 20 multiple choice questions) will be conducted before the semester examination during each semester. Each practical course examination will be based on the respective theory course and will be of 20**0 marks**. Duration of university practical examination shall be of five hours.

The question paper of theory course (80 marks) will consist of seven questions, carrying 16 marks each, of which the student shall have to attempt **five** questions. The last question will be **compulsory** consisting of short answer type questions. The types of questions and their distribution will be as follows:

i) Descriptive or essay type questions (50 – 60 %)

ii) Short answer type questions (20 – 30 %)

Examination :

Theory : 1 Internal Marks: 20 per paper theory

2 External Marks: 80 per theory paper (examination at the end of semester)

Practical: A total 800 marks examination will be conducted for practical courses at the end of 2nd semester (400 marks practical examination will be conducted) and at the end of 4th semester (350 marks examination will be conducted and 50 marks for project evaluation).

Project work Evaluation: By Internal and External Examiner at the end of Fourth Semester.

15. **Equivalence according with Titles and contents of papers**

MSc II Semester III	
Old Titles	**New Equivalence Titles**
Paper IX: Cytogenetics and Crop Breeding	CCS-301: Cytogenetics and Crop breeding
Paper XI : XI) Advanced plant physiology and Plant biochemistry XI) Taxonomy of Fungi XI) Cytogenetics XI) Environment and its aspects XI) The Evolution and Classification of Angiosperms XI) General Marine Botany XI) Plant Tissue culture	CCS -302: CCS 302.1- Advanced plant physiology and Plant biochemistry CCS 302.2- Taxonomy of Fungi CCS 302.3- Cytogenetics CCS 302.4- Environment and its aspects CCS 302.5- The Evolution and Classification of Angiosperms CCS 302.6- General Marine Botany CCS 302.7- Plant Tissue culture
Paper XII: XII) Plant Growth and Development Integrated XII) Disease management XII) Plant Breeding XII) Population and Community Ecology XII) Modern trend in Angiosperm Taxonomy XII) Physiology and biochemistry of Marine Plants XII) Molecular Biotechnology and Genetic engineering	CCS-303: CCS 303.1- Plant Growth and Development CCS 303.2- Integrated Disease management CCS 303.3- Plant Breeding CCS 303.4- Population and Community Ecology CCS 303.5- Modern trend in Angiosperm Taxonomy CCS 303.6- Physiology and biochemistry of Marine Plants CCS 303.7- Molecular Biotechnology and Genetic engineering
Paper X: Biotechnology and Genetic engineering	DSE-304: Biotechnology and Genetic Engineering
	CCPR-305: Practical (CCS-301, CCS-302,CCS-303, DSE-304)
	Non CGPA AEC-306
MSc II Semester IV	
Paper XIII: Plant Physiology and Metabolism	CC-401: Plant Physiology and Metabolism

Paper XV: XV) Stress Physiology of Plants XV) Industrial Mycology XV) Molecular Genetics XV) Experimental Ecology and Energy Studies XV) Angiosperm Taxonomy Floristic and Biosystematics XV) Marine Ecology XV) Application and Prospects of Plant Tissue culture	CCS-402: CCS 402.1-Stress Physiology of Plants CCS 402.2- Industrial Mycology CCS 402.3-Molecular Genetics CCS 402.4-Experimental Ecology and Energy Studies CCS 402.5-Angiosperm Taxonomy Floristic and Biosystematics CCS 402.6-Marine Ecology CCS 402.7-Application and Prospects of Plant Tissue culture
Paper XVI: XVI) Applied Plant Physiology XVI) Integrated Disease Management XVI) Special Approaches in Genetic improvements of Crop plants. XVI) Environmental issues, assessment and Restoration XVI) Phylogeny and Floral Biology of Angiosperms XVI) Applied Marine Botany XVI) Application, Regulation and Patenting Biotechnology	CCS 403: CCS 403.1- Applied Plant Physiology CCS 403.2- Integrated Disease Management CCS 403.3- Special Approaches in Genetic improvements of Crop plants. CCS 403.4- Environmental issues, assessment and Restoration CCS 403.5- Phylogeny and Floral Biology of Angiosperms CCS 403.6-Applied Marine Botany CCS 403.7-Application, Regulation and Patenting Biotechnology
Paper XIV: Biodiversity : Conservation and Utilization	DSE 404: Biodiversity: Conservation and Utilization
	CCPR 405: Practical (401,402,403,DSE 404)
	Non CGPA- SEC:406 GE-407-Horticulture and Green House Technology

16. **Special instruction if any**: NA

17. **Table (Detailed titles of paper**).

M. Sc. II Sem III CCS-301: Cytogenetics and Crop breeding
CCS -302: CCS 302.1- Advanced plant physiology and Plant biochemistry CCS 302.2- Taxonomy of Fungi CCS 302.3- Cytogenetics CCS 302.4- Environment and its aspects CCS 302.5- The Evolution and Classification of Angiosperms CCS 302.6- General Marine Botany CCS 302.7- Plant Tissue culture
CCS-303: CCS 303.1- Plant Growth and Development

CCS 303.2- Integrated Disease management CCS 303.3- Plant Breeding CCS 303.4- Population and Community Ecology CCS 303.5- Modern trend in Angiosperm Taxonomy CCS 303.6- Physiology and biochemistry of Marine Plants CCS 303.7- Molecular Biotechnology and Genetic engineering DSE-304: Biotechnology and Genetic Engineering

M.Sc II Sem IV CCS-402: CCS 402.1-Stress Physiology of Plants CCS 402.2- Industrial Mycology CCS 402.3-Molecular Genetics CCS 402.4-Experimental Ecology and Energy Studies CCS 402.5-Angiosperm Taxonomy Floristic and Biosystematics CCS 402.6-Marine Ecology CCS 402.7-Application and Prospects of Plant Tissue culture
CCS 403: CCS 403.1- Applied Plant Physiology CCS 403.2- Integrated Disease Management CCS 403.3- Special Approaches in Genetic improvements of Crop plants. CCS 403.4- Environmental issues, assessment and Restoration CCS 403.5- Phylogeny and Floral Biology of Angiosperms CCS 403.6-Applied Marine Botany CCS 403.7-Application, Regulation and Patenting Biotechnology DSE 404: Biodiversity, Conservation and Utilization
CCPR 405: Practical (401,402,403,DSE 404)
Non CGPA- SEC:406 GE-407-Horticulture and Green House Technology

18. Recommended reading material:

C. Other features:

1. Intake capacity/Number of Students: 50

2. Library and Laboratory equipments

D General Guidelines:

M.Sc. PART -II (SEMESTER III)

(CC 301): Cytogenetics and Crop Improvement

Total Lectures: 60

UNIT I:

Cytology: Chromatin organization, Chromosome structure and packaging of DNA, Molecular organization of centromere and telomere, Nucleolus and ribosomal RNA genes, Euchromatin and heterochromatin, Karyotype analysis and evolution, Banding patterns. Chromosome tracking/ introgression using FISH and GISH, localization and mapping of genes or genomic segments

UNIT II:

Genetics of Prokaryotes and Eukaryotes: Mapping of prokaryotic and eukaryotic genome, Mobile genetic elements and their significance, Gene families. Process of crop evolution and stabilization of polyploids (cytogenetic and genetic stabilization)

Crop Genetic Resources: Centres of origin of cultivated plants, Importance of genetic conservation, Global network for genetic conservation and utilization in major crops of world, Institutes engaged in conservation and improvement of crop genetic resources, Wild relatives of crop plants, Gene banks, Gene sanctuaries

UNIT III:

Population and Evolutionary Genetics: Evolutionary theory and population genetics, Theory of allele frequencies, Changes in genetic structure of population: Natural selection, Migration, Mutation, Genetic drift. Genetic variation in natural populations. Gene flow and population structure.

UNIT IV:

Classical and modern methods of crop breeding and improvement: Genetic variability in crop plants, Methods of breeding in self and cross pollinated crops, Heterosis and hybrid development Use of cytoplasmic male sterility in hybrid breeding, Breeding methods in asexual and clonally propagated crops, clonal selection, Marker assisted breeding.

CYTOGENETICS AND CROP IMPROVEMENT PAPER IX: PRACTICAL COURSE

UNIT V (CCPR 305.1):

1. Determination of mitotic index
2-3. Karyotype analysis of *Allium cepa*
4. Isolation of plasmid from *E. coli*
5. Orcein banding
6. Field visit: National Research Institutes/NBPGR centre/Seed company

UNIT VI:

1. Meiotic studies in *Allium cepa*
2-3. Study of floral biology of crop plants
4. Genetic problems on gene mapping in higher plants
5. Centres of origin of crop plants
6. Determination of allele frequency in population

Reference Books:

Bahekar V. S. 1993. Problems in Genetics Vol. I Arati Prakashan , Aurangabad.

Chahal G. S. and Gosal S. S. 2003, Principles and Procedures of Plant Breeding biotechnological and conventional approaches. Narosa Publishers, New Delhi.

Darnel, J., Lodish, H. and Baltimore, D. 1990 Molecular cell biology. Scientific American Books.

Gardner, E. J. 1991 Principles of Genetics. John Wiley and sons, New York.

Jahier, J. 1996 Techniques of plant Cytogenetics. Oxford and IBH Publishing.

Lewin, B. 2008, Genes IX. Oxford University Press,

Mandal, A. K., Ganguli, P. K. and Banarjee, S. P. 1991 Advances in plant breeding Vol. I and II. CBS Publishers & Distributors.

Mayo, O. 1980. The theory of Plant Breeding. Clarendon Press, Oxford.

Mitra Sandhya 1994 Genetics a blueprint of life. Tata McGraw- Hill Publishing Company Ltd, New Delhi.

Roy Darbeshwar 2000, Plant breeding analysis and exploitation of variance. Narosa Publishers, New Delhi.

Russell P. J. 1998. Genetics (Fifth edition) Benjamin / Cummings Publishing Company Canada.

Sharma J. R. 1998 Statistical and Biometrical techniques in Plant Breeding New Age International Publishers, New Delhi.

Sharma, A. K. and Sharma, A. 1980. Chromosome techniques- Theory and practice. Butterworth and Co. (Publishers) Ltd., London.

Sharma, J. R. 1994 Principles and practice of plant breeding. Tata McGrow Hill Publ. Co. Ltd., New Delhi.

Singh, B. D. 2000. Plant breeding- Principles and methods. Kalyani Publishers, Ludhiana.

Snustad D. P. and Simmons M. J. 2003, Principles of Genetics, (Third edition) John Wiley and Sons Inc.

Strickberger, M. W. 1968. Genetics. The Macmillan Company, New York.

Swaminathan, M. S., Gupta, P. K. and Sinha, U. 1983. Cytogenetics of crop plants. Macmillan India Ltd., Delhi.

Swanson, C. P. 1968. Cytology and Cytogenetics. Macmillan and Co. Ltd., London.

Sybenga, J. 1975. Meiotic configurations. Springer Verlag, Berlin, Germany.

Winkler, U. Ruger W. and Wackernagel W. 1979. Bacterial, phage and molecular genetics. Narosa Publication, New Delhi.

Journals:

Indian Journal of Genetics and Plant Breeding. Journal of Genetics. Journal of Cytology and Genetics. Cytologia. Caryologia. International Journal of Food Science and Technology. Plant Breeding. Theoretical and Applied Genetics.

M. Sc. PART- II (SEMESTER III)

(CCS- 302.1): Plant Physiology

(SPECIAL PAPER I) ADVANCED PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

Total Lectures: 60

UNIT I:

Photosynthesis: A brief outline of chlorophyll biosynthesis and the pigment organization in thylakoid membrane. Regulation of PCR Cycle and C4 Pathway; RUBISCO and PEPCase; C3 -C4 intermediates. [15]

UNIT II:

Carbohydrate metabolism: Regulation of starch and sucrose biosynthesis, Synthesis and degradation of cellulose, A brief idea of pectin biosynthesis and enzymes involved in pectin degradation. [15]

UNIT III:

Respiration: Glycolysis in plants and its regulation, Regulation of Pentose Phosphate Pathway and TCA Cycle, Regulation of electron transport chain and role of alternate oxidase. [10]

Organic acid metabolism: Metabolism and roles of oxalic acid, ascorbic acid and malic acid [5]

UNIT IV:

Secondary metabolites : Shikimate Pathway and its role in biosynthesis of Secondary Metabolites. [8]

Phosphorus nutrition – Forms of phosphorus in soil. Phosphorus uptake, factors controlling 'P' uptake, 'P' fractions in plants. Role of Pyrophosphate in plant metabolism. [7]

CCSPR 305.2.1: PLANT PHYSIOLOGY PAPER XI: PRACTICAL COURSE I

UNIT V:

1. To study the effect of potassium on glycolytic enzyme pyruvate kinase .
2. Estimation of starch.
3. Study of Oxalic acid accumulation in leaf tissue.
4. Estimation of Ascorbic acid.
5. Estimation of Polyphenols.
6. Estimation of Cellulose.

UNIT VI:

1. Study of Phosphorus distribution in different plant parts.

2. Study of enzyme inorganic pyrophosphatase.
3-4. Study of effect of light on chlorophyll biosynthesis.
5. Study of enzyme polygalacturonase.

Reference Books:

Bidwell, R. C. S. (1979): Plant Physiology. Macmillan

Bonner, J. and **Varner, J.E**. (1972): Plant Biochemistry. IBH.

Edwards G. and **Walker D.,** eds. (1983). C3, C4: mechanisms, and cellular and environmental regulation, of photosynthesis. Oxford: Blackwell Scientific Publications.

Govindjee, H. (ed.) (1982): Photosynthesis, Vol. 1 and Vol. 2. Academic Press, N.Y. (Vol. 1); 0-12- 294302-2 (Vol. 2))

Hopkins, W. C. (1995): Introduction to Plant Physiology. Wiley, New York.

Krishnamurthy, H.N. (1992): Physiology of Plant Growth and Development. Atma Ram and Sons, Delhi.

Marschner, H. W. (1986): Mineral nutrition of Higher Plants. First Edition, Academic Press, Elsevier Science Ltd.

Marschner, H. W. (2003): Mineral nutrition of Higher Plants. Second Edition, Academic Press, Elsevier Science Ltd.

Moore, T.C. (1974): Research experience in Plant Physiology, A Laboratory manual. Springer-Verlag, Berlin.

Mukherjee, S.P. and **Ghosh A.N**. (1996): Plant Physiology. New Central Book Agency (P) Limited Tata McGraw Hill.

Noggle, **G.R**. and **Fritz, G. J**. (1976): Introductory Plant Physiology. Prentice- Hall, Inc., Englewood Cliffs, NJ.

Pessarakli, M. (Ed.). (2001). Handbook of Plant and Crop Physiology, 2nd Edition, Revised and Expanded. Marcel Dekker, Inc., New York

Pessarakli, M. (Ed.). (2005). Handbook of Photosynthesis, 2nd Edition, CRC Press, Taylor & Francis Publishing Company, Florida

Randhir Singh and **Sawhney S. K**. (1988): Advances in frontier Areas of Plant Biochemistry. Prentice Hall of India

Sadasivam S. and **Manickam A**. (1996): Biochemical methods. New Age International.

Salisbury, F. B. and **Ross, C.W**.(1992): Plant Physiology IV ed. Cengage Learning

Smith, H. (1975): Phytochrome and Photomorphogenesis. McGraw-Hill Inc.,US

Taiz, L. and **Zeiger, F.** (1998): The Plant Physiology. Second Edition, Sunderland: Sinauer Associates.

Wilkins, M. B. (1976): Physiology of Plant Growth and Development. McGrow-Hill Publishing Company Limited

Journals

Annual Review of Plant Physiology and Molecular Biology

Annual Review of Plant Physiology

Indian Journal of Plant Physiology

Journal of Experimental Botany

Physiologia Plantarum, Sweden
Plant Physiology, Bethedsa, USA
Plant Cell

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M. Sc. PART- II (SEMESTER III)

(CCS- 302.2): Mycology and Plant Pathology

(SPECIAL PAPER I) TAXONOMY OF FUNGI

Total Lectures: 60

UNIT I:

General features of fungi [4]

Various systems of classification of fungi: Ainsworth (1973), Webstor (1980) and Hawksworth *et al*. (1995) [4]

Micrometry: Study of micrometry and its significance in fungal taxonomy. [4]

Culture: Types of culture media and their preparation, special culture media. [3]

UNIT II:

Criteria used in the classification of fungi

Morphology: External and Internal, Vegetative and Reproductive, Cytological and Genetical. [15]

UNIT III:

Criteria used in the classification of fungi

Serological and Nutritional. [5]

Physiological and Biochemical. [5]

Host specificity. [2]

Ultrastructural and cultural. [3]

UNIT IV:

Microtomy: Types of microtomes, Techniques of microtomy, stains and fixatives used. [11]

Status of fungi and research in Mycology and Plant Pathology in India: An overview. [4]

CCSPR 305.2.2: MYCOLOGY PAPER XI: PRACTICAL COURSE I

UNIT V:

1. Measurement of fungal dimensions and identification of fungal genera.

2- 4. Measurement of spore size and study of spore morphotypes, determination of standard deviation and frequency distribution, histogram and polygon.

5-6. Preparation of culture media, PDA, Czapek Dox Agar and Richard's medium.

UNIT VI:

1-2. Microtomy of fungal specimens.

3. Isolation of fungi from soil and their identification and classification

4. Isolation of fungi from water and their identification and classification.

5. Isolation of fungi from air and their identification and classification.

6. Isolation of fungi from their host and their identification and classification.

Reference Books:

Ainsworth, **G.E., Sparrow, F. K. and A. S. Sussman.** 1973. The Fungi.Vol. I, II and III. Academic Press, New York.

Alexopoulous, **C.J., C.W. Mims and M. Blackwell.** 1979. Introductory Mycology. A national book foundation, USA

Aneja K.R. 1993 : Experiments in Microbiology,Plant Pathology and Tissue New Age international.

Barnett, H.L. (1960): Illustrated genera of imperfect fungi. American Phytopathological Society, U.S.A.

Bessey, **E.A.** (1967): Morphology and Taxonomy of fungi Blakiston Company, U.S.A.

Buller,**A.H.R**.(1909-50):Researches on Fungi Vol.I-VIII. Longmans Green & Company, London, U. K.

Gangopadhyay, S. (1994): Clinical Plant Pathology. Kalyani Publishers, Daryaganj, New Delhi.

Gangulee, **H. S.** and **A. K. Kar** (1992): College Botany Vol. II. IV-A and IV-B. New Central Book Agency (P) Ltd., Kolkata. W. B.

Johanson, **D.A**. (1940): Plant Microtechniques. McGraw-Hill Publishing Company Ltd., New York. U. S. A.

Kendrick,**W.B**. (1979): Taxonomy of fungi imperfecti. Uni. Of Toronto Press, Canada

Pandey,**B.P**.(1994): A Text Book of Botany: Fungi. International Publishing House, New Delhi.

Rangaswamy G. (1975): Diseases of crop plants in India. PHI Learning Pvt. Ltd., M97 Cannaught Circle, New Delhi.

Raychudhary , **S. R.** ***et al.*****(**1975): Advances in Mycology and Plant Pathology.

Sharma,**O. P.** (1989): Text Book of Fungi. Tata McGraw-Hill Education, 1989

Journals

Annual Review of Plant Pathology.

Canadian Journal of Botany.

Mycologia.

Indian Journal of Plant Pathology.

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M.Sc. PART- II (SEMESTER III)

(CCS- 302.3): Cytogenetics and Plant Breeding

(SPECIAL PAPER- I) CYTOGENETICS

Total Lectures – 60

UNIT I:

Introduction to cytogenetics. Mitotic and meiotic cell division

Meiosis: modes of meiosis, Chromosome disjunction. Genetic control of meiosis, mechanism and theories of crossing over, Recombination models, Synaptonemal complex

UNIT II:

Structural variations in chromosomes, their cytological consequences, Structural hybrids, B chromosome its origin and consequences . Evolutionary significance of chromosomal aberration, balanced lethal and chromosome complexes.

Numerical variation in chromosomes, sources and consequences including syndromes, classification, natural and induced polyploids Utilization of aneuploids in gene location/mapping and gene transfer. Role of polyploids in crop breeding. Evolutionary advantages of autopolyploids Vs allopolyploids

UNIT III:

Genome analysis in crop plants: Triticales , Wheat, Cotton, Tobacco.

Meiotic analysis in hybrids

Alien genetic resources in crop improvement: Alien addition and substitution lines, hybrids between species with same chromosome number, alien translocation, hybrids between species with different chromosome number, gene transfer using amphidiploids, bridge species

UNIT IV:

Apomixis; types of apomixes in higher plants, evolutionary significance in plant breeding and genetic disadvantages

Chromosome hybridization case studies: production and use of haploids, dihaploids and double haploids in genetics and breeding.

Drosophila genetics: Life cycle, special type of chromosome, genetic regulation of development in *Drosophila*

CYTOGENETICS AND PLANT BREEDING PAPER XI: PRACTICAL COURSE I

UNIT V (CCPR 305.2.3):

1-2. Smear preparations in *Sorghum bicolor, Zea mays*, *Delphinium malbaricum*, *Lycopersicum esculentum*, *Coix lachryma-jobi*, *Solanum sp.*

3. Meiotic analysis in plants (Stages, chiasma, chiasma terminalization by using photographs, Pachytene analysis).
4. Meiotic studies in structural hybrids (*Setcreatia* sp *Cyanotis* sp)
5. Study of B chromosome in *Maize/Drimia*
6. Cytological analysis of polyploidy in plants.

UNIT VI:

1. Study of life cycle in *Drosophila melanogaster*
2. Special type of chromosomes in *Drosophila melanogaster*
3. Study of bacterial conjugation

4. Study of bacterial transduction
5. Study of transformation in *E. coli*
6. Induction of mutation and study of mutants in *E. coli*
7. GUS expression in plants

Reference Books:

Khush G. S. 1973. Cytogenetics of aneuploides. Academic Press New York USA.

Burnham C. R. 1962. Discussions in Cytogenetics. Burgess Publishing Co. Minnesota.

Harti D. L. and Jones E. W. 1998. Genetics: Principles and Analysis 4th Edition. Jones and Barew Publishers Massachusetts USA.

Karp G. 1999. Cell and Molecular Biology : Concepts and Experiments, John Wiley and Sons Inc USA.

Fikui K. and Nakayama S. 1996. Plant chromosomes; Laboratory Methods CRC Press Boca Ration Florida.

Gupta P. K. 1999. Cytogenetics. Rastogi Publication Meerut.

Prasad G. 1998. Introduction to Cytogenetics. Kalyani Publishers, New Delhi.

Sinha U. and Sinha S. 1998. Cytogenetics, Plant Breeding and Evolution. Vikas Publishing house Pvt. Ltd. New Delhi

Swaminathan M. S., Gupta P. K. and Sinha U. 1974. Cytogenetics of Crop Plants MacMillan India Ltd. New Delhi.

Swanson C. P., Merz T. and Young J. 1973. Cytogenetics. Prentice Hill of India Private Ltd. New Delhi.

M. Sc. PART- II (SEMESTER III)

(CCS- 302.4): Energy, Ecology and Environment

(SPECIAL PAPER I) ENVIRONMENT AND ITS ASPECTS

Total Lectures: 60

UNIT I:

Abiotic Environment: Leibig's Law of Minimum, Law of Limiting Factors. [5]
Environment in Terrestrial Ecosystems: Classification of Biotic and Abiotic [5]
Atmosphere Climate: Classification of climate, Climograph [5]

UNIT II:

Soil Process: origin and formation of soil, Weathering process (Physical and chemical weathering Soil composition, Soil texture, Soil complex) [6]
Soils: Soil profile, Formation of humus,[5]
Soil erosion, Causes**,** Soil conservation methods, Soil types of India,. [4]

UNIT III:

Land use classification, integrated land use planning and water shade management, Waste land development, concept of soil map. [7]
Water: Resources and Management. Surface and subsurface of water, Demand of Water (Agriculture, Domestic and Industrial), Hotspots of surface water, Role of state/ central commission in water resource management. [8]

UNIT IV

Environment in aquatic ecosystem:
Marine Environment: Light, Waves, Currents, Winds, Tides, Zonation in the sea [09]
Fresh water environment: Wind, Current, Temperature [06]

CCPR 305.2.4: ECOLOGY PAPER XI: PRACTICAL COURSE I

UNIT V:

1 Analysis of water samples from polluted and non polluted lakes for DO.
2. Determination of BOD at R.T.
3-4. Study of wilting coefficient.
5. Study of effect of effluents on plant growth.
6. Field visits to Industrial area

UNIT VI:

1. Determination of quality of water by physical parameters (colour, EC, pH, TSS, TDS and TS).
    1. Study of MPN as hydrobiological indicator.

3-4. Study of soil profile.
5. Determination of organic matter from soil.
6. Ecological instruments used in air and water pollution studies.

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Reference Books:

Agarwal, S. K. (1992): Fundamentals of Ecology. New Delhi: Ashish Publishing House.

Bradbury, I. K. (1990): The Biosphere. Published by John Wiley & Sons, Chichester.

Das, S. M. (1989): Handbook of Limnology and water pollution with practical Methodology. Published by South Asian Publishers, New Delhi.

Etherington, J. R. (1975): Environment and plant ecology : aims and development. Publisher Wiley.

Freedman, H. I. (1980): Deterministic mathematical models in population ecology. Marcel Dekker Inc., New York.

Greig Smith, P. (1983): Quantitative Plant Ecology. *Publisher*: WILEYBLACKWELL

Grims, J. P. *et al* (1988) : Comparative Plant Ecology. Colvend, Dalbeattie, Kirkcudrightshire [Scotland] : Castlepoint Press.

Hashimoto, Y. *et al* (1990) : Measurement techniques in plant sciences. San Diego, Calif. : Academic Press

Kershaw, K. A. (1964) : Quantitative and dynamic ecology. Publisher: Edward Arnold

Kormondy, E. J. (1996) : Concept of ecology. Publisher: Benjamin Cummings.

Krebs, C. J. (1978) : Ecology. Harper & Row., New York.

Lieth, H. F. ***et al*** (1973) : Patterns of primary production in the biosphere. Kluwer Academic Publishers-Plenum Publishers.

Misra, K. C. (1989) : Manual of plant ecology. Oxford and IBH Publishing Co., New Delhi.

Misra, R. and **Das, R. R**. (1971) : Proceedings of the school of plant ecology. Publisher: Calcutta Oxford & IBH Pub. Co.

Odum, E. P. (1971) : Ecology. Publisher: Saunders

Odum E. P. (3rd ed. 1996) : Fundamentals of Ecology. Natraj Publishers, Dehra Dun.

Pandeya S. C. *et al* (1963) : Research methods in plant ecology. Asia Publishing House.

Watt K. E. F. (1973) : Principles of Environment Sciences. Published by McGraw-Hill.

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M. Sc. PART- II (SEMESTER III)

(CCS- 302.5): Angiosperm Taxonomy

(SPECIAL PAPER-I) THE EVOLUTION AND CLASSIFICATION OF ANGIOSPERMS

Total Lectures: 60

UNIT I:

Principles and Practices in Plant Taxonomy: Definitions and concepts, importance of taxonomy and need for classification, hierarchical classification, Alpha and Omega taxonomy, taxonomy as synthetic discipline. [5]

The New Global Taxonomy Initiatives: Systematic agenda - 2000, systematic knowledge and value of biodiversity, the missions of systematic agenda-2000. Biodiversity strategy and systematics Agenda for 2020. [3]

A Brief History of Pre-Darwinian Classifications:

Systems based on habit: Theophrastus, Albert Magnus, Otto Brunfels, Jerome Bock, Andrea Cesalpino, Jean Bauhin, Joseph Pitton de Turnefort, John Ray [3]

The sexual system: Carolus Linnaeus and his students [2]

Systems based on form-relationships: Michel Adanson, Jean B. A. P. M. de Lamarck, De Jussieu, De Candolle, Bentham and Hooker. [2]

UNIT II:

A Brief History of Post Darwinian Classifications: The evolutionary theory by Darwin and Wallace. Systems based on phylogeny:

i) The Englarian School of thoughts: August Wilhelm Eichler, Adoph Engler, Alfred Rendle, Carl Christian Mez, August A. Pulle, Carl Skottberg, B. Hayata [4]

ii) The Ranalian School of thoughts: Richard von Wettstein, Charles E. Bessey, Hans Hallier, John Hutchinson, Oswald Tippo, G. Gunderson, Lyman Benson. [3]

Recent Systems of Classifications: Broad outline of classification by Armen L. Takhtajan and R. M. T. Dahlgren [3]

APG IV: Basal angiosperms, Magnoliids, Monocots, Commelinids, Eudicots, Core Eudicots, Rosids, Fabids, Malvids, Asterids, Lamiids and Campanulids. [5]

UNIT III:

Evolution of Flowering Plants: Angiosperm apomorphies- Flower, Stamens, Reduced male gametophyte, Carpel, Two integuments, Reduced female gametophyte, Endosperm formation, Sieve tube members, Angiosperm specializations, Vessels. Origin of angiosperms. [6]

Taxonomic Hierarchy: Ranks of Taxa, Forms of scientific names; major categories: division, class, order, family; minor categories: genus, species and intraspecific categories. [3]

Plant Morphology: Plant structure - Roots, Stems, Leaves, Flowers, Perianth, Androecium, Nectaries, Gynoecium, Carpel, Pistil, Inflorescences, Fruits and seeds. [6]

UNIT IV:

Morphological variations, systematic position, interrelationships, phylogeny and economic importance of following families:

ANITA GRADE, Hydatellaceae, Austrobaileyaceae [2]

MAGNOLIIDS: Lauraceae, Piperaceae, Aristolochiaceae [4]

MONOCOTS:Alismataceae,Hydrocharitaceae,Potamogetonaceae,Aponogetonaceae. [4]

COMMELINIDS: Commelinaceae, Typhaceae, Eriocaulaceae, Zingiberaceae, Costaceae, Musaceae. [5]

CCPR 305.2.5: PAPER XI: ANGIOSPERM TAXONOMY: PRACTICAL COURSE I

UNIT V:

1. Exercises on nomenclature problems.
2. Describing new taxon.

3-4. Study of flowers of primitive families: Magnoliaceae, Lauraceae, Aristolochiaceae, Piperaceae, Ranunculaceae, Alismataceae, Nymphaeaceae.

5. Identification of wild and cultivated plant species using regional and national floras.

6. Study of different types of ovules and placentations.

UNIT VI:

7-12. Descriptions, Sketching, classification and identification of families: ANITA GRADE- Hydatellaceae, Austrobaileyaceae; MAGNOLIIDS- Lauraceae, Piperaceae, Aristolochiaceae; MONOCOTS- Alismataceae, Hydrocharitaceae, Potamogetonaceae, Aponogetonaceae; COMMELINIDS- Commelinaceae, Typhaceae, Eriocaulaceae, Zingiberaceae, Costaceae, Musaceae.

Any additional practical/s based on theory syllabus will be added whenever necessary.

Reference Books:

Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.

Cronquist, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.). Allen Press, U.S.A.

Davis, P. H. and **V. H. Heywood** 1991. Principles of Angiosperm Taxonomy. Today and Tommorow Publications, New Delhi.

Manilal, K. S. and **M. S. Muktesh Kumar** [eds.] 1998. A Handbook of Taxonomic Training. DST, New Delhi.

Naik, V. N. 1984. Taxonomy of Angiosperms. Tata McGraw-Hill, New Delhi.

Quicke, Donald L. J. 1993. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London.

Taylor, D. V. and **L. J. Hickey** 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.

Lawrence, G. H. M. 1951. Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi.

Takhtajan, A. 1969. Flowering plants-Origin and Dispersal. Oliver and Boyd, Edinburg.

Hutchinson, J. 1959. Families of Flowering plants. Clarendon Press, Oxford.

Judd Walter S., Campbell, C. S., Kellogg, E. A., Stevens, P.F. and **M. J. Donoghue**. 2008. Plant Systematics- A Phylogenetic Approach. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.

Simpson, M. G. 2010. Plant Systematics. Elsevier, Amsterdam.

M. Sc. PART- II (SEMESTER III)

(CCS- 302.6): MARINE BOTANY

(SPECIAL PAPER I) GENERAL MARINE BOTANY

Total Lectures: 60

UNIT I:

Marine environment and organisms: Benthic & Pelagic environment, Classification of marine organisms-Plankton, Nekton, Benthos, Marine Plant Groups [3]

Marine phytoplankton: Classification & diversity, Buoyancy, Red tides [3]

Microbial diversity in marine habitat: Brief idea of Marine Fungi, Actinomycetes, Marine Bacteria , Viruses & Marine Lichens [5]

Coral reefs: Types, Biology, Zooxanthellae, Reef algae & herbivores, Importance. [4]

UNIT II:

Microalgae: Classification & Salient features of Cyanophyta, Pyrrhophyta ,Chrysophyta , Cryptophyta , Examples from each division. [6]

Macroalgae: Classification of Seaweeds, General characteristics, life cycle & type studies of Chlorophyta (*Ulva*, *Enteromorpha*), Phaeophyta (*Sargassum*, *Padina*) & Rhodophyta (*Gracilaria*, *Porphyra*), Evolution of thallus in different classes. [9]

UNIT III:

Biodiversity of mangroves: Definition of the term 'mangrove', biodiversity, brief idea of Creek, Estuary, Lagoon and Delta. Distribution & biogeography of Indian mangroves, East and west coast mangroves, Mangrove forest types. [6]

Salient Features of Important Mangrove Families: Rhizophoraceae , Sonneratiaceae, Avicenniaceae, Myrsinaceae, Acanthaceae . Mangrove associates. [9]

UNIT IV:

Salt marshes: Salt marsh flowering plants-Occurrence, Taxonomy, Distribution, Morphological and anatomical adaptations, Ecological roles, Salt marsh ferns, bryophytes, algae. [5]

Sea grasses: Taxonomy, Distribution, Morphological & anatomical adaptations, Ecological roles, Sea grasses & Human affairs. [5]

Sand dunes: Occurrence, Formation of coastal sand dunes .Classification, Embryo dune, Yellow dune, Grey dune, Succession in dune vegetation, Dune vegetation. [5]

CCPR 305.2.6: MARINE BOTANY PAPER XI: PRACTICAL COURSE I

UNIT V:

1. Study of characteristic features of Chlorophyta Ex. *Enteromorpha, Chaetomorpha, Ulva, Caulerpa*.
2-3. Study of characteristic features of Phaeophyta Ex. *Padina, Dictyota, Sargassum.*
4. Study of characteristic features of Rhodophyta Ex. *Gracilaria, Gelidium , Hypnea.*
5. Sampling and identification of marine phytoplankton.
6. Study of sand dune plants (*Canavalia*, *Derris*, *Pandanus, Spinifex, Ipomoea* etc.).

UNIT VI:

1. Type study of mangroves from Avicenniaceae (*Avicennia* species)

2-3. Type study of mangroves from Rhizophoraceae (*Rhizophora, Bruguiera, Ceriops, Kandelia*)

4. Type study of mangroves from Sonneratiaceae (*Sonneratia*)

5. Type study of mangroves from Myrsinaceae (*Aegiceras)* and Acanthaceae (*Acanthus)*

6. Study of important mangrove associates.

Reference Books:

Alexopoulos, **C.J**. & **Bold, H.C**. (1967). Algae & Fungi: Current Concepts in Biology Series. The Macmillan Company, London.

Chapman, V. J. (1976). Coastal Vegetation. II nd edition Pergamon Press. New York

Chaudhuri. A. B. (2007). Biodiversity of Mangroves.

Desikachary, **T. V**. (1975). Marine Plants. N. C. E. R. T. New Delhi.

Kamat, N. D. (1982). Topics in Algae. Sai Kripa Prakashan, Aurangabad

Kumar H. D. 1990. Introduction to Phycology. Affiliated East West Press pvt. Ltd. publ. New Delhi.

Kumar H.D. and **H.N. Singh** (1990). Algae. Affiliated East West Press pvt. Ltd. publ. New Delhi.

McConnaughey, **B. H** (1974). Introduction to Marine Biology. 2nd ed. Mosby publisher.

Naskar Kumudranjan (2004.) Manual of Indian Mangroves. Daya Publishing House, New Delhi.

S**ambamurthy**,**A.V.S.S**.(2005). A Text Book of Algae. I. K. International Pvt. Ltd. New Delhi.

Santhanam, R.; Ramnathan,N.; Venkataramanjan K. & Jegathanam,G. (1987) . Phytoplankton of Indian Seas. & Aspects of Marine Botany.Daya Publication Home. Delhi.

Sen Neera and **Kumudranjan Naskar**, (2003). Algal Flora of Sundarbans. Mangal Daya

Stein, J. R. (1973) Handbook of Phycological Methods. Cambridge University Press.

Trainor, **F. R**. 1978. Introductory Phycology. John Wiley, New York.

Vashishta, **B. R**. (1995). Algae. S. Chand and Co. Ltd., New Delhi.

M. Sc. PART-II (SEMESTER III)

(CCS- 302.7): Plant Biotechnology

(SPECIAL PAPER I) PLANT TISSUE CULTURE

Total Lectures: 60

UNIT I:

Plant tissue culture: Objective and goals of Plant tissue culture; Laboratory design and development, operation and management [3]

Plant tissue Nutrition: Basic principles of *in vitro* culture, Factors influencing morphogenesis and Physiological significance of tissue nutrition [7]

Media preparation: Media preparation and handling, Sterilization technique, Equipment and apparatus, Procedure of media preparation and stock solution [5]

UNIT II:

Types of Cultures: Explant culture, Callus formation and culture, Callus desiccation, Organogenesis, Meristem culture, Axillary bud culture, Protocols and schedule of observation. [9]

Organ culture: anther, ovary culture, embryo rescue [4]

Hardening of tissue cultured plants [2]

UNIT III:

Cell suspension culture: Batch culture, continuous culture (Open, Closed), semi culture, Growth measurements, Synchronization of suspension culture cells, Application. [6]

Cell line isolation [4]

Somaclonal variation: Nomenclature; schemes for obtaining somaclonal variations- without invitro selection and with invitro selection; factors influencing somaclonal variation, ; Applications; Basis of somaclonal variations, Limitations; Gametoclonal variations. [6]

UNIT IV:

Protoplast isolation, culture and somatic hybridization [6]

Cell immobilization and synseed production [3]

Cryopreservation: Introduction, principle, procedure, importance and future prospects [6]

CCPR 305.2.7: PLANT BIOTECHNOLOGY PAPER XI: PRACTICAL COURSE I

UNIT V:

1. Media preparation and Sterilization techniques
2. Callus culture
3. Meristem culture

4-6. Organogenesis

UNIT VI:

1. Technique of hardening
2. Anther culture
3. Cell suspension culture
4. Embryo rescuing

5-6. Visit to commercial greenhouse/ Tissue culture laboratory

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Reference Books:

Bhojwani, **S. S**. and **Razdan, M. K**. 1983. Plant tissue culture, theory and practice. Elsevier Publ.

Dixon, **R. A.** 1985. Plant cell culture- a practical approach. Oril Press Oxford.

Doddas, J. H. and **Roverts, L.W**.1985. Experiments in plant tissue culture. Cambridge Uni. press.

Evans *et al.* 1983. Hand book of plant cell culture vol. I, II, III. McMillan Publ. Co., New York.

Gamborg, **O. L**. and **Phillips, G. C.**1966. Plant, tissue and organ culture- fundamental Methods. Narosa Publishing House, New Delhi.

Narayanswamy, S. 1997. Plant cell and tissue culture. Tata McGraw Hill Publishers, New Delhi.

Nelson, **P. V**.1973.Greenhouse operation and management. Reston Publishing Co. Inc.

Old, R. W. and **Primerose, S. B**. 2002. Principles of gene manipulation. Blackwell, Oxford, England.

Raghavan, **V**. 1997. Molecular embryology of flower plants. Cambridge Uni. Press.

Ravishankar, **G. A**. and Venkataraman, L. V. 1997. Biotechnological applications of plant tissue and cell culture. Oxford and IHB Publishing Co. Pvt. Ltd., New Delhi.

Reddy, S. M., Srivastava, H. P., Purohit, D. K. and Reddy, S. R. 1997. Microbial biotechnology. Scientific Publishers, Jodhpur, India.

Reinsert, J. and Bajaj, Y. P. S. 1976. Plant cell, tissue and organ culture. Springer Verlag, Berlin.

Street, **H. E.** 1974. Tissue culture. Academic Press, New York.

Thorpe, **T. A.** 1981. Plant tissue culture. Academic Press, New York

Vasil, I. K. 1984. Cell culture and somatic cell genetics of plants (I). Laboratory procedures and their applications. Academic Press Inc.

M. Sc. PART-II (SEMESTER III)

(CCS- 303.1): Plant Physiology

(SPECIAL PAPER II) PLANT GROWTH AND DEVELOPMENT

Total Lectures: 60

UNIT I:

Growth and morphogenesis: Photomorphogenesis; History and discovery of phytochromes and cryptochromes and their photochemical and biochemical properties. phytochrome biosynthesis, cellular localization, roles, mechanism of action of photo morphogenetic receptors. [15]

UNIT II:

Pollen germination: Physiology of pollen germination and pollen-pistil interaction. [5]

Senescence and PCD: Biochemical changes during senescence of leaves and petals. Regulation of senescence, Programmed Cell Death. [6]

Seed Development: Biochemical changes during seed development. [4]

UNIT III:

Post harvest physiology: Ripening of fruit and its regulation. Metabolism of leafy vegetables during storage. [9]
Role of biotechnology and mutants in physiological studies. [6]

UNIT IV:

Plant growth regulators: Discovery, role and possible mechanism of action of Triacontanol, Brassins, Salicylic acid, Jasmonates and Polyamines. Role of plant growth retardants- CCC, Maleic hydrazide,Trizoles and TIBA. [15]

CCPR 305.3.1: PLANT PHYSIOLOGY PAPER XII: PRACTICAL COURSE II

UNIT V:

1-2. Hormonal regulation of leaf and petal senescence.
3-4. Study of changes in RNA and Proteins during senescence.
5. Study of changes in starch content during seed development.
6. Study of changes in protein content during seed development.

UNIT VI:

1. Study of enzyme pectinase/pectin methyl esterase during ripening of fruit.
2. Study of changes in respiration rate during ripening of fruits.
3. Study of lipid accumulation during development of oil seeds.
4. Effect of chemical compounds on pollen germination.
5-6. Study of effect of different PGRs on seedling growth and vigour.

Reference Books:

Bidwell, R. C. S. (1979): Plant Physiology. Macmillan

Bonner, J. and **Varner, J.E**. (1972): Plant Biochemistry. IBH.

Edwards G. and **Walker D.,** eds. (1983). C3, C4: mechanisms, and cellular and environmental regulation, of photosynthesis. Oxford: Blackwell Scientific Publications.

Govindjee, H. (ed.) (1982): Photosynthesis, Vol. 1 and Vol. 2. Academic Press, N.Y. (Vol. 1); 0-12- 294302-2 (Vol. 2))

Hopkins, W. C. (1995): Introduction to Plant Physiology. Wiley, New York.

Krishnamurthy, H.N. (1992): Physiology of Plant Growth and Development. Atma Ram and Sons, Delhi.

Marschner, H. W. (1986): Mineral nutrition of Higher Plants. First Edition, Academic Press, Elsevier Science Ltd.

Marschner, H. W. (2003): Mineral nutrition of Higher Plants. Second Edition, Academic Press, Elsevier Science Ltd.

Moore, T.C. (1974): Research experience in Plant Physiology, A Laboratory manual. Springer-Verlag, Berlin.

Mukherjee, S.P. and **Ghosh A.N**. (1996): Plant Physiology. New Central Book Agency (P) Limited Tata McGraw Hill.

Noggle, **G.R**. and **Fritz, G. J**. (1976): Introductory Plant Physiology. Prentice- Hall, Inc., Englewood Cliffs, NJ.

Pessarakli, M. (Ed.). (2001). Handbook of Plant and Crop Physiology, 2nd Edition, Revised and Expanded. Marcel Dekker, Inc., New York

Pessarakli, M. (Ed.). (2005). Handbook of Photosynthesis, 2nd Edition, CRC Press, Taylor & Francis Publishing Company, Florida

Randhir Singh and Sawhney S. K. (1988): Advances in frontier Areas of Plant Biochemistry. Prentice Hall of India

Sadasivam S. and Manickam A. (1996): Biochemical methods. New Age International.

Salisbury, F. B. and **Ross, C.W**.(1992): Plant Physiology IV ed. Cengage Learning

Smith, H. (1975): Phytochrome and Photomorphogenesis. McGraw-Hill Inc.,US

Taiz, L. and **Zeiger, F.** (1998): The Plant Physiology. Second Edition, Sunderland: Sinauer Associates.

Wilkins, M. B. (1976): Physiology of Plant Growth and Development. McGrow-Hill Publishing Company Limited

Journals

Annual Review of Plant Physiology and Molecular Biology
Annual Review of Plant Physiology
Indian Journal of Plant Physiology
Journal of Experimental Botany
Physiologia Plantarum, Sweden
Plant Physiology, Bethedsa, USA
Plant Cell

M. Sc. PART-II (SEMESTER III)

(CCS- 303.2) MYCOLOGY AND PLANT PATHOLOGY (SPECIAL PAPER II) INTEGRATED DISEASE MANAGEMENT

Total Lectures: 60

UNIT I:

Principles of plant pathology: History, Classification of crop diseases. Deficiency of micronutrients. [5]

Seed pathology: Methods of detection of internal and external seed borne Fungi, Bacteria and Viruses, biodeterioration and mycotoxins. [10]

UNIT II:

Role of enzymes and toxins in disease development. Cell wall degrading enzymes: Cellulolytic, Pectolytic, Proteolytic and Lipolytic. Toxins: lycomarsmine, alternic acid, Fusaric acid, Piricularin, Victorin and aflatoxins. [15]

UNIT III:

Physiology and Biochemistry of host pathogen interaction: Respiration, Photosynthesis, Proteins, Nucleic acids, phenols- phytoalexins and plant growth regulators. [15]

UNIT IV:

Genetics of host pathogen interaction, gene for gene hypothesis, protein for protein hypothesis, antigen and antibody reaction. Immunoglobulins, application of immunological techniques, physiological specializations. [15]

CCPR 305.3.2: MYCOLOGY AND PLANT PATHOLOGY PAPER XII: PRACTICAL COURSE II

UNIT V:

1-3. Estimation of fungal enzyme (Cellulases, Amylases and Pectinases).

4. Estimation of nucleic acids from healthy and infected plants.

5. Use of biocontrol agents (*Trichoderma* spp.) against plant pathogens.

6. Extraction and detection of aflatoxins from infected seeds.

UNIT VI:

1. Estimation of protein from healthy and infected plants.

2-3. Study of external and internal seed mycoflora.

4. Immunological techniques-purification and fragmentation of immunoglobulins.

5-6. Symptomology and histo-pathology of diseases mentioned in the theory.

Reference Books:

Agrios, G. N. (2006). Plant Pathology (5th Edition). Academy Press, London.

Aneja, K. R. (1993). Experiments in Microbiology, Plant Pathology and Tissue Culture. New Age international.

Cooke, A. A. (1981). Diseases of Tropical and Subtropical Field, fiber and Oilplants.

Gangopadhyay, S. (1994). Clinical Plant Pathology. Kalyani Publishers, Daryaganj, New Delhi.

Gangulee, H. S. and Kar, A. K. (1992). College Botany Vol. II. New Central Book Agency (P) Ltd., Kolkata. W. B.

Jha, D. K. (1993). Atext book on Seed Pathology. Vikas Publishing House Pvt. Ltd., 576 Masjid Road, jangpura, New Delhi-110014.

Kuljit, J. (1969). The Biology of parasitic flowering plants. Uni. Of California Press, U. S. A.

Mahadevan, A. and Shridhar, R. (1982). Methods in Physiological Plant. PHI Learning Pvt. Ltd., M97 Cannaught Circle, New Delhi.

Mehrotra, R. S. (1980). Plant Pathology. Tata McGraw-Hill Publishing Company Ltd., New Delhi.

Nair, L. N. (2007). Topics in Mycology and Plant Pathology. New Central Book Agency (P) Ltd., Kolkata. W. B.

Neergard, P. (1977). Seed Pathology. Vol. I & II, Macmillan Press, London.

Nyvall, R. F. (1979). Field Crop Diseases Handbook.

Padoley, S. K. and Mistry, P. B. A manual of plant Pathology.

Paul Khurana, S. M. (1998). Pathological problems of Economic Crop Plants and their Management.

Plank, J. E. Vander(1968). Plant Diseases, Epidemics and Control. Academy Press, London.

Plank, J. E. Vander(1968). Disease Resistance in Plants. A. P. London and New York.

Rangaswamy, G. (1975): Diseases of crop plants in India. Diseases of crop Plants in India. PHI Learning Pvt. Ltd., M97 Cannaught Circle, New Delhi.

Singh, **R. S**. (1963): Plant Diseases. Oxford and IBH Publishing

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M. Sc. PART- II (SEMESTER III)

Paper-XII (CCS- 303.3): Cytogenetics and Plant Breeding

(SPECIAL PAPER II) PLANT BREEDING

Total Lectures: 60

UNIT I:

Objectives of Plant Breeding, Domestication, Selection under domestication; Introduction, Quarantine; and Acclimatization of plants, Germplasm: Gene pool concept, Genetic erosion, Exploration and collection of germplasm, conservation and utilization, Mechanism of pollination control: self incompatibility and male sterility, Concept of plant ideotype and its role in crop improvement.

UNIT II:

Inheritance of qualitative and quantitative characters, Biometrical techniques in plant breeding: Introduction, Assessment of variability, Components of variance, Genetic diversity, QTL and linkage maps. Heritability, estimation of variance components additive and dominance variances, combining ability GSC, SCA effects.

UNIT III:

Aids to Selection: Correlation coefficient analysis, Path analysis and Discriminant functions. Choice of parents and breeding procedures: Diallele, Partial diallele, Triallele, Line tester, Generation mean analysis, Biparental cross analysis with various designs and Varietal adaptation Cultivar development: testing, release and notification maintenance. Plant breeders' right and regulations for plant variety protection and farmers right, DUS testing

UNIT IV:

Breeding for biotic and abiotic stresses: Disease and Insect resistance; Drought, Salinity, Heat and

cold resistance. Mutation breeding
Variety development and seed production

CYTOGENETICS AND PLANT BREEDING PAPER XII: PRACTICAL COURSE II (CCPR 305.3.3)

UNIT V

1. Germplasm collection, cataloguing, data storage and retrieval
2. To study crossability between cultivars
3. Study of pollen germination and demonstration of incompatibility.
4. Study of cytoplasm male sterility
5. Designing field experiments
6. Floral biology of self pollinated and cross pollinated species
7. Genome analysis in wheat/*Gossypium*.

UNIT VI

1. Metroglif analysis
2. D^2 analysis
3. Estimation of heritability
4. Screening of germplasm for biotic and Abiotic stresses
5. To study the effect of mutagen on germination, seedling growth and on mitosis
6. Field and lab visits of self and cross pollinated plants
7. Induction of polyploidy using Colchicine.

Reference Books:

Singh, B. D. 2000. Plant breeding- Principles and methods. Kalyani Publishers, Ludhiana.

Sharma, J. R. 1994. Principles and practice of plant breeding. Tata McGrow Hill Publ. Co. Ltd., New Delhi.

Siddiqui B. A. and Khna S. 1999. Breeding in crop plants. Mutation and In vitro mutation breeding . Kalyani Publishers New Delhi

IAEA 1995. Induced mutations and Molecular techniques for crop improvement. Proc FAO/IAEA Symposium Vienna

IAEA 1991. Plant Mutation Breeding crop improvement Proc. FAO/IAEA Symposium (Vol 1&2)Vienna

Micke A. 1991. Induced Mutation for crop improvement. Gamma Field Symposia No.30 Institute of Radiation Breeding Pullman USA.

Allard R. W. 1960. Principles of Plant Breeding John Wiley and Sons, New York.

Hays H. K., Immer F.R. and Smith D.C. 1955. Methods of Plant Breeding. McGraw Hill Book Company Inc New York.

Fehr W. R. 1987. Principles of Cultivar Development (2 Volumes) MacMillan Publishing Co. New York.

Poehlman J.M. 1986. Breeding Field Crops AVI Publishing Company Connecticut. NEW YORK

Sharma J. R. 1998. Statistical and Biometrical techniques in Plant Breeding New Age International Publishers New Delhi.

Singh R. K. and Singh B. D. 1997. Biometrical Methods in Quantitative genetic Analysis. Kalyani Publishers, New Delhi.

Vijendra Das L. D. 2000. Problems Facing Plant Breding CBS Publishers New Delhi

Rosielle A. A. and Hamblin J. 1981 Theoretical aspects of selection for yield in stress and non-stress environments Crop Sci, 21: 932-946.

Levitt J. 1980. Response of Plants to Environmental Stress: Water, Salt and Other stresses. Academic Press, New York.

Bulm A. 1988. Plant Breeding for stress Environments. CRC Press Florida.

Chopra V. L. 1989. Plant Breeding .oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Roy Darbeshwar 2000, Plant breeding analysis and exploitation of variance. Narosa Publishers New Delhi.

Journals:

Indian Journal of Genetics and Plant Breeding.
Journal of Genetics
Caryologia
Journal of Cytology and Genetics
International Journal of Food Science and Technology
Cytologia
International Journal of Plant Breeding

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M.Sc. PART- II (SEMESTER III)

(CCS- 303.4): Energy, Ecology and Environment

(SPECIAL PAPER II) POPULATION AND COMMUNITY ECOLOGY

Total Lectures: 60

UNIT I:

Population Ecology: Population regulation, Density dependent and Independent regulation: Role of different factors,[6]

Genecology: Ecads, Ecotypes, Characteristics of Ecotype, Origin of new ecotype and significance, concept of niche.[9]

UNIT II:

Community Ecology: Community as a Unit: Clementsian unit of vegetation. [4]

Community Nature: Individualistic and organismic nature of communities, community stratification. [11]

Unit III

Functional Aspects of Community: Community Metabolism, Community Periodism [5]
Community Sability: Maturation of Communities, Regulation of communities [5]
Community Stability: Edges and Ecotone Community as Indicator [5]

UNIT IV

Forest Ecology : Scope and relevance, Forest types of India, Structure of forest ecosystem. Accumulation and decomposition of forest litter, Forest humus, the geochemical, biogeochemical cycling of nutrients. [8]

Statistical thinking in Ecology: Ecosystems and scale, theory, knowledge and research design, Ecological study unit, Experimental versus observation methods in ecology, hypothesis testing,formulating right problem, Publish or Perish. [7]

CCPR 305.3.4: ECOLOGY PAPER XII: PRACTICAL COURSE II

UNIT V:

1. Study of litter production.
2. Determination of similarity index and association index.
3. Study of stratification and physiognomy.
4. Study of population dynamics.
5-6. Determination of IVI.
8. Study of population growth curve.

UNIT VI:

1. Study of vegetation by transect method.
2. Study of vegetation bisects.
3. Measurement of biomass production.
4-5. Biomass profile of the plant community.
6. Visit to local protected or conserved area.

Reference Books:

Abe, T., Levin, S. A. and Higashi, M. (1997) (ed.): Biodiversity an Ecological Perspective. Springer Verlag.

Bradbury I.K.1990): The Biosphere.

Brij Gopal and Bhardwaj, N. (1979): Elements of Ecology. Sahibabad: Vikas Publishing House PVT. Ltd.

Galston, K. J. (1996): Biodiversity: A biology of numbers and differences. Kluwer Academic *Publishers*, Dordrecht, the Netherlands.

Greig Smith P. (1983):Quantitative Plant Ecology. *Publisher*: WILEYBLACKWELL

Hamson, H. C. and Churchill, E. D. (1961): The Plant Community. Rein hold *publishing* corporation, New York.

Hashimoto Y et al (1990) : Measurement techniques in plant sciences. San Diego, Calif. : Academic Press.

Kormondy E. J. (1996) (4th ed.): Concept of ecology. Publisher: Benjamin Cummings.

Krattiger, A. I. et al (1994): Widening Perspectives on Biodiversity. Kluwer Academic***Publishers***.

Krebs C. J. (1978) : Ecology. Harper & Row., New York.
Misra K. C. (1989) : Manual of plant ecology. Oxford and IBH Publishing Co., New Delhi.
Nair, P. K. G. (1990): Principles of Environmental Biology. Himalaya *Publishing* House (Bombay).
Odum E. P. (3rd ed. 1996) : Fundamentals of Ecology. Natraj Publishers, Dehra Dun.
Pandeya S. C., Puri, G. S. and Singh, J. S. (1968) : Research methods in plant ecology. Asia Publishing House.
Shukla, R. S. and Chandel, P. S. (1983): Plant Ecology. Oxford and IBH.***publishers***, New Delhi, India.
Walter, H. (1979); Vegetation of the Earth and Ecological Systems of Geobiosphere. Springer, New York.
Weaver, J. E. and Clements, F. S. (1938): Plant Ecology. Springer, New York.
Willis, A. J. (1973): Introduction to Plant Ecology. *Willis A J. Publisher.*
Yadav, P. S. and Singh, J. S. (1997): Progress in Ecology vol. II. Today & Tomorrow's Printers & *Publishers*, New Delhi.

M. Sc. PART-II (SEMESTER III)

(CCS- 303.5): Angiosperm Taxonomy

(SPECIAL PAPER II) MODERN TRENDS IN ANGIOSPERM TAXONOMY

Total Lectures: 60

UNIT I:

Embryology in relation to taxonomy: Embryological characters of taxonomic importance, utilisation of embryological data in solving taxonomic problems at different levels. [5]

Anatomy in relation to taxonomy: Vegetative, wood and floral anatomy, anatomical characters of taxonomic importance, use of anatomical data in understanding interrelationship and evolution of angiosperms and solving taxonomic problems. [5]

Palynotaxonomy: Pollen morphology-Polarity, symmetry, NPC of pollen, exine stratification, excrescences, L/O pattern, palynogram; pollen characters of taxonomic importance. [5]

UNIT: II

Cytotaxonomy: Chromosome number, Basic chromosome number, polyploidy, aneuploidy, chromosome morphology, karyotype, chromosome banding, meiotic analysis and plant systematics, scope and limitations. [7]

Chemotaxonomy: Origin of chemotaxonomy, classes of compounds and their biological significance, Stages in chemotaxonomic investigations, techniques, Use of chemical criteria in plant taxonomy; Proteins and taxonomy: seed proteins, techniques of protein electrophoresis, protein analysis procedures, analysis of amino acid sequence and its significance in systematics; serology

and taxonomy: history, precipitation reaction, techniques, antigen, antisera, antibody, application of serological data in systematics. [8]

UNIT: III

Ultrastructural systematics: SEM and TEM studies and plant systematics; SEM and plant surface stucture, TEM and dilated cisterneae of endoplasmic reticulum and sieve element plastids, applications of data in the classification of higher taxa. [3]

Molecular Systematics: Molecular diagnostic tools, Restriction Fragment Length Polymorphism (RFLPs), Random Amplified Polymorphic DNA (RAPD), Polymerase Chain Reaction (PCR) analysis, specific applications of RAPD, AFLP in molecular systematics. Molecular data and systematic position of Hydatellaceae. [7]

Plant geography, ecology and systematics: Patterns of geographic distribution, Disjunction and Vicariance, Vicariance biogeography, Endemism, Centres of diversity, Ecological differentiation, Alien plants, Phenotypic plasticity [5]

UNIT: IV

Morphological variations, systematic position, interrelationships, phylogeny and economic importance of following families:

EUDICOTS**:** Menispermaceae, Ranunculaceae, Nelumbonaceae [3]

CORE EUDICOTS: Nyctaginaceae, Portulacaceae, Polygonaceae, Loranthaceae, Santalaceae. [5]

ROSIDS: Vitaceae, Zygophyllaceae, Oxalidaceae, Euphorbiaceae, Rhizophoraceae, Passifloraceae, Polygalaceae. [7]

CCPR 305.3.5: ANGIOSPERM TAXONOMY PAPER XII: PRACTICAL COURSE II

UNIT V:

1. Microtome technique for study of embryological characters
2. Study of wood characters: vessels, storied and nonstoried wood
3. Semipermanent pollen preparations by acetolysis and study of different pollen morphotypes.
4. Study of chromosomes and Karyotype analysis.
5-6. Interpretation of flavonoids/alkaloids data for taxonomy using chromatography.

UNIT VI:

1. Exercise on Numerical taxonomy

2. Study of plant surface attributes with the help of SEM photographs and sieve tube plastid and dilated cisternae of endoplasmic reticulum with the help of TEM photographs

3-6. Descriptions, Sketching, classification and identification of families:

EUDICOTS: Menispermaceae, Ranunculaceae, Nelumbonaceae;

CORE EUDICOTS: Nyctaginaceae, Portulacaceae, Polygonaceae, Loranthaceae, Santalaceae;

ROSIDS: Vitaceae, Zygophyllaceae, Oxalidaceae, Euphorbiaceae, Rhizophoraceae, Passifloraceae, Polygalaceae.

Any additional practical/s based on theory syllabus will be added whenever necessary.

(At least two local tours should be arranged to study vegetation, ecology and flowering of the region in first term. Student is supposed to submit herbarium specimens (50) and plant materials in the form of slides (5) and preserved specimens.)

Reference Books:

Bhojwani, S. S. and Bhatnagar, S. P. 1984. Embryology of Angiosperms. Vikas Publ. House, New Dehli.

Cronquist, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.

Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.

Davis, P. H. and V. H. Heywood 1991. Principles of Angiosperm Taxonomy. Today and Tommorow Publications, New Delhi.

Erdtman, G. 1952. Pollen Morphology and Plant Taxonomy. Angiosperms. Almquist and Wiksell. Stockholm.

Fahn, A. 1979. Plant Anatomy, Pergamon Press, London.

Erdtman, G. 1952. Pollen Morphology and Plant Taxonomy. Angiosperms. Hafner Publ. Co. New York.

Johri, B. M. 1984. Comparative embryology of Angiosperms. Ind. Nat. Sc. Acad. New Delhi.

Maheshwari, P. 1985. An Introduction to Embryology of Angiosperms. Tata McGraw Hill, New Delhi.

Manilal, K. S. and M. S. Muktesh Kumar [ed.] 1998. A Handbook of Taxonomic Training. DST, New Delhi.

Naik, V. N. 1984. Taxonomy of Angiosperms Tata McGraw-Hill, New Delhi.

Nair, P. K. K. 1966. Pollen morphology of Angiosperms. Periodical Expert Book Agency, New Delhi.

Quicke, Donald, L. J. 1993. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London.

Taylor, D. V. and L. J. Hickey 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.

Lawrence, G. H. M. 1951. Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi .

Paech, K. and M. V. Tracey. 1956. Modern Methods of Plant Analysis. Vol-I & II. Springer-Verlag.

Shivanna, K. R. and N. S. Rangaswamy. 1992. Pollen Biology- A Laboratory Manual. Springer-Verla

Sharma A. K. and A. Sharma. 1980. Chromosome Technique: Theory and Practices (3rd ed.) Butterworths, London.

Judd Walter S., Campbell, C. S., Kellogg, E. A., Stevens, P.F. and M. J. Donoghue 2008. Plant Systematics-A Phylogenetic Approach Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.

Simpson, M. G. 2010. Plant Systematics. Elsevier, Amsterdam.

Stace, C. A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.

M. Sc. PART-II (SEMESTER III)

(CCS- 303.6): Marine Botany

(SPECIAL PAPER II) PHYSIOLOGY AND BIOCHEMISTRY OF MARINE PLANTS

Total Lectures: 60

UNIT I:

Photosynthesis in Marine Algae: Overview, light harvesting, Photosynthetic pigments (chlorophylls. phycobiliproteins, carotenoids), effect of low light condition. Photosynthetic carbon fixation- Dark Reactions, Inorganic carbon sources and uptake, Photosynthetic pathways in seaweeds, Light independent carbon fixation, C_3 versus C_4 characteristics of seaweeds. Carbon metabolism and calcification [8]

Storage and Structural Components in Algae: Seaweed polysaccharides; Alginates, Agars, Carrageenans, Fucoidan, Laminaran, Xylans, Mannans, Algal Starches, Polysaccharide synthesis,

Low Molecular Weight compounds in algae-Fatty acids, Lipids, Steroids, Triterpenoids etc. [7]

UNIT II:

Salt Regulation in Halophytes: Salt regulation strategies, salt secretion through glands, Ultrastructure of salt glands, Salt glands in mangroves, Mechanism of salt secretion, Salt retransportation, Salt bladders, Leaf succulence, Selective ion absorption. [6]

Salinity and Metabolism:

Water relations, osmoregulation and photosynthesis in mangroves. Significance of vivipary in mangroves [5]

Salinity and Water relations in seagrass communities. [2]

Salinity, salt regulation and photosynthesis in salt marshes. [2]

UNIT III:

Bioactive Compounds in Mangroves: Chemical classes- Heterocyclic compounds, alkaloids, lignins & polysaccharides, lipids, flavonoids, phenolics, tannins, saponins, limonoids etc. Traditional Products, Toxicants & medicines from mangroves. [10]

Mangrove Research and Activities: Contributions of Indian and Global Institutions- UNESCO, UNDP, ITTO, ISME, NIO, MSSRF, GEER, ENVIS and SUK. [5]

UNIT IV:

Mineral Nutrition in Algae: Nutrient requirement, Essential elements, vitamins for growth of algae. Availability in sea water, Uptake, Factors affecting, Metabolic role of major elements and trace elements. [7]

Algal Research: Contributions of major Research Institutes- CSMCRI **(**Bhavnagar), Krishnamoorthy Institute of Algology (Mandapam ,Chennai), NIO (Goa), Department of Botany (SUK). [5]

Algal Biotechnology: Present status & future prospects. [3]

CCPR 305.3.6: MARINE BOTANY PAPER XII: PRACTICAL COURSE II

UNIT V:

1. Estimation of pigments from marine algae-I: Chlorophylls a, b, c and d.
2. Estimation of pigments from marine algae-II: Carotenoids and Phycobilins.
3. Isolation of agar agar from seaweeds.

4. Extraction of alginic acid from seaweeds.

5-6. Estimation of total carbohydrates from marine algae.

UNIT VI:

1. Phytochemical analysis of seaweeds through qualitative tests.
2. Detection of phenols as bioactive compound in mangroves.
3. Determination of alkaloids from mangroves.
4. Estimation of total lipids from seaweeds.
5. Estimation of tannins from of mangroves (bark, stems and leaves).
6. Detection of bioactive compounds from mangroves using, phytochemical tests

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Reference Books:

Chapman, **V. J**. (1976): Costal Vegetation. IInd edition Pergamon Press. New York.

Ring, M. (1982): The Biology of Marine Plants. Edward Arnold Publishers, London.

Gerald, E. Ecophysiology of Economic Plants in Arid and Semiarid Land.

Jackson, D. F. (1972): Algae and Man. Plenum Press.

Lobban, **C. S**. & **Harrison, P. J.** (1985): Seaweed Ecology and Physiology. Cambridge University Press.

Lobban, C. S. And Wynne, M. J. 1981. The Biology of Seaweeds. Botanical Monographs Volume 17. Blackwell Scientific Publications.

Sambamurthy, **A. V. S. S**. (2005): A Text Book of Algae. 1st. Ed.I. K. International Pvt. Ltd. New Delhi.

Stein, **J. R**. (1973): Handbook of Phycological & Biochemistry.

Stewart, **W. D**. (1974): Algal Physiology & Biochemistry.

Tasks for Vegetation Science. 1983. Physiology and Management of Mangroves. Vol. 8, Dr. W. Junk Publishers.

Waisel, Y. (1972): Biology of Halophytes Academic Press, London and New York.

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M. Sc. PART-II (SEMESTER III)

(CCS- 303.7): Plant Biotechnology

(SPECIAL PAPER II) MOLECULAR BIOTECHNOLOGY AND GENETIC ENGINEERING

Total Lectures: 60

UNIT I:

Fundamentals of molecular biotechnology [2]

Vectors in gene cloning and their selection [6]

Molecular research procedure; Gene amplification, basic PCR, its modification, application, DNA polymorphism [7]

UNIT II:

Use of various enzymes in recombinant DNA technology [6]

Recombinant DNA and gene cloning, Techniques of restriction mapping, construction of chimeric DNA, cloning in bacteria and eukaryotes, molecular probes, southern northern and western blotting, dot and slot blots, constriction and screening of genomic and cDNA libraries, chromosome walking and chromosome jumping libraries [9]

UNIT III:

Isolation, sequencing and synthesis of genes: Isolation of genes, DNA sequencing, synthesis, gene synthesis machines [10]

Plant genetic engineering: gene transfer techniques [5]

UNIT IV:

Genomics: Human genome project, Nucleotide sequence databases [3]

Proteomics: Protein sequence information, composition and properties, Sequence comparison and protein databases [4]

Enzymology: IUB system, characteristics of enzyme and enzyme- substrate complex, Effect of temperature, pH, and substrate concentration on reaction rate [3]

Immunology: Immune system, Antibodies, Molecular biology of antibodies, Interferons and Vaccines [5]

CCPR 305.3.7: PLANT BIOTECHNOLOGY PAPER XII: PRACTICAL COURSE II

UNIT V:

1. Estimation and comparison of genomic DNA by UV-vis spectrophotometry

2. DNA purification by gel electrophoresis
3. Isolation of proteins
4-5. Two- dimensional (2-D) paper chromatography of amino acids

UNIT VI:

1-2. Genetic transformation: GUS
3. Isolation of protoplast
4. Restriction digestion of DNA
5-6. Determination of optimum temperature for enzyme activity

Reference Books:

Chavala, H. S. 1998. Biotechnology in crop improvement. International Book Distributing Co. New Delhi.

Glick, B. R. and Pasternak, J. J. 1994. Molecular Biotechnology- Principles and applications of recombinant DNA. ASM Press, Washington.

Gupta, P. K. 2000. Elements of Biotechnology. Rastogi Publisher, Meerut, India.

Jogdand, S. N. 1997. Gene Biotechnology, Himalaya Publishing House, Mumbai, India.

Joshi, P. 1998. Genetic Engineering and its applications. Agrobotanica.

Kakralya, B. and Ahuja, I. 2001. Transgenic Plants-Promise or Danger. Agrobios, India.

Mitra, S. 1996. Genetic Engineering- principles and practice. Mcmilan, India ltd.

M. Sc. PART- II (SEMESTER III)

(DSE- 304)

Biotechnology and Genetic Engineering

Total Lectures: 60

UNIT I:

Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors. *In vitro* mutagenesis and deletion techniques, gene knock-out in bacterial and eukaryotic organisms, RNA interference and CRISPER cas9.

Process and Techniques in plant transformation, Binary vectors for plant transformation

UNIT II:

DNA sequencing methods, strategies for genome sequencing.

Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques.

Isolation, separation and analysis of carbohydrate and lipid molecules.

RFLP, RAPD, SSR and AFLP techniques.

UNIT III:

Concept, principle and applications of recombinant DNA technology

Enzymes used in recombinant DNA technology, Restriction mapping, Cloning vectors, Construction of chimeric DNA

Strategies for engineering resistant plants for biotic and abiotic stresses.

Transgenic crops for nutritional quality improvement.

UNIT IV:

Screening of transgenics using blotting techniques- Southern, Northern and Western.

Genomics: *Arabidopsis* genome, Comparative genomics, Functional genomics

Proteomics: Rationale, basic assumptions, methods for protein engineering

Intellectual property rights (IPR) and protection (IPP): Concept, importance, ecological risks, ethical concerns and economic concerns.

CCPR 305.4: BIOTECHNOLOGY AND GENETIC ENGINEERING PAPER X: PRACTICAL COURSE

UNIT V:

1.and 2. Preparation of MS medium for Plant tissue culture and sterilisation techniques.

3. Callus culture
4. Micro propagation

5.and 6 - *Agrobacterium* mediated transformation (Hairy roots/ tumor formation)

7. Isolation and culture of soil/ root nodule bacteria

UNIT VI:

1. Isolation of genomic DNA.
2. and 3. Agarose gel electrophoresis.
4. Cell line isolation for secondary metabolites.
5. Nucleotide sequence and BLAST.
6. Patent filing pre-requisites

Reference Books:

Gupta, P. K. 2010. Plant Biotechnology. Rastogi Publications, Meerut.

Glick, B, R. and Pasternak, J. J. 1994. Molecular Biotechnology- Principles and Applications of Recombinant DNA. ASM Press, Washington D. C.

Gupta, P. K. 2009. Biotechnology and Genomics. Rastogi Publications, Meerut.

Trehan, K. 1994. Biotechnology. Wiley Eastern Limited, New Delhi.

Ramawat, K. G. 2006. Plant Biotechnology. S. Chand and Company Ltd., New Delhi.

Trivedi, P. C. (ed.) 2000. Plant Biotechnology- Recent Advances. Panima Publishing Corporation, New Delhi.

Chawla, H. S. 1998. Biotechnology in Crop Improvement. International Book Distributing Company, Lucknow.

Aneja, K. P. 1996. Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation. Weshwa Prakashan, New Delhi.

Sullia, S. B. and Shantharam, S. 2005. General Microbiology. Oxford & IBH Publ. Ltd., New Delhi.

Tauro, P.; Kapoor, K. K. and Yadav, K. S. 1996. An Introduction to Microbiology. Wiley Eastern Lmited, New Delhi.

Razdan, M. K. 1994: An Introduction to plant tissue culture. Oxford & IBH Publ. Ltd., New Delhi.

Kumar, H. D. 1993. Molecular Biology and Biotechnology, Vikas Publ., New Delhi.

Gamborg, O. L., Phillips, G. C. 1995. Plant Cell, Tissue and Organ Culture- Fundamental Methods. Narosa Publ. House, New Delhi.

Reinhert, J. and Bajaj ,Y. P. S. 1977. Applied and fundamental aspects of plant cell, tissue and organ culture, Springer Verlag, Berlin.

Dodds, J. H. and Roberts ,L. W. 1985. Experiments in plant tissue culture. Cambridge University Press, Cambridge.

Boyce, C.O.L. 1986. Novo's Handbook of Practical Biotechnology. Novo Industry.

M.Sc. II PART-II (SEMESTER IV)

(CC401): Plant Physiology and metabolism

Total Lectures: 60

UNIT I:

Active and passive mechanisms of solute transport, Mechanisms of phloem loading and unloading of photoassimilates, source-sink relationship and its applications.

UNIT II:

Photosynthesis: Photo oxidation of water and C_3 pathway, RUBISCO, Sub classification of C_4 plants, PEPcase, ecological significance and modification of CAM.

Respiration: Overview of plant respiration, Anaerobic respiration, Modern concept of electron transport and ATP synthesis. Inhibitors of respiration. Gluconeogenesis.

UNIT III:

Nitrogen metabolism: Nitrate and ammonium assimilation; amino acid biosynthesis.

Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

UNIT IV:

Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action of ABA.

Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

PRACTICAL COURSE CCPR 405: PLANT PHYSIOLOGY AND METABOLISM

UNIT IV:

1. Determination of lipid peroxidation in plants under stress.
2. -3. Determination of rate of respiration in germinating seeds under aerobic and anaerobic conditions.
4. Estimation of free amino acid
5. Study of enzyme Nitrate reductase
6. Effect of PGR's on seed germination and seedling growth

UNIT V:

1-2. Estimation of enzyme Phenyl Alanine Ammonia Lyase
3. Separation of secondary metabolites using TLC
4. Measurement of RWC in plants under stress.
5. Estimation of proline from stress and non-stress plants.

REFERENCE BOOKS

Bidwell, R. C. S. (1979): Plant Physiology. Macmillan

Bonner, J. and Varner, J.E. (1972): Plant Biochemistry. IBH.

Buchnan, B.B., Gruissem, W. And Jones, R.L. (2000) Biochemistry and Molecular Biology of Plants. Wiley-Blackwell

Edwards G. and Walker D., eds. (1983). C3, C4: mechanisms, and cellular and environmental regulation, of photosynthesis. Oxford: Blackwell Scientific Publications.

Govindjee, H. (ed.) (1982): Photosynthesis, Vol. 1 and Vol. 2. Academic Press, N.Y. (Vol. 1); 0-12- 294302-2 (Vol. 2))

Hopkins, W. C. (1995): Introduction to Plant Physiology. Wiley, New York.

Krishnamurthy, H.N. (1992): Physiology of Plant Growth and Development. Atma Ram and Sons, Delhi.

Marschner, H. W. (1986): Mineral nutrition of Higher Plants. First Edition, Academic Press, Elsevier Science Ltd.

Marschner, H. W. (2003): Mineral nutrition of Higher Plants. Second Edition, Academic Press, Elsevier Science Ltd.

Moore, T.C. (1974): Research experience in Plant Physiology, A Laboratory manual. Springer-Verlag, Berlin.

Mukherjee, S.P. and Ghosh A.N. (1996): Plant Physiology. New Central Book Agency (P) Limited Tata McGraw Hill.

Noggle, G.R. and Fritz, G. J. (1976): Introductory Plant Physiology. Prentice- Hall, Inc., Englewood Cliffs, NJ.

Pessarakli, M. (Ed.). (2001). Handbook of Plant and Crop Physiology, 2nd Edition, Revised and Expanded. Marcel Dekker, Inc., New York

Pessarakli, M. (Ed.). (2005). Handbook of Photosynthesis, 2nd Edition, CRC Press, Taylor & Francis Publishing Company, Florida

Randhir Singh and Sawhney S. K. (1988): Advances in frontier Areas of Plant Biochemistry. Prentice Hall of India

Sadasivam S. and Manickam A. (1996): Biochemical methods. New Age International.

Salisbury, F. B. and Ross, C.W.(1992): Plant Physiology IV ed. Cengage Learning

Sinha R.K. (2014) Modern Plant Physiology Second Edition, Narosa Publishing House Pvt. Ltd.

Smith, H. (1975): Phytochrome and Photomorphogenesis. McGraw-Hill Inc.,US

Taiz, L. and Zeiger, F. (1998, 2002, 2006): The Plant Physiology. Second Edition, Third Edition, Sunderland: Sinauer Associates.

Wilkins, M. B. (1976): Physiology of Plant Growth and Development. McGrow-Hill Publishing Company Limited

Journals

Annual Review of Plant Physiology and Molecular Biology.

Annual Review of Plant Physiology

Indian Journal of Plant Physiology.

Journal of Experimental Botany.

Physiologia Plantarum Sweden.

Plant Physiology (Bethedsa, USA).

Plant Cell

M.Sc. PART- II (SEMESTER IV)

(CCS402.1): Plant Physiology

(SPECIAL PAPER III) STRESS PHYSIOLOGY OF PLANTS

Total Lectures: 60

UNIT I:

Water stress: Causes of water stress: Arid and Semiarid regions, Drought effect on physiological processes in plants, Mechanism of stomatal action, various mechanisms of drought resistance in plants, Antitranspirants, Drought hardening, Transgenic approach. [8]

Flooding stress: Nature of waterlogging stress. Effect of flooding stress on physiological processes in plants. Wetland and non wetland species. Mechanism of waterlogging tolerance. [7]

UNIT II:

Salt stress: Definition of saline soil, Causes of soil Salinization. A brief outline of Salt affected soils in India, Physiological responses of plants to salinity stress, Halophytes and glycophytes mechanism of salinity tolerance in higher plants, Genetic engineering for salt tolerance. [9]

Ionic stress: Effect of ion toxicity (iron, zinc), heavy metals toxicity and aluminum toxicity in plants, Phytoremediation, Mechanism of aluminium tolerance, Transgenic approaches. [6]

UNIT III:

Thermal stresses: Effect of high and low temperatures on plant metabolism, Mechanisms of high and low temperatures tolerance, Cold hardening, Role of HSP. [5]

Radiation stress: Influence of high light intensity on photosynthesis, Photoprotection mechanisms, Effect of UV radiations on plants, Mechanism of UV tolerance. [5]

Oxidative stress: Generation of reactive oxygen species, Effect of ROS on metabolism, ROX detoxification mechanisms in plants, Transgenic approaches. [5]

UNIT IV:

Gaseous stress: Effect of elevated CO_2 concentration on plant metabolism, Effect of air pollutant SO_2 and O_3 on plants. [6]

Biotic stress: Effect of fungal infection on plant metabolism, Biochemical mechanism of disease resistance, Allelopathy [9]

CCPR 405.1 : PLANT PHYSIOLOGY PAPER XV: PRACTICAL COURSE III

UNIT V:

1. Measurement of osmotic potential of controlled and stressed tissue.

2. Determination of chlorophyll stability index.

3-4.. Effect of foliar applications of some commercial PGR's and biotonics on crop productivity parameters (carbohydrate status).

5. Study of effect of fungal infection on polyphenol oxidase activity.

UNIT VI:

1. Study of free radicals scavenging enzymes, catalase in healthy and infected plants..
2. Study of super oxide dismutase in healthy and infected plants.
3. Study of effect of source manipulation on sink capacity in any crop plant.
4. Study of effect of weedicides on some aspects of weed metabolism (chlorophylls/ nitrate reductase)
5. Determination of Harvest Index (HI) of different crops (Wheat and chickpea)

Reference Books:-

Buchnan, B.B., Gruissem, W. And Jones, R.L. (2000) Biochemistry and Molecular Biology of Plants. Wiley-Blackwell

Cherry, J. H. (ed.) (1989) Environmental Stress in Plants: Biochemical and Physiological Mechanisms Associated with Environmental Stress Tolerance in Plants (NATO ASI Series G, vol. 19). Springer, Berlin.

Fitter, A.H. and R.K.M. Hay, (1987) Environmental Physiology of Plants. Academic Press, San Diego, CA, 2nd. ed.

Hale, M.G. and Orcutt, D.M. (1987) The Physiology of plants under stress. John Wiley and Sons, New York.

Kozlowski, T.T. (1984) Flooding and Plant Growth. Ed. T.T. Kozlowski. Academic Press, Orlando, FL

Levitt, J. (1980) Responses of plants to environmental stresses: Vol.II, Water, Radiation, Salt and other. Academic Press, New York

Mansfield, T.A. (1976) Effects of Air Pollutants on Plants. CUP Archive

Mehrotra, R. S. (1980): Plant Pathology. Tata McGraw-Hill

Paleg, **L.G. and Aspinal, D. (1982)** The Physiology and Biochemistry of Drought resistant in Plants. Academic Press, Sydney.

Poljakoff-Mayber, A. and Gale, J. (eds.). (1975) Plants in saline environments. Springer Verlag, New York, USA

Rice, E. L. (1974) Allelopathy, Academic Press, New York, San Francisco, London

Srivastava Y.N. (2009) Environmental Pollution APH Publishing Corporation, New Delhi
Turner, N. C., and Kramer, P. J. (1980) Adaptation of Plants to Water and High Temperature Stress. Wiley, New York

Taiz, L. and Zeiger, F. (1998, 2002, 2008): The Plant Physiology. (Second Edition 1998, Third Edition2002, Fourth Edition 2008) Sunderland: Sinauer Associates.

Journals

Allelopathy Journal

Annual Review of Plant Physiology and Molecular Biology.

Annual Review of Plant Physiology

Indian Journal of Plant Physiology.

Journal of Experimental Botany.

Physiologia Plantarum, Sweden.

Plant Physiology, Bethedsa, USA

Plant Cell

M. Sc. PART-II (SEMESTER IV)

(CCS402.2): Mycology and Plant Pathology

(SPECIAL PAPER III) INDUSTRIAL MYCOLOGY

Total Lectures: 60

UNIT I:
Role of fungi in industry: Scope and their utility. [5]
Commercial fungal strains: Selection, improvement, development and their maintenance. [5]

Fermentation:
Industrial alcohol production through fermentation
Industrial production of organic acids: citric, fumaric, itaconic and kojic acid. [5]

UNIT II:
Industrial production of enzymes: amylases, proteases, pectinases and invertases. [7]
Industrial production of vitamins: vitamin B_{12}, riboflavin, vitamin A. [6]
Industrial production of gibberellins [2]

UNIT III:

Industrial production of antibiotics [6]
Production of ergot alkaloids. [4]
Economics of fermentation. [5]

UNIT IV:
Edible fungi, their nutritional value and role in cottage industry. Large and small scale cultivation technique of *Agaricus bisporus*, *Pleurotus* spp.,*Volvariella volavacea* and their preservation, diseases and their control, cost benefit analysis. [15]

CCPR 405.2 : MYCOLOGY & PLANT PATHOLOGY PAPER XV: PRACTICAL COURSE III

UNIT V:

1. Maintenance of fungal strains using different methods.
2. Production of industrial alcohol by fermentation technique.
3. Detection of citric acid from mycelial biomass using circular paper chromatography.
4. Detection of antibiotics from mycelial biomass.
5 & 6. Production of ergot alkaloid by using fungal elicitors.

UNIT VI:

1 & 2.Preparation of spawn: Grain, Perlite and manure spawn.
3 & 4. Cultivation of mushroom.
5& 6. Study of some enzymes (amylases, proteases, pectinases and invertases) of fungal origin.

Refernce Books:

Casida, L. E. Jr. (1964). Industrial Microbiology. John Wiley and Sons, USA

Whipps, J. M. and Lumsden, R. D. (1989). Biotechnology of fungi for improving plant growth. Press Syndicate of the University of Cambridge, UK

Turner (1971). Fungal metabolism. Academic Press, USA

Atal (1978). Indian Mushroom Science-I. Indo American Literature House

Kannaiyan (1980). A hand book of edible mushrooms. Todays and Tomorrow's. Publ.
Purkhyastt (1976). Indian edible mushrooms. Firma KLM, 1976 Cornell University

Smith, J. F. and Barry, D. R. The filamentous fungi Vol.I Industrial Mycology Vol.II and III. Edward Arnold, London.

Dodge, C.W. (1935). Industrial Mycology.

Prescott, S. G. and Dunn, C. D. (1959). Industrial Microbiology. AVI Pub.n Com. Westport, CT

Christensen, C. M. (1975): Mould, Mushrooms and Mycotoxins. University of Minnesota press, Minneapolis

Rose, A. H. (1961). Industrial Microbiology. Butterworths, London

Singer, R. (1961). Mushrooms and Truffles cultivation and utilization. Leonard Hill, Ltd.,

Rhodes, A. and Fletcher, D. L (1966). Principles of industrial microbiology. Pergamon Press, Oxford, UK

Gray, W. D. (1970). The use of fungi as food and food processing. Cleveland, Oh: CRC Press, USA

Lodder, J. (1970). The Yeast. North- Holland, Amsterdam

Chang, S. T. and Hays, W. A. (1978). The biology and cultivation of edible mushrooms. Academic Press, New York.

Aneja, K. R. (1993). Experiments in Microbiology,Plant Pathology and Tissue Culture.

Onions, A. H. S. D. Allsopp and Eggins, H. O. W. (1981). Smith's Introduction to Industrial Mycology. New Age International Publishers

Barger, G. (1931). Ergot and Ergotism. Edward Arnold

Fletcher, J. T.,White, P. F.and Gaze, R. H.(1989). Mushrooms: Pest and Disease Control. Intercept, Ltd., VCH Publishers, Suite 909, 220 East 23rd Street, New York,

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M.Sc. PART-II SEMESTER IV

(CCS402.3): Cytogenetics and Plant Breeding

(SPECIAL PAPER- III) MOLECULAR GENETICS

Total Lectures: 60

UNIT I:

Microbial Genetics: Genetic studies in microorganisms with special reference to *Escherichia coli* and *Agrobacterium* spp. Genetic exchange in bacteria- an overview (mutants, conjugation, Transduction and transformation) site directed mutagenesis.

UNIT II:

The Genetics of Viruses: The structure and life cycle of bacterial virus, Mapping the bacteriophage genome (Phage phenotypes, genetic recombination in phage, fine structure and deletion mapping), T_4 genetic map, bacteriophage X 174. Molecular analysis of DNA, RNA and proteins using blotting techniques and micro arrays; molecular markers (third and fourth Generation) and their uses.

UNIT III:

PCR and DNA sequencing: PCR and its types. Classical methods for DNA sequencing,

Automatic DNA sequencer, Restriction maps and molecular maps. Genome wide association studies (GWAS)

UNIT IV: Bioinformatics, Genomics and Proteomics: Bioinformatics tools for analyzing genomic information; Biological databases, Comparative genomics- Ancient duplications and Palaeopolyploidy, Phylogenetic analysis. Genomes of higher plants- *Arabidopsis,* Rice, Soybean, Maize and grapevine.

Comparative genomics tools and techniques, macro and microsynteny, evolutionary principles and applications

CYTOGENETICS AND PLANT BREEDING PAPER XV: PRACTICAL COURSE III

(CCPR 405.3)

UNIT V:

1. *In silico* studies (Identification of SSRs, Primer designing and Similarity search analysis using different BLAST programs)
2. Preparation of linkage map using mapmaker and join map
3. QTL analysis using QTL Cartographer and QTL Network
4. EST analysis in crops
5. Study of polymorphism in crop plants using molecular markers (RAPD/ ISSR)
6. Demonstration of southern blotting
7. Phylogenetics analysis

UNIT VI:

1. Study of restriction digestion analysis by gel electrophoresis
2. Secondary metabolite production and analysis
3. Anther culture and haploid production
4. Cell line isolation
5. Hairy root culture
6. Study of transgenic plants
7. Detection and estimation of protease inhibitors from cereals/pulses

Reference Books:

Twyman R. M. 1998. Advanced molecular Biology. Viva Books Pvt. Ltd. New Delhi.

Wolfe S. L. 1993. Molecular and cellular biology. Wadwith Publishing Co. California USA.

Lewin, B. 2008, Genes IX Oxford University Press, New York.

Brown T. A. 1998. Genomes. John Wiley and sons Singapore.

Alberts B. et al 1994. Molecular biology of the cell 3rd Edition Garland Publishing, New York.

Singh B. D. 1990. Fundamentals of Genetics. Kalyani Publishers Ludhiana.

Latchman D. S. 1990. Gene regulation an eukaryotic perspective. Unwin Hyman Publication London.

Klug W. S. and Cummings M. R. 1983. Concepts of Genetics. Charles E. Merrill Publishing Company London.

Jain H. K. 1999. Genetics Principles, Concepts and Implications. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Gupta P. K. 1985. Genetics Rastogi Publications Meerut.

Griffith A. J. F. Miller J. H., Suzuki D. T., Lewontin R. C. and W. M. Gelbart 1996. An introduction to Genetics Analysis. 6th Edition W. H. Freeman New York.

Strickberger M. W. 1996 Genetics 3rd Edition MacMillan Publishing Co. New Delhi.

Journals:

1. Annual review of Microbiology
2. Journal of Cytology and Genetics
3. Cytologia
4. Caryologia
5. Indian Journal of Experimental Biology
6. Journal of Experimental Botany
7. Trends in Biotechnology (Elsevier)

M.Sc. II PART- II (SEMESTER IV)

(CCS402.4): Energy, Ecology and Environment

(SPECIAL PAPER III) EXPERIMENTAL ECOLOGY AND ENERGY STUDIES

Total Lectures: 60

UNIT I:

Ecological Methods: Autecology and synecology. Various methods involved in aquatic studies [6]

Methods of community study: Minimal area curve, Quadrats, Transects, Grid, Use of GPS in Mapping. Measurement of primary productivity in terrestrial and aquatic ecosystems. [9]

UNIT II:

Systems Ecology: Introduction and basic elements of system ecology. [3]

Field survey, Introduction of remotesensing techniques and application. Construction of model essential elements. [9]

Methods to study ecology of genetic erosion to construct model and examples. [3]

UNIT III:

Energy Sources: Biomass as a source of energy, Composition of biomass (cellulose, hemicelluloses, lignin), Terrestrial biomass, aquatic biomass. [8]

Bio energy: Energy plantation, social forestry, silviculture, energy farms, petroleum plants, hydrocarbon from higher plants (*Hevea, Euphorbia*) , algal hydrocarbons [7]

UNIT IV

Energy from Waste: Biogas production, Biomass to electricity, Bio village concept, Eco Cook stoves, Rain harvesting, Vermicomposting technology – Role of earth worm, Process of vermin composting, application. [10]

Non conventional energy sources and their programme in India : Wind, Geothermal, Hydropower, Solar, Nuclear energy. [5]

CCPR 405.4 : ECOLOGY PAPER XV: PRACTICAL COURSE III

UNIT V:

1. Survey and mapping of area by GPS.
2. Seed germination under various treatments for tree species.
3. Study of seed output and reproductive capacity.
4. Study of petro crops and energy plants.

5-6 Study of effect of natural light intensity on primary productivity of an aquatic ecosystem.

UNIT VI:

1. Setting up of an ecological model.
2. Use of ecological model in the field study.
3. Determination of Leaf Area Index (LAI).
4. Induction of rooting.
5. Statistical analysis of ecological data.
6. Determination of calorific value of wood

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Reference Books:

Agarwal S. K. (1992): Fundamentals of Ecology. New Delhi: Ashish Publishing House.

Bradbury I. K. (1990):The Biosphere. Published by John Wiley & Sons, Chichester.

Das S. M. (1989): Handbook of Limnology and water pollution with practical Methodology. Published by South Asian Publishers, New Delhi.

Etherington J.R. (1975): Environment and plant ecology : aims and development. Publisher Wiley.

Freedman H. I. (1980): Deterministic mathematical models in population ecology. Marcel Dekker Inc., New York.

Greig Smith P. (1983): Quantitative Plant Ecology. *Publisher*: WILEYBLACKWELL

Grims J. P. ***et al*** (1988): Comparative Plant Ecology. Colvend, Dalbeattie, Kirkcudrightshire [Scotland] : Castlepoint Press.

Hashimoto Y ***et al*** (1990): Measurement techniques in plant sciences. San Diego, Calif. : Academic Press

Kershaw K. A. (1964): Quantitative and dynamic ecology. Publisher: Edward Arnold

Kormondy E. J. (1996): Concept of ecology. Publisher: Benjamin Cummings.

Krebs C. J. (1978): Ecology. Harper & Row., New York.

Lieth H. F. ***et al*** (1973): Patterns of primary production in the biosphere. Kluwer Academic Publishers-Plenum Publishers.
Misra K. C. (1989): Manual of plant ecology. Oxford and IBH Publishing Co., New Delhi.
Misra R. and Das R. R. (1971): Proceedings of the school of plant ecology. Publisher: Calcutta Oxford & IBH Pub. Co.
Odum E. P. (1971): Ecology. Publisher: Saunders

Odum E. P. (3rd ed. 1996) : Fundamentals of Ecology. Natraj Publishers, Dehra Dun.
Pandeya S. C. ***et al*** (1963) : Research methods in plant ecology. Asia Publishing House.
Watt K. E. F. (1973) : Principles of Environment Sciences. Published by McGraw-Hill.

M. Sc. PART II (SEMESTER IV)

(CCS402.5): Angiosperm Taxonomy

(SPECIAL PAPER III) ANGIOSPERM TAXONOMY FLORISTICS AND BIOSYSTEMATICS

Total Lectures: 60

UNIT I:

Floristic: Need and significance of floristic studies, methodology, analysis and data presentation. [3]

Taxonomic literature: General taxonomic indexes, world floras and manuals, monographs and revisions, bibliographies, catalogues, review serials, periodicals, glossaries, dictionaries, cultivated and economic plants, maps and cartography, biographical references, dates of publication, location of type specimens, dictionaries and addresses, colour charts, outstanding botanical libraries.[7]

Botanical keys: Diagnostic, synoptic and artificial keys-Single access (sequential)-bracketed and indented keys and multi-access keys, edge-punched and body-punched (polyclave) keys, tabular and lateral keys; computerized keys, their merits and demerits. [5]

UNIT: II

History of botanical exploration in India: Beginning of botany in India, contributions made in earlier phase by Garcia d'Orta, C. Acosta, Van Rheede, John Burman, John Koenig, Robert Kyd, Buchanan, Roxburgh, N. Wallich, William Griffith, Robert Wight, Thomas Thomson, J. D. Hooker, Collet, Brandis, T. Cooke, Duthie, Fyson, Gamble, Haines, Parkinson, Prain, Santapau, and recent works with special emphasis on Maharashtra. Botanical Survey of India (BSI). [10]

Biosystematics: Aims, concepts of species, steps in biosystematic study, biosystematic categories-ecotype, ecospecies, cenospecies, comparium, methods in biosystematic studies, ecotypic variations and taxonomy, scope and limitations. [5]

UNIT: III

Origin of agriculture and rise of food crops: Introduction, food plants, origin and spread of *Homo sapiens*, centres of plant domestication of major crops, crop dispersal and distribution. [5]

Plant domestication: Introduction, Evolution of farming, Plant domestication, origin of crops, changes during domestication, genetic regulation of domestication syndromes, evolution of weeds, genetic diversity and domestication. [5]

Crop plants and their wild relatives: Cereal grains (rice, sorghum, wheat), legumes (chickpea, black gram, mung bean, cowpea, moth bean), starch plants (banana, yam), fruits (apple, citrus, grape, peach, strawberry), vegetables (cucurbits) [5]

UNIT: IV

Morphological variations, systematic position, interrelationships, phylogeny and economic importance of following families:

ROSIDS**:** Rhamnaceae, Moraceae, Urticaceae, Cucurbitaceae, Begoniaceae, Casuarinaceae, Lythraceae, Onagraceae, Myrtaceae, Melastomataceae, Rutaceae, Meliaceae, Sapotaceae, Lecythidaceae, Solanaceae. [15]

CCPR 405.5 : ANGIOSPERM TAXONOMY PAPER XV: PRACTICAL COURSE III

UNIT I:

1. Herbarium technique
2. Botanical keys
3. Study of ecotypes/ variations in population of species
4. Identification of taxa with the help of computerized key
5. Study of weeds found in the region
6. Study of crop plants and their wild relatives (cereals and legumes)

UNIT II:

1. Study of crop plants and their wild relatives (Fruit and vegetables)

2-6. Description, sketching, classification and identification of families: ROSIDS- Rhamnaceae, Moraceae, Urticaceae, Cucurbitaceae, Begoniaceae, Casuarinaceae, Lythraceae, Onagraceae, Myrtaceae, Melastomataceae, Rutaceae, Meliaceae, Sapotaceae, Lecythidaceae, Solanaceae and identification of wild and cultivated plants represented in local flora.

Any additional practical/s based on theory syllabus will be added whenever necessary.

Reference Books:

Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.

Cronquist, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.

Davis, P. H. and V. H. Heywood 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi.

Endress Peter, K. 1994. Diversity and Evolutionary Biology of Tropical Flowers. Cambridge.

Judd Walter S., Campbell C. S., Kellogg, E. A., Stevens P.F. and M. J. Donoghue 2008. Plant Systematics-A Phylogenetic Approach. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.

Judd Walter S., Campbell C. S., Kellogg, E. A., Stevens P.F. and M. J. Donoghue 2008. Plant Systematics-A Phylogenetic Approach. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.

Lawrence, G. H. M. 1951. Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi.

Naik, V. N. 1984. Taxonomy of Angiosperms. Tata McGraw-Hill, New Delhi.

Quicke, Donald, L. J. 1993. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London.

Rao, R. R. 1994. Biodiversity of India (Floristic Aspects). Bishen Singh Mahendra Pal Singh, Dehra-Dun.

Rao, **R. R. 1994.** Biodiversity of India (Floristic Aspects). Bishen Singh Mahendra Pal Singh, Dehradun.

Richard, A. J. 1997. Plant Breeding Systems. (2ed.) Chapman and Hall.

Shivanna, K. R. and B. M. Johri 1985. The Angiosperm Pollen: Structure and Function. Wiley Eastern limited, New Delhi.

Taylor, D. V. and L. J. Hickey 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.

M. Sc. PART-II (SEMESTER IV)

(CCS402.6): Marine Botany

(SPECIAL PAPER III) MARINE ECOLOGY

Total Lectures: 60

UNIT I:

Marine environment: Exposed coasts, estuaries, oceans**. Abiotic factors** - Geological factors- oceans, ocean floor, classification of coasts. Physical factors- light, temperature, water movements (waves, tides, currents), Chemical factors-sea water, salinity, O_2 & CO_2 in sea water, ionic concentration & nutrients. **Biotic factors** –Food webs & chains, succession in marine communities, biological interactions. [12]

Zonation of marine algae: Intertidal, submerged, sublittoral zonation pattern, seasonality. [3]

UNIT II:

Ecology of mangroves: Morphological, anatomical and physiological adaptations in mangroves. Vivipary and it's role in mangroves. Zonation and succession in mangroves.

Faunal components of mangrove habitat- Invertebrates, birds, reptiles, fishery resources, mammals, sediment fauna. [7]

Mangrove conservation, restoration & management [4]

Legal Framework: Forest Conservation Act, Coastal Regulation Zone (CRZ), Biodiversity and wild life act. [4]

UNIT III:

Coastal vegetation and organic matter export: Decomposition, Detritus food chain, Ecological role of microbes. Microbial diversity in mangrove ecosystem - N_2 fixing, PO_4-solubilizing, S-reducing, methanogenic bacteria, Actinomycetes and fungi in mangrove ecosystem. [6]

Coral Reefs: Occurrence, distribution and types. Formation and erosion of coral reefs. Calcification, nutrient cycling, reef micro and macro algae, natural and anthropogenic stresses, management & restoration of coral ecosystem, concept of marine park/ marine protected areas. [9]

UNIT IV:

Marine pollution: Types, sources, heavy metal pollution-effects on algal metabolism, oil spills, fate of oil and effect on algal metabolism, synthetic organic chemicals-herbicides, insecticides, industrial chemicals (pcbs), complex wastes and eutrophication, pulp mill effluent, domestic

wastes, radioactive pollution, biological damage and indirect damage, management and restoration. Biomagnification. [10]

Ecological role of mangrove ecosystem: Screening of solar radiations, control of cyclones, flood, prevention of coastal erosion, support for fishes and wild life population, protection to other ecosystems. [5]

CCPR 405.6 : MARINE BOTANY PAPER XV: PRACTICAL COURSE III

UNIT V:

1-2. Determination of EC, pH, salinity and chlorinity of seawater.

3. Determination of nitrate content of seawater.

4. Determination of phosphate content from seawater.

5-6. Study of salts glands, trichomes, sclereids in mangroves.

UNIT VI:

1. Study of vivipary in mangrove families.

2-3. Study of faunal members from mangroves ecosystem.

4. Determination of oil and grease / hydrocarbon content of polluted sea water

5. Study of zonation pattern in mangroves.

6. Determination of sulphate content from marine sediment/soil.

Reference Books:-

Chapman,V. J. (1976).Costal Vegetation.2 nd edition Pergamon Press. New York.

Daves, C. J (1985).Marine Botany Physiology and Ecology of Seaweeds.

Dawson (1960).Marine Botany.

Gerald, E. Ecophysiology of Economic Plants in Arid and Semiarid Land.

Lobban, C. S. & Harrison, P. J. (1985). Seaweed Ecology and Physiology.Cambridge University Press.

McConnaughey, B. H (1974).Introduction to Marine Biology.

Naskar, Kumudranjan, Dwijendra Narayan Guha ,Bakshi. Mangrove Swamps of the Sundar bans. An Ecological Perspective. Naya Prakash.

Naskar, Kumundrajan and Rathindranath Mandal (1999). Ecology and Biodiversity of Indian Mangroves, Vol. I and II.

Pandey B.P. (1994). Algae . S. Chand and Co. Ltd., New Delhi. Current trends in life

science, Vol.23: Agromicrobes, Today and Tomarrow. Publ. New Delhi.

Parsons, T. R. , Maita,Y & Lalli, C. M. A Manual of Chemical and Biological Methods for Sea Water Analysis.

Ranade, D. R. & Gadre, R. V. (1988). Microbial Aspects of Anaerobic Digestion. Laboratory

Saenger, P. (2002). Mangrove Ecology, Silviculture and Conservation. Springer.

Soepadmo, E. A. N. Rao and Macintosh, D. J. (1988). Proceedings of Asian Symposium. Mangrove Environment Research Management, Kuala Lumpur.

Stein, J. R. (1973) Handbook of Phycological Methods. Cambridge University Press.

Tait, R. V. (1981) Elements of Marine Ecology.

Zha, M. N. (1999). Current Trends in Life Sciences Vol.23, Agromicrobes. Today and Tomorrow . Publi,. New Delhi.

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M. Sc. PART-II (SEMESTER IV)

(CCS402.7): Plant Biotechnology

(SPECIAL PAPER III) APPLICATION AND PROSPECTS OF PLANT TISSUE CULTURE

Total Lectures: 60

UNIT I:

Application of biotechnology in conservation of plant generic resources: *In- situ* conservation, *Ex-situ* conservation [5]

Application of tissue culture in agriculture: Plant improvement through tissue culture technology; production of resistant lines to biotic and abiotic stresses [10]

UNIT II:

Applications of tissue culture in horticulture, forestry and sericulture: micropropagation of Banana, Bamboo, *Tectona*, *Nothapodytes* and *Morus* [7]

Tissue culture in orchids and *Gerbera* [6]

Prospects in plant tissue culture industry in India; Applications in public sector [2]

UNIT III:

Secondary metabolite production from callus and cell suspension [4]

Biotransformation, process design and product recovery from cultured plant cells. Factors affecting product yield, bioreactors [8]
Secondary metabolites from immobilized plant cells; production of single cells proteins [3]

UNIT IV:

Transgenic plants for crop improvement: Resistance to abiotic stresses (salt, oxidative, herbicide and drought resistance); Resistance to biotic stresses (fungi, insect and virus resistance) [11]

Molecular farming, edible vaccines [4]

CCPR 405.7 : PLANT BIOTECHNOLOGY PAPER XV: PRACTICAL COURSE III

UNIT V:

1-2.*In vitro* culture of any RET plant species
3. Screening of cell cultures for abiotic (PEG)/ biotic (fungal) stress
4. Micropropagation of Banana
5. *In vitro* germination of orchid seeds
6. Micropropagation of *Gerbera*

UNIT VI:

1-2. Hairy root culture
3-4. Production of synseeds and cell immobilization
5. Effect of elicitor (Chitosan) on production of secondary metabolites from cell culture
6. Study of transgenic plants (Bt/ Terminator/ edible vaccines etc.)

Reference Books:

Altman, A. 1998. Agricultural Biotechnology. Marcel Dekker, New York.

Chavala, H. S. 1998. Biotechnology in crop improvement. International Book Distributing Co. New Delhi.

Glick, B. R. and Pasternak, J. J. 1994. Molecular Biotechnology- Principles and applications of recombinant DNA. ASM Press, Washington.

Gupta, P. K. 2000. Elements of Biotechnology. Rastogi Publisher, Meerut, India.

Kakralya, B. and Ahuja, I. 2001. Transgenic Plants-Promise or Danger. Agrobios, India.

Ravishankar, G. A.and Venkataraman, L. V. 1997. Biotechnological applications of plant tissue and cell culture. Oxford and IHB Publishing Co. Pvt. Ltd., New Delhi.

Reddy, S. M., Srivastava, H. P., Purohit, D. K., and Reddy, S. R. 1997. Microbial biotechnology. Scientific Publishers, Jodhpur, India.

Schlegel, H. G.1995. General microbiology. Cambridge University Press.

Trehan, K.1994.Biotechnology.Wiley Eastern Ltd. New Delhi.

M. Sc. PART-II (SEMESTER IV)

(CCS403.1): Plant Physiology

(SPECIAL PAPER IV) APPLIED PLANT PHYSIOLOGY

Total Lectures: 60

UNIT I:

Crop growth and its regulation: Growth analysis of crop plants and its significance. Factors controlling crop productivity, Harvest Index (HI), Water Use Efficiency (WUE). [5]

Nutriophysiology: Foliar diagnosis of critical nutrient status. Applications of lime and gypsum lime as soil additives. Role of chelates in mineral utilization. Foliar applications of mineral elements. Biofertilizers, CO_2 as a fertilizer. [10]

UNIT II:

Reproductive physiology: Role of PGRs in flowering, sex determination and fruit development. Ethylene and post harvest physiology. [9]

Source-Sink capacity in crop plants and its significance. [6]

UNIT III

Plant growth regulators in agriculture and horticulture: Mode of applications of PGR's

Pre sowing soaking treatment, foliar application and other modes

Roles: Ethylene and ethylene generating compounds, long chain alcohols, Brassinosteroids, plant growth retardants, amino acid mixtures and other commercial products. Biotonics. [15]

UNIT IV:

Invading weeds, crop-weed interaction, weedicides and their mode of action [8]
Physiological aspects of transgenic crops. [4]
A brief idea of crop physiological research in India. [3]

CCPR 405.3.1 : PLANT PHYSIOLOGY PAPER XVI: PRACTICAL COURSE IV

Project work based on special papers.

Reference Books:-

Asana, R.D. and Sarin, M.N. (1968) Crop physiology in India. Tech. Bull. 16.

Indian Coun. Agric. Res. (Agric. Ser.)

Buchnan, B.B., Gruissem, W. And Jones, R.L. (2000) Biochemistry and Molecular Biology of

Plants. Wiley-Blackwell

Evans, L.T.(1972): Crop Physiology. Some Case Histories. Cambridge, NY

Fageria, N. K. (1992): Maximizing crop yield. CRC Press

Fitter, A.H. and R.K.M. Hay (1987) Environmental Physiology of Plants.(Second Edition) Academic Press, San Diego, CA

Gupta U.S. (1988) Progress in Crop Physiology. Oxford and IBH. Pub. Co.

Gupta U.S. (1995) Production and Improvements of Crops for Drylands. Oxford and IBH. Pub.

Co.

Krishnamurthy, H.N. (1992): Physiology of Plant Growth and Development. Atma Ram and Sons, Delhi.

Nickell, L.G. (1982) Plant Growth Reggulators- Agricultural Uses. Springer-Verlag,New York

Pessarakli, M. (Ed.). (2001). Handbook of Plant and Crop Physiology, 2nd Edition, Revised and Expanded. Marcel Dekker, Inc., New York

Taiz, L. and Zeiger, F. (1998, 2002, 2008): The Plant Physiology. (Second Edition 1998,

Third Edition2002, Fourth Edition 2008) Sunderland: Sinauer Associates.

Journals

Annual Review of Plant Physiology and Molecular Biology.

Annual Review of Plant Physiology

Indian Journal of Plant Physiology.

Journal of Experimental Botany.

Physiologia Plantarum Sweden.

Plant Physiology (Bethedsa, USA).

Plant Cell.

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M. Sc. PART-II (SEMESTER IV)

(CCS403.2): Mycology and Plant Pathology

(SPECIAL PAPER IV) INTEGRATED DISEASE MANAGEMENT

Total Lectures: 60

UNIT I:

Methods of disease diagnosis: Field observation, isolation and identification of Pathogens. [5]

Integrated management of plant diseases: Definition of IDM, international approach, Quarantine laws, Culture methods, avoidance of pathogen, breeding and use of disease resistant varieties. Seed certification. [10]

UNIT II:

Chemical methods, formulation and classification of fungicides, contact and systemic fungicides, uptake and mode of action. Seed, soil, plant treatments of fungicides, fungicide resistance in plant pathogens and their management. Antibiotics and biological control of plant pathogenic fungi. Biological control agents, VA-Mycorrhiza, *Trichoderma viride,T. harzianum, Pseudomonas flurescans, Glomus* spp. Use of botanicals and other biopesticides. [15]

UNIT III:

Integrated management of some important diseases-History, symptomology, pathogen, etiology and management: Jowar (Head and Grain smut), Bajara (Green ear), Wheat (Rust and Bunt), Rice (Blast), Groundnut (Leaf spot and Rust), Sunflower (Downy mildew), Soybean (Mosaic), Cotton (Angular leaf spot). [15]

UNIT IV:

Integrated management of some important diseases-Sugarcane (Whip smut and Grassy shoot), Banana (Blight), Citrus (Canker), Grapes (Powdery mildew, Anthracnose, Downy mildew), Pigeon pea (Wilt), Bhendi (Yellow vein mosaic virus), Potato (Early and late blight), Tomato (Early blight). [15]

CCPR 405.3.2: MYCOLOGY AND PLANT PATHOLOGY PAPER XVI: PRACTICAL COURSE IV

Project work based on special papers.

References Books:

Lalithakumari D. (2000). Fungal Protoplast: A Biotechnological Tool: Oxford and IBH Publishing Co. Pvt.Ltd.

Mathews, R. E. F. (1970). Plant Virology. Academic Press, New York

Tilak, S.T. (1998). Aerobiology. Satyajeet Prakashan

Kenneth M. Smith (1968). Plant Viruses. Acacdemic Press, New York

Bawden, F. C. (1964). Plant Viruses and Virus Diseases. Biotech Books, New Delhi

Mehrotra, R. S. (1980). Plant Pathology Tata McGraw-Hill Publishing Company Ltd.

Agrios, G. N. (2006). Plant Pathology (5th Edition). Academic Press, New York

Ny Vall, R. F. (1979). Field Crop Diseases Handbook. Wiley

Singh, R. S. (1963). Plant Diseases.—
Padoley, S. K. and P. B. Mistry: A manual of Plant pathology. International Book House, New Delhi

Gangopadhyay, S. (1984): Clinical Plant Pathology Kalyani Publishers

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M.Sc. PART-II SEMESTER IV

(CCS403.3): Cytogenetics and Plant Breeding

(SPECIAL PAPER IV) SPECIAL APPROACHES IN GENETIC IMPROVEMENT OF CROP PLANTS

Total Lectures: 60

UNIT I:

Functional genomics: Genome annotation
RNA interference mechanism, synthesis and its applications, Virus induced gene silencing (VIGS), VIGS in plant genomic research
Transcriptomics and methods of transcriptome analysis

UNIT II:

Quantitative trait loci (QTL), Methods of QTL analysis by using molecular markers.
Mapping population (RIL,NILS, DH , back cross) their mechanism an development.
Bulk segregation analysis. Allele Mining for crop improvement: Approaches for allele mining, significance of novel alleles, applications of allele mining.
Marker assisted selection for crop improvement: Selection of markers, breeding schemes involved, gene pyramiding applications of MAS.
Epigenetics and Epigenomics for crop improvement

UNIT III:

Tissue Culture: Anther culture, production of haploids, embryo rescuing and its uses in crop improvement.
Production of secondary metabolites, cell line isolation, hairy root culture with some important secondary metabolite production and use of bioreactors
Production of biotic and abiotic resistant plants using tissue culture.

UNIT IV:

Transgenics: a) Methods of gene transfer and its expression
b) Transgenic crops for biotic and abiotic stresses, nutritional quality improvement,
c) Transgenic crops field testing and regulatory measures

CCPR 405.3.3. :CYTOGENETICS AND PLANT BREEDING PAPER XVI: PRACTICAL COURSE IV

Project work based on special papers.

Reference Books:

Thimmaiah S. R. 1999, Standard methods of biochemical analysis. Kalyani Publishers Ludhiana.

Mitra Sandhya 1996, Genetic Engineering Macmillan India Ltd.

Lal R. and Lal S. 1993, Genetic engineering of plants for crop improvement. CRC Press.

Winkler, U. Ruger W. and Wackernagel W. 1979. Bacterial phage and molecular genetics. Narosa Publication New Delhi.

Chawala H. S. 2000 Introduction to Plant Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd.

Vidhyashekaran P. 1993 Molecular biology and tissue culture fro crop pest and disease management. Daya Publishing House New Delhi.

Kumar U. 2005 Methods in Plant Tissue culture Agrobios Jodhpur India.

Razdan M. K. 2003 Introduction to plant tissue culture. Oxford and IBH publishing Co. Pvt. Ltd.

Gustafson J. P. 1990 Gene manipulation in plant improvement I and II. Plenum Press London.

Old R. W. and Primrose S. B. 1989 Principles of Gene Manipulation. Blackwell Scientific Publ Oxford UK.

Razdan M. K. and Cocking E.C. 2000 Conservation of plant genetic recourses in vitro. Oxford and IBH publishing Co. Pvt. Ltd.

Razdan M. K. and Bhojwani S. S. 1996, Plant tissue culture: Theory and practice a revised edition. Elsevier Science.

Gupta P. K. 2010 Plant Biotechnology. Rastogi Publications Meerut.

Singh B. D. 2003 Biotechnology Expanding Horizons. Kalyani publishers Ludhiana.

Trigiano R. N. and Gray D. J. 2000 Plant tissue culture concepts and laboratory exercises. CRS press LLC.

Manibhushanrao K. and Mahadevan A. 1996 Recent developments in biocontrol of plant pathogens. Today and Tomorrow's printers and publishers New Delhi.

Reinert J. and Bajaj Y. P. S. 2000 Plant cell, Tissue and Organ culture. Springer –Verlag. New York,

Chrispeels M. J. and Sadava D. E. 1994 Plants, Genes and Agriculture. Jones and Barlett Publishers Boston, USA.

Gustafson J. P. 2000 Genomes. Kluwer Academic Plenum Publishers New York USA.

Brown T. A. 1999 Genomes. John Wiley and Sons Pvt. Ltd. Singapore.

Liu Ben Hui 1998 Statistical Genomics :Linkage Mapping and QTL Analysis. CRC Press LLC Florida USA.

Wennacker Ernst L. 1987 From Genes to Clones; Introduction to Gene Technology VCH publishers Weinheim (Federal Republic of Germany)

Mount D. W. 2001 Bioinformatics Sequence and Genome Analysis. Cold Spring Harbour Laboratory. New York.

Jagota A. 2000 Data Analysis and Classification for Bioinformatics. Published by Bioinformatics by the bay Press. University of Michigan, USA

Durbin R, Sean R., Eddy, Anders Krogh, Graeme M.1999 Biological Analysis-Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press.

Andreas Baxevanis, B. F. Francis Ouellette and B. F. Cuellette 1998 Bioinformatics : A Practical Guide to the analysis of Genes and Proteins, Wiley Publishers, New York

Journals:

1. Indian Journal of Biotechnology
2. Indian Journal of Experimental Biology
3. Journal of Experimental Botany
4. Trends in Biotechnology (Elsevier)
5. Trends in biochemical Sciences (Elsevier)
6. Journal of Molecular Plant Pathology
7. Journal of Plant Biotechnology
8. International Journal of Food Science and Technology.

M.Sc. II PART- II (SEMESTER IV)

(CCS403.4): Energy, Ecology and Environment

(SPECIAL PAPER IV) ENVIRONMENTAL ISSUES, ASSESSMENT AND RESTORATION

Total Lectures: 60

UNIT I:

Air pollution: Classification, Acidic precipitation, causes and consequences. Air pollution monitoring devices. [6]

Water pollution: Classification of water pollutants. Oxygen demanding pollutants and their activity. Pathogens, nutrients, salts, heat, heavy metals and pesticides. Radioactive and oil pollutants. Self-purification of natural streams.Oxygen sag analysis. [9]

UNIT II:

Environmental issues: Ozone – Positive and negative influence of ozone.
Air quality loss, nuclear winter, vehicular and industrial gases, global climate change [9]
Land degradation: Loss of soil fertility, mining etc [6]

Unit III :

Environmental impact assessment: Concept, scope and objectives of EIA, Biological monitoring programme, Bio indicators and environmental monitoring [6]
Remote sensing and GIS, Environmental impact assessment, Methodology, Component of EIA Environmental management India environmental law.[9]

UNIT IV:

Natural resources: Conservation and management of natural resources such as Water, Soil, Forest, Wildlife etc. [9]
Recycling of natural resources, Waste management, Waste disposal [4]
Ecotourism and Eco-friendly measures: Guideline, Sustainability of ecotourism [2]

CCPR 405.3.4 : ECOLOGY PAPER XVI: PRACTICAL COURSE IV

Project work based on special papers.

Reference Books:

Adriano, D. C. and **Johnson, A. H**. (1989): Acidic precipitation, vol. II. John Wiley *Publishers*.

Balkrishnan, M., Borgstrom, R. and Bie, S. W. (1994): Tropical Ecosystems. Oxford and IBH *Publishing* Co.

Dash,M. C. (1993): Fundamentals of Ecology. Tata *Mc*.Graw Hill *Publishing*Company Ltd. New Delhi.

De, A. K. (1994): Environmental Chemistry. New Age international *publishers.*

Good, R. E. *et al* (1978): Fresh water wetlands. Margraf *Publishers.*

Gregory S. (1988): Recent climatic changes: A regional approach. Kluwer Academic *Publisher.*

Lal, J. B. (1987): Environmental Conservation. *Publisher*: International Book Distributors.

Misra K. C. (1989): Manual of plant ecology. Oxford and IBH Publishing Co., New Delhi.

Owen, M. and Black, J. M. (1990): Waterfall Ecology. Blackie *Publishers*, Glasgow, Scotland.

M. Sc. PART-II (SEMESTER IV)

(CCS403.5): Angiosperm Taxonomy

(SPECIAL PAPER IV) PHYLOGENY AND FLORAL BIOLOGY OF ANGIOSPERMS

Total Lectures: 60

UNIT I:

Origin of Angiosperms: Pre-cretaceous and Cretaceous fossil angiosperms, time of origin of angiosperms, cradle of angiosperms, probable ancestors of angiosperms- *Isoetes*-monocotyledon theory, Coniferales-amentiferae theory, Gnetales-angiosperm theory, Anthostrobilus theory, Caytonian theory, Stachyospory-phyllospermae theory, Pteridosperm theory, Pentoxylales theory and Durian theory, monophyletic verses polyphyletic origin of angiosperms. [9]

Fossil Angiosperms of India: A brief account of fossil angiosperms of India- Palmae: *Palmoxylon, Rhizopalmoxylon, Palmocarpon*; Cyclanthaceae: *Cyclanthodendron, Tricoccites*; Pandanaceae: *Viracarpon;* Musaceae: *Musa cardiospermum*; Gramineae: *Graminocarpon*; Sonnertiaceae: *Sonnertioxylon, Sonnertiorhizos, Sahnianthus, Enigmocarpon*; Guttiferae: *Indocarpa*, Myrtaceae: *Sahnipushpam*; Malvaceae: *Sahniocarpon*, *Harissocarpon, Daberocarpon, Chitaleypushpam*. Fossil angiosperms and palaeoecology of India. [6]

UNIT II:

Floral Biology-I: Evolution of flower, evolution of floral biology in basal angiosperms, co-evolution of flowering plant and insects, sex in flowers, sex distribution in plants, types of pollination, chasmogamy and cleistogamy; biology of floral parts-calyx, corolla, androecium, pollen, style and stigma. [15]

UNIT-III

Floral Biology-II: Anemophily, haydrophily, ornithophily, cheiropterophily, entomophily- beetle, fly, bee, wasp, *Catasetum*, fig wasp, butterfly, moth, carpenter bee pollination; floral diversity and evolutionary steps toward asclepiad flowers. [15]

UNIT IV

Morphological variations, systematic position, interrelationships, phylogeny and economic importance of following families: ASTERIDS-Convolvulaceae, Boraginaceae, Rubiaceae, Apocynaceae, Oleaceae, Scrophulariaceae, Bignoniaceae, Lentibulariaceae, Verbenaceae, Lamiaceae [15]

CCPR 405.3.5: ANGIOSERM TAXONOMY PAPER XVI: PRACTICAL COURSE IV

Project work based on special papers.

Reference Books:

Cronquist, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.

Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.

Davis, P. H. and V. H. Heywood. 1991. Principles of Angiosperm Taxonomy. Today and Tommorow Publications, New Delhi.

Manilal, K. S. and M. S. Muktesh Kumar [ed.]. 1998. A Handbook of Taxonomic Training. DST, New Delhi.

Naik, V. N. 1984. Taxonomy of Angiosperms Tata McGraw-Hill Publication Com. Ltd. New Delhi.

Quicke, Donald, L. J. 1993. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London.

Rao, R. R. 1994. Biodiversity of India (Floristic Aspects). Bishen Singh Mahendra Pal Singh, Dehra-Dun.

Taylor, D. V. and L. J. Hickey. 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.

Lawrence, G. H. M. 1951. Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi .

Shivanna, K. R. and B. M. Johri. 1985. The Angiosperm Pollen: structure and Function. Wiley Eastern limited, New Delhi.

Endress Peter, K. 1994. Diversity and Evolutionary Biology of Tropical Flowers. Cambridge.

Richard, A. J. 1997. Plant Breeding Systems. (2ed.) Chapman and Hall.

Nayar, M. P. 1996. Hot Spots of Endemic Plants of India, Nepal and Bhutan. Tropical BotanicaGardens and Research Institute, Palode, Kerala

Ahmedullah, M. and M. P. Nayar. 1987. Endemic Plants of the Indian Region Vol I. Botanical Survey of India.

Synge, Hugh (ed.). 1980. The biological aspects of Rare Plant Conservation. John Wiley & Sons.

Judd Walter S., Campbell C. S., Kellogg, E. A., Stevens, P.F. and M. J. Donoghue. 2008. Plant Systematics. Sinauer Associates, INC,Publishers. Sunderland, Massachusetts, USA.

Percival, M. S. 1965. Floral Biology. Pergamon Press, London.

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M. Sc. PART-II (SEMESTER IV)

(CCS403.6): Marine Botany

(SPECIAL PAPER IV) APPLIED MARINE BOTANY

Total Lectures: 60

UNIT I:

Primary Production: Overview, GPP and NPP, Oceanic Production, effect of light and nutrients, Biomass harvesting/ harvest method, litter fall, chlorophyll method, gas exchange technique. Standing crop, light and dark bottle method, ecological indices. [8]

Methods of Mangrove Analysis: Collection by field methods-Transect, Quadrat, Phytosurvey. Geological Methods-Location, Elevation, Use of remote sensing technique in mapping of vegetation, Use of GPS. [7]

UNIT II:

Collection and Preservation of Marine Algae: Methods of collection, chemical preservation, herbarium technique. [3]

Seaweed Mariculture: Commercial cultivation of economic seaweeds, Scientific bases for seaweed mariculture, Techniques of seaweed mariculture- *Porphyra , Laminaria, Undaria, Kappaphycus Gracilaria* etc Future prospects: [12]

UNIT III:

Utilization of Seaweeds: Human food, sea vegetables, fodder, fertilizer and manure ,kelp industry, antibiotics and drugs, phycocolloides and their applications. Algal Products- Soda and Potash, Iodine, Trace elements. Use of algae as Bio fuel. [10]

Laboratory Culture of Algae : Use of natural and synthetic culture media, types of culture, requirements/conditions of growth, difficulties in getting axenic culture. [5]

UNIT IV:

Coastal Bioresources: Bioresource profile. Wild bioresources - food , feed, fodder, fire wood, timber, medicinal products, potential genetic resources, ornamentals. Domestic bioresources - crops, cereals, pulses, oil crops, horticultural crops, live stock, aquaculture, apiculture. [5]

Nursery Techniques in Mangroves: Nursery practices-collection of seed/ propagule/seeding material, storage, sowing of seeds, shading, watering, disease control and transplantation. [6]

Mangrove Plantation Techniques: Direct and indirect methods, zonation, season, gap filling, soil condition etc. [4]

CCPR 405.3.6: MARINE BOTANY PAPER XVI: PRACTICAL COURSE IV

Project work based on special papers.

Reference Books:

Beck. Biotechnology of Microalgae.

Bhosale, L. J.(2005). Mangroves of Maharashtra. (Field Guide). Shivaji University,Kolhapur.

Chapman,V. J. (1976). Costal Vegetation. II nd edition Pergamon Press. New York.

Jackson. D. F. (1972). Algae and Man. Plenum Press.

Kannupandi, T. (1998). Coral Reefs of India. State of Art Report. ENVIS Publication Series 2/98.

Krishnamurthy, V. (1985). Marine Plants. (A.G. Untawale, Asso. Editor), Seaweed Research and Utilization Association, Madras.

Santhanam, R.; Ramnathan,N.; Venkataramanjan K. & Jegathanam,G. (1987) . Phytoplankton of Indian Seas. & Aspects of Marine Botany.Daya Publication Home. Delhi.

Stein, J. R. (1973) Handbook of Phycological Methods. Cambridge University Press.

Stoermer, E. F. & Smol, J. P. The Diatoms. Applications for Environment and Earth Sciences

Swaminathan M. S. Research foundation (2003). Bioresources Status in Selected Costal Location. National Bioresource Development Board (Department of Biotechnology) Govt. of India.

Trainor, F. R. Introductory Phycology.

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M. Sc. PART-II (SEMESTER IV)

(CCS403.7): Plant Biotechnology

APPLICATION, REGULATION AND PATENTING BIOTECHNOLOGY

Total Lectures: 60

UNIT I:

Biotechnology in Agriculture: Bioethical principles for agricultural biotechnology, ethical aspects and public acceptance [5]
Biological Nitrogen Fixation: Mechanism of N_2 fixation, Symbiotic N_2 fixation, Mechanism of N_2 fixation in root nodules, Nod genes, Nif genes, Hup genes [7]Use of microbes in Industry and agriculture [3]

UNIT II:

Application of biotechnology in environmental protection: Pollution control, phytoremediation immobilized microbial cells, wastewater treatment, microbes in leaching of metals [10]

Economic and legal issues of biotechnology [5]

UNIT III:

Regulating the use of biotechnology in recombinant DNA technology, food, food ingredients and GMO's – cost benefit analysis of GMO's [6]

Global biotech scenario, public verses private enterprises, international organizations involved in biotechnological inventions, cooperative programmes [5]

Biotechnological spotlights [4]

UNIT IV:

Intellectual property; Intellectual Property Rights (IPR) and its protection, IPR and Plant Genetic Resources, GATT and TRIPS [5]

Patent systems in India, sources of patent information: a case study [5]

Patenting biotechnological inventions: Patent of higher plants, patent of genes and DNA sequences, plant breeder's right and farmer's right [5]

CCPR 405.3.7: PLANT BIOTECHNOLOGY PAPER XVI: PRACTICAL COURSE IV

Project work based on special papers.

Reference Books:

Altman, A. 1998. Agricultural Biotechnology. Marcel Dekker, New York.

Gupta, P. K. 2000. Elements of Biotechnology. Rastogi Publisher, Meerut, India.

Glick, B. R. and Pasternak, J. J. 1994. Molecular Biotechnology- Principles and applications of recombinant DNA. ASM Press, Washington.

Mitra, S. 1996. Genetic Engineering- principles and practice. Mcmilan, India ltd.

Technology information, forecasting and assessment council **(TIFAC).** 2002. Sources of patent information and patent agents. Technology Bhavan, New Delhi.

Technology information, forecasting and assessment council **(TIFAC).** 2002. Lecture notes on patents. Technology Bhavan, New Delhi.

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M. Sc PART-II (SEMESTER IV)

PAPER-XIV (DSE- 404)

BIODIVERSITY: CONSERVATION AND UTILISATION

Lectures: 60

UNIT-I

BIOLOGICAL DIVERSITY: Mega diversity countries, magnitude of biodiversity, direct, indirect and ethical values of biodiversity, loss of biodiversity, reasons for loss of biodiversity, Taxonomic initiatives, Systematic agenda 2020.

ENDEMISM: Definition, types of endemism, RED list categories of IUCN, Hot spots and Hottest hotspots, Keystone and Flagship species, Biodiversity of India, Hotspots of plant diversity in India, Plant endemism in India with special emphasis on Western Ghats.

UNIT-II

Principles of Biodiversity Conservation, Status of plants based on International Union for Conservation of Nature (IUCN), General account of activities of BSI, NBPGR, CSIR, DBT, NGOs. Convention on Biological diversity (CBD) and Documentation of biodiversity.

UNIT -III

In- situ conservation : concept, Protected areas – 1. Protected Areas category-system proposed by IUCN, 2. Protected Area Network of India including sanctuaries, National parks, conservation reserves, community reserves.3.Biosphere Reserves, Wetlands, Mangrove and Coral Reefs.

Ex- situ conservation: Concept, Botanical gardens, Gene banks, Seed banks, Pollen bank, Cryobanks.

UNIT-IV

WILD PLANT RESOURCES AND THEIR UTILIZATION: Wild Plants of ornamental potential, wild relatives of cultivated plants, wild edible plants and their nutritive value, under exploited medicinal plants, plants of commercial importance, energy plants, petrocrops, Plants suitable in phyto-remediation.

CCPR 405.4 : PLANT BIODIVERSITY AND CONSERVATION

PAPER XIV: PRACTICAL COURSE

Unit V:

1-3.Preparation of plant based products : dyes, essential oils, mosquito repellents, dhoop sticks

4. Study of endemic plants from Western Ghats (CR, EN, VU – 20 species)

5. Study of wild plants of Ornamental potential (15 plant species)

6. Wild relatives of cultivated plants (*Abelmoschus, Cucumis, Momordica, Vigna,* Rice*, Sorghum,* Sugarcane, *Flemingia*, *Cajanus*, banana etc.)

Unit VI:

1-2 Study of wild edible plants: microchemical test to detect sugar, starch, protein and lipids
3. Preparation of jam and jellies/ pickles/ sarbat/ tea etc.
4. Plants of commercial importance: detection of alkaloids (Solanaceae members)
5. Energy plants: determination of lipids (Castor, *Jatropha* and *Pongamia* seeds)
6. Plants useful in Phytoremediation

Books and References:

1. Tayler, V.E.; Brady, L.R. and Robber, J. R. 1976, Pharmacognosy, Balliere Tindall, Calcutta. Trease and Evans, 1972, Pharmacognosy, Lea and Fobiger, Philadelphia. .
2. Wagner, H. 1984, Plant Drug Analysis.
3. Wagner, H., 1977, New Natural Products and Plant Drugs with Pharmacological, Biological or Therapeutical Acitvity.
4. Wallis, T. E., 1967, Practical Pharmacology J and A Churchill LTD, London.
5. Dewick Paul M. 1998Medicinal natural products (a biosynthetic approach), Ist edn, by, John Wiley and sons Ltd., England
6. Pushpangadam P., Nyman UIF,.George V, 1995, Glimpses of Indian Ethanopharmacology Tropical botanic Gardon and research institute.
7. Peter B. Kaufman 1998 Natural Products from plants, Ist edn, by, CRC press, Newyork,
8. Farooqui A . A. and Shreeramu B.S. 2001 Cultivation of medicinal and aromatic crops, 1st edn, University press, new Delhi
9. Schirmer, R.E., 2000,Modern Methods ofPharmaceutical Analysis, Vol. 1, 2, Boca Raton F.L: CRC Press
10. Indian Pharmacopoeia 2007.
11. European Pharmacopoeia 6th Edn. 2008.
12. Leadlay, E. and Jury, S. (eds.). 2006. Taxonomy and Plant Conservation. Cambridge
13. University Press.

14. Heywood, V. H. and Watson, R. T. (eds.). 1995. Global Biodiversity Assessment. UNEP, UK,Cambridge University Press.
15. UNEP. 1992. Convention on Biological Diversity (CBD): Text and Annexes. Geneva,
16. Switzerland: CBD Interim Secretariat.
17. UNEP. 2002a. Global Taxonomy Initiative (GTI). DecisionVI/8. UNEP/CBD/COP/6/20
18. Montreal, Canada: CBD Secretariat.
19. A manual of ethnobotany Ed., S. K. Jain, Eciatific publications Jodhpur
20. A New moral Economy to India's forests ? – Roger Feffery and Nandini Sundar (1999). Sage Pub., New Delhi.
21. Advances in Oilseeds Production and Technology, G. V. Ramanamurthy. ICAR New Delhi (1985)
22. Agricultural Botany. N. T. Gill and K. C. Vear. Garal Duekworth and Co. Ltd. London (1969)
23. Agrofrestry India Perspeetive. L.K. Jha and P. K. Sengupta. Ashish Publishing House., New Delhi
24. Allen and Unwin Ltd., London (1954)
25. Applied Ethnobotany – E.Varghesee S-VD
26. Complete Gardening of India. K. S. Gopalaswaniengar, Rengedhy G. Parthasarathy and P. Mukadam. Pupl. By G. Partha ocrruthy Bengalore (1991)
27. Crop Protection Principles and Pratices, S.R. Chapmen and L.P. Carter. Publ. W. H. Freeman and Company Son Fran (1976)
28. Deep Aublicatins, New Delhi (1996)
29. Economic Botany, B. B. Simpson and M-Conner
30. Economic Botany, Hill A. Mcgrow Hill Book Company (1962)
31. Energy Plant Species. Their use and inpact on environment and development. N. El. Bassam. Publ. Jemes and Jemes (Science Publichers) U. K. (2005)
32. Field crops of India by A.K. Aiyer. Banglore Printing and Publishing Company Bangalore (1966)
33. Forest Management (1996). P. R. Trivedy and K.M. Sudarshan. Discovery publishing House, New Delhi.
34. Forest Resources – Crises and Management Natraj Publishers, Dehradun. Vandana Shiva, V. M. Meherhomji and N.D. Joryal (1992)
35. Forestry and the People (1994) L. K. Jha and P. K. Sen Sharma . Ashish Pub. House, New Delhi.
36. Forestry Handbook Ed. R. D. Forbes Publ. The Ronald Press Company New York (1955)
37. Foristry Research and Education in India. P.D. Dogra and R C. Dhiman (edt.) 1994. A Diamond Jubilee Publication by INSA, New Delhi.

DEPARTMENT OF BOTANY
(CHOICE BASED CREDIT SYSTEM) SEM I
Generic Elective Course Botany (GE 407)
Botany and Human Welfare

Total Lectures:30

Unit-I: Plants, Human and Environment (15)

1) Introduction to plants, plant resources and their importance in progress, prosperity and survival of human race (5)
2) Plants as key solution for major global problems viz. Energy, pollution control, agricultural productivity, global warming, climate change, soil fertility and conservation etc. (10)

Unit-II: Plants and plant products (15)

1) Vegetables, oil yielding plants, wild edible plants, food crops, spices and condiments, Forage- fodder plants (5)
2) Fibre yielding plants, textile fibres, cordage fibres, fibres for stuffing (3)
3) Important timber yielding plants and non-wood forest products (2)
4) Petro and sericulture crops (1)
5) Resin, dye, tannin and gum yielding plants and their applications in industry (2)
6) Grasses, their economic importance and human civilization (2)

References

Jain, S. K. 2004. A manual of ethnobotany. 2nd edition, Scientific publishers, India.

Ramanamurthy, G. V. 1985. Advances in Oilseeds Production and Technology. ICAR, New Delhi

Gill, N. T. and K. C. Vear and D.J. Barnard. 1980. Agricultural Botany. 3rd revised edition. Duckworth, London.

Jha, L.K. and P. K. Sarma.1993. Agrofrestry: Indian Perspective. Ashish Publishing House, New Delhi

Varghese, E. 1996. Applied Ethnobotany : A case study among the Kharias of Central India. Deep Publications, New Delhi.

Chapman S. R. and Carter L.P. 1976. Crop Production: Principles and Practices. Freeman and Company, San Francisco, USA.

EL Bassam, N. 1998.Energy Plant Species: Their Use and Impact on Environment and Development. Routledge.

Aiyer, A. K. 1966. Field crops of India. Banglore Printing and Publishing Company, Bangalore.

Shiva Vandana, V. M. Meherhomji and N.D. Joryal. 1992. Forest Resources-Crises and Management. Natraj Publishers, Dehradun.

Jha, L. K. and P. K. Sen Sarma. 1994. Forestry for the People. Ashish Publishing House, New Delhi.

Dogra, P.D. and R C. Dhiman (eds.). 1994. Forestry Research and Education in India. INSA, New Delhi.

Handbook of Agriculture. 1969. ICAR, New Delhi.

Wickens, G.E, N. Haq, P.Day (eds.). 1986. New Crops for Food and Industry. Chapman and Hall, New York.