PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR (CHHATTISGARH)

CURRICULUM & SYLLABI
(Based on CBCS & LOCF)

M.Sc. BOTANY
Program Code- 401

SEMESTER SYSTEM

ACADEMIC YEAR
2024-2026

Approved by	Board of Studies	Academic Council
Date		

M.Sc. BOTANY

PROGRAME OBJECTIVES:

M.Sc. Botany Master of science in Botany program is a two-year (four semester) post graduate program, which deals with basic and advanced study of plant. It is one of the multi-disciplinary field partially including sectors like agriculture, horticulture ,biotechnology, genomics, forest and environment .Starting from microbiology the course includes Phycology (the aquatic plants),the heterotroph fungi ,the amphibious bryophytes, the vascular pteridophytes ,the naked seeded gymnosperms and finally angiosperms .The students perusing this course are trained in taxonomy and can assess the floristic composition leading to analyse the status of bio diversity and environment assessment. In economic botany the knowledge of plants needed by human being is imparted. In ethnobotany plant- human relationship and identification and use of medicinal plants is studied. In genetics, besides basic knowledge the methods of producing new plant variety by gene transfer and production of transgenic plants are studied. No doubt, this field of plant science has contributed a lot in green revolution in our country. The modern techniques of gene isolation, gene mapping and gene transfer is a part of this program courses.

PROGRAM OUTCOMES(PO):

Upon successful completion of the Master of Science in Botany program, students will be able to:

PO-1	Disciplinary Knowledge: the curriculum provides exclusive knowledge of various life forms of plant kingdom, understanding about anatomy, embryology and plant propagation by tissue culture method besides plant pathology related disease control and production of disease resistant varieties.
PO-2	Critical Thinking and Reasoning: Exhibit advanced critical thinking skills by analysing and evaluating various techniques applied in plant science and their reasonable up gradation to enhance efficiency and accuracy.
PO-03	Problem Solving: provides an opportunity to solve problems related to obsolete tools and techniques and refine it on their own through project work.
PO-04	communication Skills: Possess advanced skills in both technical and non-technical audiences through written reports, presentation and teaching.
PO-05	Research related skill: The curriculum planning of M.Sc. botany program is to maintain a high level of scientific excellence in botanical research. in order to enhance research related skill students are encouraged for better dissertation and research related fieldwork in collaboration with premier institutions.

PO-06	Social/ Interdisciplinary Interaction: Integrate botanical concepts and techniques into interdisciplinary contexts, collaborating effectively with professionals from other fields to solve complex problems.
PO-07	Self-directed and Life-long Learning: Recognize the importance of ongoing professional development and lifelong learning in the rapidly evolving field of botany, and will exhibit the ability to continue learning independently or in formal educational settings.
PO-08	Effective Citizenship: Leadership and Innovation: Lead and innovate in various botanical contexts, contributing to advancements in the field and applying botanical and environmental insights to emerging challenges.
PO-9	Ethics: Demonstrate ethical and responsible conduct in botanical research, teaching, and collaboration, adhering to professional standards and best practices.
PO-10	Further Education or Employment: Engage for further academic pursuits, including Ph.D. programs in botany or related fields. Get employment in academia, research institutions, industry, government, and other sectors.
PO-11	Global Perspective: Recognize the global nature of botanical research and its impact, appreciating diverse cultural perspectives in botanical practices.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

At the end of the program, the student will be able to:

PSO-01	Understand the utility of botany and explore the application of the subject in present context.
PSO-02	Apply the knowledge of botany with allied subjects like ecology and genetics in interdisciplinary fields for finding appropriate solutions in challenging areas.
PSO-03	Pursue research in challenging areas of pure/applied botany.
PSO-04	Apply confidently the knowledge of botanical software, international database and tools for solving complex problems in scientific investigations.
PSO-05	Qualify national level tests like NET/GATE etc.

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M.Sc. BOTANY

Program Code- 401

Programme Scheme

Semester	Paper	Course Code	Title	External marks	Internal marks	Credit
First	I	BOT-110	Cytology	70	30	5
	II	BOT-120	Genetics	70	30	5
	III	BOT-130	Microbiology,Phycology and Mycology	70	30	5
	IV	BOT-140	Bryophyta, Pteridophyta and Gymnosperm	70	30	5
	LC - I	LBOT-150	Lab Course-I (Based on paper I &III)	70	30	2
	LC - II	LBOT-160	Lab Course-II (Based on paper I &IV)	70	30	2
Second	I	BOT-210	Plant development and plant resources	70	30	5
	II	BOT-220	Molecular Biology	70	30	5
	III	BOT-230	Plant physiology	70	30	
	IV	BOT-240	Plant metabolism	70	30	5
	LC- I	LBOT-250	Lab Course-I (Based on paper I &II)	70	30	2
	LC-II	LBOT-260	Lab Course-I (Based on paper II &IV)	70	30	2
Third	I	BOT-310	Taxonomy and diversity of plants	70	30	5
	II	BOT-320	Plant Ecology– I (Ecosystemand vegetation ecology)	70	30	5
	III	BOT-330	Biotechnology I (Genetic engineering of plants & microbes)	70	30	5
	IV	BOT-340-A	Elective paper-1 Molecular plant pathology-I	70	30	5
		BOT-340-B	Elective paper-II Limnology-I			
		BOT-340-C	Elective paper-III Ethnobotany I			
	LC-I	LBOT-350	Lab Course-I (Based on paper I &II)	70	30	2
	LC-II	LBOT-360	Lab Course-II (Based on paper III &IV)	70	30	2

Fourth	**I**	**BOT-410**	**Plant reproduction and plant resources utilization**	**70**	**30**	**5**
	II	**BOT-420**	**Plant Ecology II(Pollution and biodiversity conservation)**	**70**	**30**	**5**
	III	**BOT-430**	**Biotechnology II (Plant cell, tissue culture & organ culture)**	**70**	**30**	**5**
	IV	**BOT-440-A**	**Elective paper-1 Molecular plant pathology-II**	**70**	**30**	**5**
		BOT-440-B	**Elective paper-II Limnology-II**			
		BOT-440-C	**Elective paper-III Ethnobotany II**			
	LC-I	**LBOT-450**	**Lab Course-I (Based on paper I &II)**	**70**	**30**	**2**
	LC-II	**LBOT-460**	**Lab Course-II (Based on paper III &IV)**	**70**	**30**	**2**

- Choice Based Credit System: Semester II Course Forestry Seed Technology. Marks 100, Credit Points -03, Total Hours -50
- Choice Based Credit System: Semester III Course Environmental Science. Marks 100, Credit Points -03, Total Hours -50
- Each theory paper will have 5 questions of equal marks. First question will encompass all the five units without internal choice, whereas rest questions will be unit wise with internal choice.
- The respective teachers on each paper will ensure the internal evaluation by a class test and a seminar / poster presentation of 20 marks each and submit the foil and counter foil to the HOD by the end of the activity.

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SCHEME OF EXAMINATION,

M.Sc. I SEMESTER,

BOTANY THEORY

PAPER	COURSE CODE	TITLE	MAX. MARKS	Internal Assessment/ Seminar	Total marks
I	BOT-110	CYTOLOGY	70	30	100
II	BOT-120	GENETICS	70	30	100
III	BOT-130	MICROBIOLOGY, PHYCOLOGY AND MYCOLOGY	70	30	100
IV	BOT-140	BRYOPHYTA, PTERIDOPHYTA AND GYMNOSPERM	70	30	100

M.Sc. (BOTANY) II - SEMESTER,

BOTANY THEORY

PAPER	COURSE CODE	TITLE	MAX. MARKS	Internal Assessment /Seminar	Total marks
I	BOT-210	PLANT DEVELOPMENT AND PLANT RESOURCES	70	30	100
II	BOT-220	MOLECULAR BIOLOGY	70	30	100
III	BOT-230	PLANT PHYSIOLOGY	70	30	100
IV	BOT-240	PLANT METABOLISM	70	30	100

Choice Based Credit System: Semester II **Course Forestry Seed Technology.Marks 100, Credit Points -03, Total Hours -50**

PRACTICAL

LAB COURSE-I	LBOT-150	BASED ON PAPER I & II	70	30	100
LAB COURSE-II	LBOT-160	BASED ON PAPER III & IV	70	30	100
		TOTAL MARKS (Theory and Practical)			600

TOTAL MARKS OF SEMESTER I &II – 1200

NOTE:

- **Botanical excursion (within or outside Chhattisgarh) is compulsory for the Students of M.Sc.**
- **Students who have obtained 60 or more than 60 percentage marks can go for a dissertation. They should not study one special elective papers in the fourth semester.**

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PRACTICAL SCHEME

M.Sc. (BOTANY) I- SEMESTER

LAB COURSE- I

Time-5 Hours **Maximum Marks 100**

S.N	Exercise	Marks
1.	Exercise based on Cytology	15
2.	Exercise based on Phycology	20
3	Exercise based on Mycology	15
4.	Spotting	10
5.	Viva-voce	10
6.	Sessional (Internal Assessment)	30
	Total Marks	100

PRACTICAL SCHEME

M.Sc. (BOTANY) I- SEMESTER

LAB COURSE- II

Time-5 Hours **Maximum Marks 100**

S.N	Exercise	Marks
1.	Exercise based on Genetics	10
2.	Exercise based on Bryophyta	10
3	Exercise based on Pteridophyta	15
4	Exercise based on Gymnosperm	15
5.	Spotting	10
6.	Viva-voce	10
7.	Sessional (Internal Assessment)	30
	Total Marks	100

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PRACTICAL SCHEME

M.Sc. (BOTANY) II- SEMESTER

LAB COURSE- I

Time-5 Hours **Maximum Marks 100**

S.N	Exercise	Marks
1.	Exercise based on Molecular biology	20
2.	Exercise based on plant development and plant resources	30
3.	Spotting	10
4.	Viva-voce	10
5.	Sessional (Internal Assessment)	30
	Total Marks	100

PRACTICAL SCHEME

M.Sc. (BOTANY) II- SEMESTER

LAB COURSE- II

Time-5 Hours **Maximum Marks 100**

S.N	Exercise	Marks
1.	Exercise based on Paper-III	25
2.	Exercise based on Paper-IV	25
3.	Spotting	10
4.	Viva-voce	10
5.	Sessional (Internal Assessment)	30
	Total Marks	100

Pt. Ravishankar Shukla University, Raipur (Chhattisgarh)

M.Sc. BOTANY FIRST SEMESTER			
COURSE CODE: BOT-110			**COURSE TYPE: CCC**
COURSE TITLE: CYTOLOGY		**PAPER-I**	
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: The paper deals with Mendelian and non-Mendelian inheritance, quantitative genetics, molecular markers and linkage mapping, prokaryotic and eukaryotic genome-structure, gene function and regulation, epigenetics, cytogenetics and crop evolution.			

UNIT –1	• The dynamic cells, Structural organization of the plant cell, specialized plant cell type chemical foundation, biochemical energetics. • Cell wall - Structure and functions, biogenesis growth. • Plasma membrane; structure, models and functions, site for ATPase, ion carrier channels and pumps, receptors.
UNIT –2	• Chloroplast-structure, genome organization, gene expression, RNA editing. • Mitochondria; structure, genome organization, biogenesis. • Plant Vacuole - Tonoplast membrane, ATPases transporters as a storage organelle.
UNIT –3	• Nucleus: Structure, nuclear pore, Nucleosome organization. • Ribosome: Structure and functional significance. • Cell cycle and Apoptosis: Control mechanisms, role of cyclin dependent kinases. • Retinoblastoma and E2F proteins, cytokinesis and cell plate formation, mechanisms of programmed cell death.
UNIT –4	• Other cell organelles: Structure and functions of microbodies, microtubules, microfilaments, Golgi apparatus, lysosome, endoplasmic reticulum. • Techniques in cell biology: Immunological techniques, in situ hybridization to locate transcripts in cell types FISH, GISH, Confocal microscopy.

LIST OF PRACTICALS

- Identification of different stages of mitosis from suitable plant material. (onion root tips,garlic root tips).
- Identification of meiosis from suitable plant material. (Onion floral buds).
- Isolation of cell organelles: Mitochondria, Chloroplast, Nucleus, Lysosomes

and their assay by succinate dehydrogenase activity (Mitochondria), acid phosphatase activity (Lysosome), acetocarmine staining (Nucleus) and microscopic observation (Chloroplast).

- Study of mitotic index from suitable plant material.
- Study of cyclosis in cells of suitable plant material.

Suggested Reading: -

1. De Robertis and De Robertis 2005 (Eight edition) (Indian) Cell and Molecular Biology, Lippincott Williams, Philadelphia. [B.I Publications Pvt. Ltd. New Delhi].
2. Albert Etal 2002 (Fourth Edition). Molecular Biology of the cell, Garland Science (Iaylarand Francis) New York Group (wt)
3. Lodish Etal 2004 (Fifth Edition). Molecular Cell Biology, W H Freeman and company, New York.
4. Giese Arthur 1979 (Fifth Edition). Cell Physiology, Toppan company Ltd., Tokyo, Japan.
5. Roy S.C and KKDe 2005 (Second Edition). Cell Biology, New central Book Agency PrivateLtd., Kolkata.
6. Krishnamurthy, K.V 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton,Florida.
7. Buchanan B.B, Gruissm W. and Jones R.L 2000. Biochemistry and Molecular Biology ofPlant. American Society of Plant Physiologist, Maryland, USA.
8. De D.N 2000. Plant Cell Vacuoles: An Introduction. CISRO Publication, Collingwood, Australia.
9. Kleinsmith L.J and Kish V.M 1995. Principles of Cell and Molecular Biology (Second Edition). Happer Collins College Publishers, New York, USA.
10. Lodish H., Berk A., Zipursky, S.L Matsudaira P., Baltimore D. and Darnell J. 2000. Molecular Cell Biology (Fourth Edition). W.H. Freeman and Company, New USA.
11. David Freifelder 1996. Essentials of Molecular Biology, Panima Publishing Company
12. Gerald Karp 1999 Cell and Molecular Biology- Concept and Expts. John Wiley and ScneIne., USA.

Course Outcome:

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

1. Understand about basic physical and structural unit i.e. cell its structure and different organelle with their functional behaviour.

2. Understand the cellular division and their inter conversation.

3. Understand the latest amino and in-situ hybridization techniques.

4. Understand the cell within cell.

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M.Sc. BOTANY FIRST SEMESTER			
COURSE CODE: BOT-120			**COURSE TYPE: CCC**
COURSE TITLE: GENETICS		**PAPER-II**	
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	

OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of importance and applications of Genetics of Plants & Breeding in Plants.

UNIT –1	• Chromatin Organization: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA genes, euchromatin and heterochromatin, Karyotype, banding pattern specialized types of chromosomes, polytene, lamp brush, B chromosomes and sex chromosomes. • Molecular basis of chromosome pairing chromosomal aberration and polyploidy.
UNIT –2	• Mapping of Bacteriophage genome, Phage phenotype, recombination in phage, genetic transformation and transduction in bacteria.
UNIT –3	• Genetic recombination & genetic mapping; Mechanism of crossing over, molecular mechanism of recombination, role of Rec-A, Rec-B, Rec- C and Rec-D enzymes, site specific recombination, linkage, linkage group, genetic marker.
UNIT –4	• Alien gene transfer through chromosome manipulation; Transfer of whole genome examples from wheat, arachis & brassica. Transfer of individual chromosomes & chromosome segment, methods for detecting alien chromatin, production.

LIST OF PRACTICALS-

- Staining of salivary gland chromosomes of Chironomus larva or Drosophila.
- Isolation of DNA and its quantification by UV- spectrophotometric method.
- Isolation of RNA and its quantification by UV- spectrophotometric method.
- Isolation of DNA by Agarose gel electrophoresis.
- Transformation and Transduction in Bacteria
- Biometry: Mean, Median and Mode
- Mendelian ratios & interaction of gene: monohybrid, dihybrid, complete and incomplete dominance, quantitative & qualitative gene interaction, lethal gene, multiple allelism, ratio for gene interaction:9:3:3:1, 12:3:1, 15:1, 9:6:1, 9:3:4, 9:7 etc.

- Reciprocal translocation in Rhoeo-discolor and Tradescantia.

Suggested Readings:

1. Albert B. Bray, D Lewis, J Raff, M. Robert, K. and Walter 1989, MolecularBiology of the Cell (Second Edition) Garland Publishing Inc, New York.
2. Atherly, A.G., Girton, J.R. and McDonald, J.F 1999. The Science of GeneticsSaunders College Publishing, Frot Worth, USA.
3. Burnham, C.R 1962. Discussions in Cytogenetics. Burgess Publishing Co.Minnesota.
4. Busch, H. and Rothblum. L 1982. Volume X. The Cell Nucleus rDNA part A.Academic Press.
5. Hartk D.L and Jones, E.W 1998 Genetics: Principles and Analysis (FourthEdition). Jones and Bartlett Publishers, Massachusetts, USA.
6. Khush, G.S 1973. Cytogenetics of Aneuploids. Academic Press, New York,London.
7. Karp, G. 1999. Cell and Molecular Biology: Concept and Experiments. JohnWiley and Sons, Inc., USA.
8. Lewin, B. 2000. Gene VII. Oxford University Press, New York, USA.
9. Lewis, R. 1997. Human Genetics: Concepts and Application (Second Edition).WCB McGraw Hill, USA.
10. Malacinski, G.M and Freifelder, D. 1998: Essentials of Molecular Biology (Third Edition). Jones and B. Artlet Publisher, Inc., London.
11. Russel, P.J. 1998. Genetics (Fifth Edition). The Benjamin/Cummings Publishing Company IND., USA.
12. Snustad, D.P and Simmons, M.J 2000. Principles of Genetics (Second Edition).John Wiley and Sons Inc., USA.
13. Gardner and Simmons Snustad 2005 (Eighth Edition). Principles of Genetics, John Wiley and Sons, Singapore.
14. Ahluwalia K.B 2005 (First Edition). Genetics. New Age International Private Ltd. Publishers, New Delhi.
15. Burus and Bottino 1989. (Sixth Edition). The Science of Genetics. MacmillanPublishing Company, New York (USA).
16. Pawar C.B 2003 (First Edition). Genetics Vol. I and II. Himalaya Publishing House, Mumbai.
17. Strickberger 2005. (Third Edition). Genetics. Prentice Hall of India Pvt. Ltd.,New Delhi.
18. Singh B.D 2004. Genetics. Kalyani Publication, Ludhiana.
19. Gupta P.K Genetics and Cytogenetics, Rastogi Publications.

COURSE OUTCOME:

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

1. Understand the structure and its behaviour.
2. Know the alien gene transfer in new crop formation.
3. Understand the linkage and crossing over inheritance of characters may be categories.

4. Know the different chromosomal behavior.

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<table>
<tr><th colspan="4">M.Sc. BOTANY FIRST SEMESTER</th></tr>
<tr><td colspan="2">COURSE CODE: BOT-130</td><td colspan="2">COURSE TYPE: CCC</td></tr>
<tr><td colspan="4">COURSE TITLE: MICROBIOLOGY, PHYCOLOGY AND MYCOLOGY
PAPER-III</td></tr>
<tr><td colspan="2">CREDIT:6</td><td colspan="2">HOURS: 105</td></tr>
<tr><td>THEORY:5</td><td>PRACTICAL:1</td><td>THEORY:70</td><td>PRACTICAL:30</td></tr>
<tr><td colspan="4">MARKS</td></tr>
<tr><td colspan="2">THEORY:100(30+70)</td><td colspan="2">PRACTICAL:70</td></tr>
<tr><td colspan="4">OBJECTIVES: This course is aimed for generating fundamental knowledge, importance and applications of Microbes and algae in industry and agriculture for human welfare.</td></tr>
<tr><td>UNIT –1</td><td colspan="3">• Archaebacteria and Eubacteria: General account, ultra-structure, nutrition and reproduction, biology and economic importance.
• Cyanobacteria: Salient feature and biological importance.</td></tr>
<tr><td>UNIT –2</td><td colspan="3">• Viruses: Characteristics and ultra-structure of virions, isolation and purification of viruses, chemical nature, replication, transmission of viruses, economic importance.
• Structure of Influenza, Harpies, Polio virus and Covid-19 etc.
• Phytoplasma: General characteristic and role in causing plant diseases.</td></tr>
<tr><td>UNIT –3</td><td colspan="3">• Phycology: Algae in diversified habitats (terrestrial, freshwater, marine), thallus organization, cell ultra structure, reproduction (vegetative, asexual, sexual).
• Criteria for classification of Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.
• Economic importance of algae.
• Perennation in algae
• Evolution and development of sex organs in algae.</td></tr>
<tr><td>UNIT –4</td><td colspan="3">• Mycology: General characters of fungi, substrate relationship in fungi, cell structure unicellular and multicellular organization, cell wall composition, nutrition (saprobic biotrophic, symbiotic) reproduction, (vegetative, asexual, sexual) heterothallism, heterokaryosis, Para sexuality, recent account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina, Mycorrhiza, fungi as biocontrol agent.</td></tr>
</table>

LIST OF PRACTICALS

ALGAE: -

a. Cyanophyta: - Range of thallus organization and reproductive structures, types showing unicellular, gonical, conical, filamentous, branched (pseudo and true branched).
b. Chlorophyta: - Chlamydomonas, Gonium, Pandorina, Eudorina, Volvox, Chlorella, Pediastrum, Hydrodictyon, Scenedesmus, Ulothrix, Cladophora, Draparnaldia, Drapernaldiopsis, Fristschiella, Chara, Nitella, Coleochaete, Ulva, Caulerpa, Oedogonium, Zygnema, Spirogyra.
c. Phaeophyta: -Ectocarpus, Dictyota, Padina, Sargassum.
d. Rhodophyta: -Porphyra, Batrachospermum, Gelidium, Gracillaria, Champia,Polysiphonia.

FUNGI: -

Thallus organization, Spore producing organs, Tissue differentiation and accessory structures of following –

a. Mastigomycotina: - Synchytrium, Saprolegnia, Achylia, Peronospora, Plasmopora, Albugo, Sclerospora.
b. Zygomycotina: -Mucor, Rhizopus, Pilobolus.
c. Ascomycotina: - Taphrina, Protomyces, Erotium, Trichoglossum, Erysiphe, Phyllactinia, Uncinula.
d. Basidiomycotina: -Uromyces, Ravenelia, Monosporidium, Melampsora,Ustilago, Agaricus, Pleurotus, Ganoderma, Polyporus, Cyathus, Lycoperdon, Phallus, Geaster.
e. Deuteromycotina: - Aspergillus, Penicillium, Fusarium, Cercospora, Colletotrichum, Alternaria.

Suggested Readings: -

1. Alexopoulos C.J, Mims C.W. and Blackwel M.I 1996. Introductory Mycology. John Wiley and Sons Inc.
2. Kumar H.D. 1988. Introductory Phycology. Affiliated East-West Press Ltd., New Delhi.
3. Mehrotra R.S and Aneja R.S 1998. An introduction to Mycology. New Age Intermediate Press.
4. Rangaswamy G. and Mahadevan A. 1999. Diseases of crop plants in India (Fourth Edition) Prentice Hall of India Pvt. Ltd. New Delhi.
5. Webster J. 1985. Introduction to Fungi. Cambridge University Press.
6. Hawker L.E. 1967. An Introduction to Fungi Cambridge.
7. Kamat M.N 1959. Hand Book of Mycology, Prakash Publication.
8. Vashista B.R & A.K Sinha 2005. Botany for degree students – Fungi, S. Chands Publication.
9. Vashista B.R & A.K Sinha 2005. Botany for degree students – Bryophyta, S. Chands Publication.
10. Ainsworth G.C 1973. The Fungi Vol IV A, IV B Academic Press.
11. Bessey 1950. Morphology and Taxonomy of fungi. The

Blakistan Co.
12. Burnett J.H. 1968. Fundamentals of Mycology. Edwards Arnold Publication.
13. Morries I 1986. An Introduction to the Algae. Cambridge University Press, U.K.
14. Round F.E. 1986. The Biology of Algae. Cambridge University Press, Cambridge
15. Vashista B.R & A.K Sinha 2005. Botany for degree students – Algae, S.Chands Publication
16. Vijay Raghavan M.R and Bela Bhatia (1997), Red Algae: Structure, ultrastructure and Reproduction, APH publishing Corporations, New Delhi.
17. Vijay Raghavan M.R and Bela Bhatia (1997), Brown Algae: Structure, ultrastructure and Reproduction, APH publishing Corporations, New Delhi.
18. Fritsch F.E (1945). The structure and reproduction of the algae Volume I and II, Cambridge University Press.
19. Chapman V.J and Chapman D.J (1973). The Algae McMillon and company, New York.
20. Bold H.C and Wynne M.J (1975). Introduction to the Algae structure and reproduction prentice hall Biological Science Series.
21. Pandey S.N. A Text-book of Botany Volume I, Vikas Publications.

Course Outcome:

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

1. Life progenitor cyanobacteria and archaea bacteria develops in to higher plants.
2. Understand the biological enigma viruses connecting link between non-living.
3. Understand the structure and development of unicellular to multicellular algae.
4. Understand the diversity and life cycle of fungi.

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M.Sc. BOTANY FIRST SEMESTER			
COURSE CODE: BOT-140		**COURSE TYPE: CCC**	
COURSE TITLE: BRYOPHYTA, PTERIDOPHYTA AND GYMNOSPERM PAPER-IV			
CREDIT:6		**HOURS: 103**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of importance and applications of bryophytes, pteridophytes and gymnosperms.			
UNIT –1	• Bryophyta: morphology, structure, reproduction, life history, distribution, classification. • General account of Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Funariales and Polytrichales: Economic and ecological importance. • Sterilization of sporogenous tissues in bryophytes, Amphibian nature and reproduction in bryophytes, Spore dispersal mechanism in bryophytes.		
UNIT –2	• Pteridophyta: morphology, anatomy and reproduction, classification, evolution of stele. • Heterospory and origin of seed habit, general account of fossil Pteridophyta. • Introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida.		
UNIT –3	• Gymnosperm: General characters of gymnosperm mentioning diversity. • Classification of gymnosperm. • Resemblances and difference amongst gymnosperm, pteridophyta and angiosperm. • Gymnosperm distribution in India. • Gymnosperm Biotechnology and Economic importance of gymnosperm. • Origin and evolution of gymnosperm stele. • Structure and theories regarding origin of Paleozoic ovule.		
UNIT –4	• Extinct gymnosperm : generalaccount of Pteridospermales, Glossopteridales, Caytoniales, Pentoxylales. • Extant gymnosperm: Cycadales, Ginkgoales, Coniferales, Ephidedrales, Gnetales, and Welwistschiales.		

LIST OF PRACTICALS

Bryophyta: -

a. Hepaticopsida: - Riccia, Marchantia, Targionia, Astrella, Porella, Cyathodium, Plagiochasma,
b. Anthocerotopsida: -Anthoceros, Notothyllus.
c. Bryopsida: -Sphagnum, Funaria, Polytrichum.

Pteridophyta:-

a. Study of the following members to observe arrangement of Sori on a receptacle: -
   Isoetes, Osmunda, Angiopteris, Ceratopteris, Achrostichum, Gleichinia
b. Morphology, Anatomy and reproductive structures of: -
   Psilotum, Selaginella, Lycopodium, Equisetum, Ophioglossum, Lygodium, Pteris, Pteridium, Salvinia, Adiantum, Azolla.

Gymnosperms: -

Morphology, Anatomy and reproductive structures of –Cycas, Zamia, Ginkgo, Pinus, Cryptomeria, Juniperus, Araucaria, Taxus, Cedrus Thuja, Podocarpus, Gnetum, Ephedra.

Suggested readings:

1. Sporne K.R. 1991. The Morphology of Pteridophytes. B.I Publishing Pvt. Ltd. Bombay.
2. Stewart W.N. and Rathwell G.W. 1993. Paleobotany and the Evolution of plants. Cambridge University Press.
3. Bhatnagar S.P and Moitra Alok 1996. Gymnosperms. New Age International Pvt. Ltd. Publishers, New Delhi, 470 pp.
4. Biswas C and Johari B.M 2004. The Gymnosperms Narosa Publishing House, New Delhi. 497 pp.
5. Sporne K.R 1965. The Morphology of Gymnosperms London, pp. 216.
6. Bierhorst D.W. 1971. Morphology of Vascular Plants. New York and London.
7. Chamberlain C.J 1934. Gymnosperms-Structure and Evolution, Chicago.(Page 19)
8. Coulter J.M. and Chamberlain C.J. 1917. Morphology of Gymnosperms, Chicago.
9. Foster A.S and Gifford E.M 1959. Comparative Morphology of Vascular Plants. San Francisco.
10. Maheshwari P. and Vasil, Vimla 1961. Gnetum, Delhi.
11. Vashishta P.C., A.R. Sinha, Anil Kumar. 2006. Gymnosperms. S.Chand. Publication
12. Vashishta P.C. 2006. Pteridophytes. S. Chand.
13. Parihar N.S. 1996. Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad
14. Parihar N.S. 1991. Bryophyta. Central Book Depot, Allahabad.
15. Puri P. 1980. Bryophytes. Atma Ram and Sons, Delhi.
16. Vashista B.R & A.K Sinha 2005. Botany for degree students – Bryophta, S.Chands Publication
17. Sporne. Morphology of Bryophytes, Oxford Publishing House
18. Rashid A (1998). An introduction to Bryophyta. First edition, Vikas Publishing House Pvt. Ltd, New Delhi.

Course Outcome:

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

1. Understand the different form of archegoniates.
2. understand the relics of the past i.e. fossils.
3. development of seed and its behaviour.
4. Understand the natural different types of mosses.

Pt. Ravishankar Shukla University, Raipur (Chhattisgarh)

<table>
<tr><td colspan="4">M.Sc. BOTANY SECOND SEMESTER</td></tr>
<tr><td colspan="2">COURSE CODE: BOT-210</td><td colspan="2">COURSE TYPE: CCC</td></tr>
<tr><td colspan="4">COURSE TITLE: PLANT DEVELOPMENT AND PLANT RESOURCES
PAPER- I</td></tr>
<tr><td colspan="2">CREDIT:6</td><td colspan="2">HOURS: 105</td></tr>
<tr><td>THEORY:5</td><td>PRACTICAL:1</td><td>THEORY:70</td><td>PRACTICAL:30</td></tr>
<tr><td colspan="4">MARKS</td></tr>
<tr><td colspan="2">THEORY:100(30+70)</td><td colspan="2">PRACTICAL:70</td></tr>
<tr><td colspan="4">OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of importance and applications of life cycle and utilization of plants.</td></tr>
<tr><td>UNIT –1</td><td colspan="3">Introduction: Unique features of plant development. Metabolism of nucleic acids, proteins and mobilization of food reserves, tropisms; control of cell division, Programmed cell death in the life cycle of plants, Seed germination, Hormonal control of Seedling growth. Seed dormancy, Overcoming of seed dormancy, Bud dormancy.
Root development: Organization of root apical meristem (RAM), Cell fates and lineages, Vascular tissue differentiation of root, Lateral roots, Root hairs, Root microbe interaction.</td></tr>
<tr><td>UNIT –2</td><td colspan="3">Shoot development: Organization of shoot apical meristem (SAM), Cytological and molecular analysis of SAM. Control of tissue differentiation; especially Xylem and Phloem, Vascular cambium. Secretary ducts and laticifers, Wood development in relation to environmental factors.</td></tr>
<tr><td>UNIT –3</td><td colspan="3">Leaf development: Development, Phyllotaxy, Control of leaf form, Differentiation of epidermis (with special reference to Stomata and Trichome) and Mesophyll cell. Senescence, Influences of hormones and environmental factors on senescence.
Flower development: Floral characteristics, Flower development, Genetics of floral organ differentiation: Homeotic mutant in Arabidopsis and Antirrhinum, Sex determination.</td></tr>
<tr><td>UNIT –4</td><td colspan="3">Plant resources: Origin, Evolution, Cultivation and Uses of (i) Food, Forage and Fodder crops, (ii) Fiber crops, (iii) Medicinal and Aromatic plants, (iv) Vegetable Oil- yielding crops (v) fruits.
Important fire-wood, Timber-yielding plants and non-wood forest products (NFPs)</td></tr>
</table>

	such as bamboos, gums, tannins, dyes and resins.

SUGGESTED LABORATORY / FIELD EXERCISES

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

SUGGESTED READINGS:

1. Bewley, J.D. and Black. M. 1994 Seeds: Physiology of development and germination. Plenum Press, New Yor.
2. Bendre, A. and Kumar, 2004 A. Rastogi pub. Meerut, India.
3. Crocker, W. and Barton V.1953 Physiology of seeds. Waltham, Mass, U.S.A

4. Santra, S.C., Chatterjee. T.P. and Das, 2005. A.P. College Botany Practical Vol. Li New Central pub. India.
5. Parihar, NS. 1964, Hormonal control of plant growth. Asia pub. House, London.

Course Outcome:

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

1. Understand the plant resources and their utilizations.

2. Understand the different internal part of the plants.

3. Understand the recurrences of new with help of seed germination and its dormancy.

4. Understand the emblem of life sex determination, most quireus question of life.

Pt. Ravishankar Shukla University, Raipur (Chhattisgarh)

M.Sc. BOTANY SECOND SEMESTER			
COURSE CODE: BOT-220		**COURSE TYPE: CCC**	
COURSE TITLE: MOLECULAR BIOLOGY PAPER- II			
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of importance and applications molecular biology in plant sciences.			

UNIT –1	• RNA and DNA Structure. A, B and Z Forms, replication, damage and repair, transcription, translation.
UNIT –2	• **Molecular Cytogenetics:** Nuclear DNA content, C-value paradox, Cot curve and its Significance, restriction mapping - concept and techniques, multigene families and their evolution, in situ hybridization and techniques, chromosomes micro dissection and micro cloning, flow cytometry and confocal microscopy and karyotype analysis.
UNIT –3	• **Gene structure and expression:** fine structure of gene, Cis-trans test, fine structure analysis of eukaryotes, introns and their significance. RNA splicing, regulation of gene expression in prokaryotes and eukaryotes. • **Protein sorting:** Targeting proteins to organelles.
UNIT –4	• **Mutation:** Spontaneous and induced mutation, physical and chemical mutagens molecular basis of gene, transposable elements in prokaryotes and eukaryotes, mutation induced by transposons, site directed mutagenesis, inherited human diseases and defects in DNA repair, translocation, intersect Robertsonian translocation, B-A translocation.

Suggested Laboratory Exercise

1. Study of structure and various types of A, B, C & Z DNA and RNA.
2. Formation and significance of chromosomal bridge, micronuclei, acentric and dicentric due to Chromosomal aberrations.
3. Physical and chemical mutagens and its role.
4. Symptoms and inheritance pattern of genetic human diseases- sickle cell anemia, phenylketonuria and thalassemia etc.

Suggested Readings:

1. Albert B. Bray, D Lewis, J Raff, M. Robert, K. and Walter 1989, MolecularBiology of the Cell (Second Edition) Garland Publishing Inc, New York.
2. Atherly, A.G., Girton, J.R. and McDonald, J.F 1999. The Science of GeneticsSaunders College Publishing, Frot Worth, USA.
3. Burnham, C.R 1962. Discussions in Cytogenetics. Burgess Publishing Co.Minnesota.
4. Busch, H. and Rothblum. L 1982. Volume X. The Cell Nucleus rDNA part A. Academic Press.
5. Hartk D.L and Jones, E.W 1998 Genetics: Principles and Analysis (FourthEdition). Jones and Bartlett Publishers, Massachusetts, USA.
6. Khush, G.S 1973. Cytogenetics of Aneuploids. Academic Press, New York,London.
7 . Karp, G. 1999. Cell and Molecular Biology: Concept and Experiments. JohnWiley and Sons, Inc., USA.
8. Lewin, B. 2000. Gene VII. Oxford University Press, New York, USA.
9. Lewis, R. 1997. Human Genetics: Concepts and Application (Second Edition).WCB McGraw Hill, USA.
10 . Malacinski, G.M and Freifelder, D. 1998: Essentials of Molecular Biology(Third Edition). Jones and B. Artlet Publisher, Inc., London.
11. Russel, P.J. 1998. Genetics (Fifth Edition). The Benjamin/Cummings Publishing Company IND., USA.
12. Snustad, D.P and Simmons, M.J 2000. Principles of Genetics (Second Edition).John Wiley and Sons Inc., USA.
13. Gardner and Simmons Snustad 2005 (Eighth Edition). Principles of Genetics,John Wiley and Sons, Singapore.
14. Sariu C 2004 (Sixth Edition) Genetics. TATA McGraw-Hill PublishingCompany Ltd., New Delhi.
15. Ahluwalia K.B 2005 (First Edition). Genetics. New Age International Private Ltd. Publishers, New Delhi.*(Page 12)*
16. Burus and Bottino 1989. (Sixth Edition). The Science of Genetics. MacmillanPublishing Company, New York (USA).
17. Pawar C.B 2003 (First Edition). Genetics Vol. I and II. Himalaya PublishingHouse, Mumbai.
18. Strickberger 2005. (Third Edition). Genetics. Prentice Hall of India Pvt. Ltd.,New Delhi.
19. Verma and Agarwal, Genetics, S. Chand Co, New Delhi.
20. Singh B.D 2004. Genetics. Kalyani Publication, Ludhiana.
21. Gupta P.K Genetics and Cytogenetics, Rastogi Publications.

Course Outcome:

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

1. Understand the due to expression of DNA how characters are be inform can be understood.

2. Cascade reaction, gene regulation and gene expression can be understood.

3. Understand the how protein can be transformed one cell to another cell.

4. Colorful grapes, corn may develop due to transposomes.

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M.Sc. BOTANY SECOND SEMESTER			
COURSE CODE: BOT-230		**COURSE TYPE: CCC**	
COURSE TITLE: PLANT PHYSIOLOGY PAPER- III			
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of importance and applications of plant phenomena.			

UNIT –1	• **Membrane transport and translocation of water and solutes:** Plant-water relation, mechanism of water transport through Xylem, root microbe interaction in facilitating nutrient uptake. Comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport system
UNIT –2	• **Signal Transduction:** Overview, receptors and G proteins, Phospholipids signaling, role of cyclic nucleotides, calcium-calmodulin cascade, diversity in protein kinases and phosphatases, specific signaling mechanism- two component sensor regulatory system in bacteria.
UNIT –3	• **Stress physiology:** Plant responses to biotic and abiotic stress, mechanism of biotic and abiotic stress tolerance, HR Fundamental and SAR, water deficit and drought resistance salinity stress, metal toxicity, freezing and heat stress, oxidative stress.
UNIT –4	• **Fundamentals of enzymology:** General aspects of allosteric mechanism, regulatory & active sites, isozymes, kinetics of enzymatic catalysis, Michaelis-Menton equation and its significance. • Sensory photobiology History of discovery of phytochromes and cryptochroms and their photo chemical and biochemical properties, photophysiology of light under responses, cellular localization, and molecular mechanism of action of enzyme.

Suggested Reading: -

1. Moore T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer – Verlag, New York, USA.

2. Nobel P.S 1999. Physiochemical and Environmental Plant Physiology (Second Edition) Academic Press, San Diego, USA.
3. Salisbury F.B and Ross C.W 1992. Plant physiology (Fourth Edition) Wadsworth Publishing Company, California, USA.
4. Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee 1999.Concept in Photobiology; Photosynthesis and Photomorphogenesis.Narosa Publishing House, New Delhi.
5. Taiz L. and Zeiger E. 1998. Plant Physiology (Second Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA.
6. Thomas B. and Vince-Prue D. 1997. Photoperiodism in Plants (Second Edition) Academic Press, San Diego, USA.
7. Verma S.K. and Verma Mohit 2007. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S.Chand Publications.
8. Lehninger A.C 1987. Principles of Biochmistry, CBS Publishers and Distributers (Indian Reprint)

Course Outcome:

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

1. Water conduction by xylem and food conduction by phloem could be understood.

2. Cellular communication by the signal transduction in bacteria can be understood.

3. Plant behaviour against biotic and abiotic resistance their tolerance etc. can be understood.

4. Antioxidant properties and oxidative stress its reasons and causes and remedies can be understood.

Pt. Ravishankar Shukla University, Raipur (Chhattisgarh)

M.Sc. BOTANY SECOND SEMESTER			
COURSE CODE: BOT-240		**COURSE TYPE: CCC**	
COURSE TITLE: PLANT METABOLISM PAPER- IV			
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of importance and applications of metabolic activity in plants.			
UNIT –1	• **Photosynthesis:** General concepts and historical background, evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting complexes, photo oxidation of water, mechanism of electron and proton transport, Carbon assimilation, the Calvin cycle, photorespiration and its significance, the C4 cycle, the CAM pathway, biosynthesis of starch and sucrose, physiological and ecological considerations.		
UNIT –2	• **Respiration and lipid metabolism:** Overview of plant respiration, glycolysis, Kreb cycle (TCA cycle), electron transport and ATP synthesis, Pentose phosphate pathway, alternative oxidase system, structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids and their catabolism Glyoxylate cycle.		
UNIT –3	• **Nitrogen and Sulphur metabolism:** Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, Sulphur uptake, transport and assimilation.		
UNIT –4	• **Plant growth regulators and elicitors:** Physiological effects and mechanism of action of auxins, gibberellins, cytokinin, ethylene, abscisic acid, Brassinosteroids, polyamines, and hormone receptors. • **The flowering process:** - Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development, Genetic molecular analysis, role of vernalization.		

LIST OF PRACTICALS: - (Based on Paper III and IV)

1. Determination of osmotic pressure of cell sap by plasmolytic method.
2. Determination of Diffusion pressure deficit in potato tuber.
3. Determination of imbibition's pressure of seeds of different categories (protein, lipid, carbohydrate containing seeds).
4. To compare the rate of imbibition of fatty and starchy seeds.
5. Determination of osmotic pressure of cell sap by plasmolytic method.
6. Determination of effect of temperature on the permeability of plasma membrane of beet root.
7. Determination of effect of different organic solvents (alcohol, formalin, benzene) on the permeability of plasma membrane of beet root.
8. Determination of effect of different concentration of organic solvents (alcohol, formalin, benzene) on the permeability of plasma membrane of beet root.
9. Determination of effect of different Phytohormones on the germination of seeds.
10. Determination of effect of different concentration of auxins on the germination of seeds
11. Determination of the rate of respiration by Ganong's Respirometer.
12. Determination of the rate of respiration by Pipette manometer.
13. Determination of R.Q. of carbohydrates, proteins and lipids by Ganong's Respirometer.
14. Separation of chlorophyll pigments by paper chromatography.
15. Separation of chlorophyll pigments by circular paper chromatography.
16. Qualitative analysis of Organic acids and amino acids by paper chromatography.
17. Separation of A.A by thin layer chromatography method.
18. Separation of chlorophyll by thin layer chromatography.
19. Determination of the effect of CO2 concentration on the rate of photosynthesis by inverted funnel method.
20. Determination of the effect of CO2 concentration on the rate of photosynthesis by Wilmot's bubbler.
21. Determination of the effect of intensity of light on the rate of photosynthesis by Wilmot's bubbler.
22. Determination of the effect of intensity of light on the rate of photosynthesis by inverted funnel method.
23. Determination of the effect of quality of light on the rate of photosynthesis by inverted funnel method.
24. Determination of the effect of quality of light on the rate of photosynthesis by Wilmot's bubbler.

MINOR EXPERIMENTS

1. Preparation of molar and molal solutions.
2. Preparation of percentage solution.
3. Preparation of normal solution of solute.
4. Preparation of normal solution of acid and base.
5. Demonstration of Brownian movement in the latex of Calotropis.
6. Demonstration of plasmolysis and deplasmolysis in plant cell.

7. Demonstration of exosmosis and endosmosis in grapes and resins.
8. Demonstration of the rate of respiration of flower buds by pipette mano-meter.
9. Demonstration of evolution of O2 during photosynthesis by inverted funnel method.
10. Demonstration of the rate of photosynthesis by inverted funnel method. 12.Demonstration of the rate of photosynthesis by Wilmot's bubbler.
11. Determination of the effect of temperature on the rate of photosynthesis by inverted funnel method.
12. Demonstration of the rise of temperature during seed germination.
13. Demonstration of evolution of CO2 during respiration.
14. Demonstration of fermentation by Kuhns tube.
15. Demonstration of Determination of R.Q. of organic acids by Ganong's Respirometer.
16. Effect of phytohormones on the growth of seedling.

BIOCHEMISTRY PRACTICALS

1. Qualitative estimation of amylase enzyme activity in the germinating seeds of wheat.
2. Qualitative estimation of amylase enzyme activity in potato tuber.
3. Qualitative estimation of catalase enzyme activity in the germinating seeds of wheat.
4. Qualitative estimation of catalase enzyme activity in potato tuber.
5. Effect of enzyme concentration on the rate of catalase enzyme activity in potato tuber.
6. Effect of enzyme concentration on the rate of catalase enzyme activity in the germinating seeds of wheat.
7. Effect of enzyme concentration on the rate of amylase enzyme activity in of potato tuber.
8. Effect of enzyme concentration on the rate of amylase enzyme activity in the germinating seeds of wheat.
9. Effect of substrate concentration on the rate of catalase enzyme activity in the germinating seeds of wheat.
10. Effect of substrate concentration on the rate of catalase enzyme activity in potato tuber.
11. Effect of substrate concentration on the rate of amylase enzyme activity in the germinating seeds of wheat.

Suggested readings

1. Moore T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer –Verlag, New York, USA.
2. Nobel P.S 1999. Physiochemical and Environmental Plant Physiology (SecondEdition) Academic Press, San Diego, USA.
3. Salibury F.B and Ross C.W 1992. Plant physiology (Fourth Edition) Wadsworth Publishing Company, California,USA.
4. Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee 1999. Concept in Photobiology; Photosynthesis and Photomorphogenesis.Narosa Publishing House,New Delhi.
5. Taiz L. and Zeiger E. 1998. Plant Physiology (Second Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA.

Course Outcome:

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

1. Understand the how plant trapping the solar light and convert them in to chemical form by various cycles.

2. Energy currency ATP its formation and utilization can be understood.

3. Most abundant gas which usually emerged is nitrogen is converted in absorbable form can be understood.

4. Different metamorphosis by the help of different phytohormones can be understood.

Pt. Ravishankar Shukla University, Raipur (Chhattisgarh)

Choice Based Credit System

M.Sc. BOTANY Second Semester			
COURSE CODE:		**COURSE TYPE: CCC**	
COURSE TITLE: Forestry seed Technology			
CREDIT:3		**HOURS: 50**	
THEORY:2	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:30**	

OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of importance and applications of seed technology.

UNIT –1	• Definition and importance of seed in the life of plants and huge plantation. • Program of reforestation formation of seed from ovule. • Morphological structure Radio spermic seeds. • Unitegmic and Bitegmic seed. Endospermic, non –endospermic and Perispermic seed wingedseeds.
UNIT –2	• Basic properties of seed**: -Vitality, Viability and Vigour.** • Seed variability –External variation, Internal variation, Chemical variation Physiological variation. • Macrobiotic, Mesobiotic and Microbiotic seed. • Seed germination hypogeal, epigeal, semi-hypogeal, Cryptogeal Devonian and Viviparous.
UNIT –3	• Parity of seeds, insert attacked seed, Hollow and without embryo, Immature seed having green cotyledons. • Cotyledons, seed maturity, Index based on fruit color and seed color. • Method of Breading seed dormancy presowing treatments, Hot water treatments. • Physical and Chemical scarification, Acid treatment after ripening heating and seed stratification.
UNIT –4	• Test for vitality Viability, and Vigour.; Field test, Laboratory test, cutting test, Biochemical test, X-Ray radiographic test. • Electrical conductivity test Catalase activity test. • Germination activity, Germination energy, Germination velocity Index (GVI), Germination value (GV), Stratification. • Seed storage: - Short term storage, long term storage, storage containers and storage condition • Cold storage, protection of stored seed from pests, and disease. • Insect infested seeds, Application of Insecticides and Pesticides, seeds certification., Seed banking and seed trading, seed collection, Artificial of high-quality seeds. seed production areas, colonel and seedling seeds orchards, artificial

	seeds or embryo embryoids.

Books Recommended

1. Prasad , R. and A.K. Kandya (1992). Handling of forestry saeeds in India. Associated publishingCo. karol Bagh, New Delhi,P.420.
2. Barton,L.V.(1961). seed preservation and longevity . Leonard Hill Publication . London ,P. 216Justice , O.L. and L.N. Bass (1979) Principles and practice of seed storage . castle House publication Ltd. London , P.275.
3. Kozlowski T.T. (1972) Seed biology Vol. I, II and III , Academic press, New York .P.317Hyedecker , W.(Ed.)(1973) Seed Ecology , Butterworth publication , London ,P. 462
4. ISTA (1985).International rules for Seed testing . Seed Sci. and Technology, 13 (2) : 299-520Thompson, J.R.(Ed) (1981) Recent advanced in research and technology of seeds Vol. 1-6 Center for agriculture publishing and documentation .Wageningen , Holland .
5. Khan, A.A. (1982) The Physiology and biochemistry of seed dormancy, development and germination .Elsevier Bio-medical Press, Amsterdam, The Netherlands,P.579.

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR (CHHATTISGARH)

CURRICULUM & SYLLABI

M.Sc. III & IV SEMESTER

BOTANY

Program Code-401

SEMESTER SYSTEM EXAMINATION

ACADEMIC YEAR
2025- 2026

Pt. Ravishankar Shukla University, Raipur (Chhattisgarh)

SCHEME OF EXAMINATION

M.Sc. III SEMESTER,

SUBJECT: BOTANY

PAPER	COURSE CODE	TITLE	External Marks	Internal Assessment/ Seminar	Total marks
I	BOT-310	TAXONOMY AND DIVERSITY OF PLANTS	70	30	100
II	BOT-320	PLANT ECOLOGY – I (Ecosystem andvegetation ecology)	70	30	100
III	BOT-330	BIOTECHNOLOGY-I (Biotechnology andgenetic engineering of plants and microbes)	70	30	100
IV	BOT-340-A	ELECTIVE- I Molecular plant pathology-I	70	30	100
	BOT-340-B	ELECTIVE-2 Limnology - I			
	BOT-340-C	ELECTIVE-3 Ethno botany – I			

PRACTICAL

LAB COURSE-I	LBOT-350	BASED ON PAPER I & II	70	30	100
LAB COURSE-II	LBOT-360	BASED ON PAPER III & IV	70	30	100
		GRAND TOTAL OF MARKS			600

Choice Based Credit System: **Semester III** Course Environmental Science.Marks 100, Credit Points -03, Total Hours -50

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SCHEME OF EXAMINATION, 2024-25
M.Sc. IV SEMESTER,
SUBJECT- BOTANY

PAPER	COURSE CODE	TITLE	External Marks	Internal Assessment Seminar	Total marks
I	BOT-410	PLANT REPRODUCTION ANDUTILIZATION OF RESOURCES	70	30	100
II	BOT-420	PLANT ECOLOGY-II (Pollution and biodiversity conservation)	70	30	100
III	BOT-430	BIOTECHNOLOGY-II (Plant cell, tissue culture and organ culture)	70	30	100
IV	BOT-440-A	ELECTIVE- I Molecular plant pathology-II	70	30	100
	BOT-440-B	ELECTIVE-2 Limnology -II			
	BOT-440-C	ELECTIVE-3 Ethnobotany - II			

PRACTICAL

LAB COURSE-I	LBOT-450	BASED ON PAPER I & II	70	30	100
LAB COURSE-II	LBOT-460	BASED ON PAPER III & IV	70	30	100
		GRAND TOTAL OF MARKS			600

NOTE:

- Botanical excursion (within or outside Chhattisgarh) is compulsory for the Students ofM.Sc.
- In each semester, each theory paper there will be five questions of equal marks. First question will be based on complete syllabus with no internal choice whereas rest question will be unit wise.

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PRACTICAL SCHEME,

LAB COURSE-I

M.Sc. III SEMESTER (BOTANY)

Time-5 Hours **Maximum Marks 100**

S.N.	EXPERIMENTS	MARKS
1	**Practical based on Paper-I**	25
2	**Practical based on Paper II**	25
3	**Spotting (1-5)**	10
4	**Viva-voce**	10
5	**Sessional (Internal Assessment)**	30
	TOTAL MARKS	**100**

PRACTICAL SCHEME,

LAB COURSE-II

M.Sc. III SEMESTER (BOTANY)

Time-5 Hours **Maximum Marks 100**

S.N.	EXPERIMENTS	MARKS
1	**Practical based on Paper-III**	25
2	**Practical based on Paper IV**	25
3	**Spotting (1-5)**	10
4	**Viva-voce**	10
5	**Sessional (Internal Assessment)**	30
	TOTAL MARKS	**100**

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PRACTICAL SCHEME,

LAB COURSE-I

M.Sc. IV SEMESTER (BOTANY)

Time-5 Hours **Maximum Marks 100**

S.N.	EXPERIMENTS	MARKS
1	**Practical based on Paper-I**	25
2	**Practical based on Paper II**	25
3	**Spotting (1-5)**	10
4	**Viva-voce**	10
5	**Sessional (Internal Assessment)**	30
	TOTAL MARKS	**100**

PRACTICAL SCHEME

LAB COURSE-II

M.Sc. IV SEMESTER (BOTANY)

Time-5 Hours **Maximum Marks 100**

S.N.	EXPERIMENTS	MARKS
1	**Practical based on Paper-III**	25
2	**Practical based on Paper IV**	25
3	**Spotting (1-5)**	10
4	**Viva-voce**	10
5	**Sessional (Internal Assessment)**	30
	TOTAL MARKS	**100**

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M.Sc. BOTANY THIRD SEMESTER			
COURSE CODE: BOT-310		**COURSE TYPE: CCC**	
COURSE TITLE: TAXONOMY AND DIVERSITY OF PLANTS PAPER- I			
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of identification, importance and applications of Higher Plants			

UNIT –1	• **Plant nomenclature :** Binomial Nomenclature, International code of Botanical nomenclature. • **Plant identification:** Herbaria, Botanical gardens, Taxonomic literature, Taxonomic- keys. • **Taxonomic hierarchy:** Major categories, minor categories, species concept. • **Taxonomic evidences:** Morphology, Anatomy, Palynology, Embryology, Cytology, Photochemistry, Genome analysis and Nucleic acid hybridization. • Geographical information system (GIS).
UNIT –2	• Pre Darwinian-Classification Based on form relationship (Benthem and Hooker) • Post Darwinian classification Engler and Prantl, Bessey's, Hutchinson, Takhtajan and Cronquist. • Basic concept of Dendrogram and Cladogram • Conservation of monotypic genus (Endemic in India) any two.
UNIT –3	• Study of following families with particular reference to systematic position, phylogeny, evolutionary trends and economic importance. Dicot families; Ranunculaceae, Magnoliaceae, Nymphaeaceae, Meliaceae, Fabaceae, Cucurbitaceae, Umbelliferae, Asteraceae, Bignoniaceae, Labiatae, Verbenaceae, Euphorbiaceae, Moraceae.
UNIT –4	• Study of following families with particular reference to systematic position, phylogeny, Evolutionary trends and economic importance, Monocot families- Zingiberaceae, Commelinaceae, Cyperaceae, Poaceae study of local available families.

LIST OF PRACTICALS: -

Angiosperms: -

1. Methods of non-destructive field collection and documentation.
2. Techniques of herbaria preparation.
3. Morphological characterization of selected families of dicots and monocotsand identification up to families.
4. Preparation of artificial key based on appropriate character combination.
5. Identification of given plant up to species with the help of modern flora keys.
6. Morphological characterization of local available families of Dicot and Monocot and identification up to family level.

Suggested readings: -

1. Blatter E and W.S Millard. 1929. Some Beautiful Indian Trees J. Bom. Nat Hist Soc. 33:624-635.
2. Bor N.L 1943. Manual of Indian Forest Botany. London.
3. Cliford H.T and W. Stephenson. 1975. An Introduction to Numerical Taxonomy.Academic Press, N.Y.
4. Cole A.J (Ed.) 1969. Numerical Taxonomy. Academic Press, N.Y.
5. Cronquist, A. 1968. The Evolution and Classification of Flowering Plants. Thomas Nel andSons, Ltd. London.
6. Davis P.H and V.H Heywood 1963. Principles of Angiosperm Taxonomy. Oliver and BoydLondon.
7. Heywood V.H 1967. Plant Taxonomy, London.
8. Lawrence, G.H.M 1951. Taxonomy of Vascular Plants. N.Y.
9. Lawrence G.H.M 1955. An Introduction to Plant Taxonomy N.Y.
10. Rendle A.B. 1925. The Classification of flowering plants. 2 Vols. London.
11. Santapau H. 1953. The Flora of Khandala on the Western Ghats of India.
12. Singh V. and D.K Jain, 1981 Taxonomy of Angiosperms. Rastogi Publication, Meerut.
13. Swingle D.B. 1946. A Text book of Systematic Botany. Mc Graw Hill Book Co. New York.
14. Pande B.P 1997. Taxonomy of Angiosperms. S. Chand Publication.
15. Takhtajan A. 1969. Flowering Plants; Origin and Disposal.

Course Outcome:

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

1. Get knowledge about taxonomic tools, species concept, ICBN, systems of classification and taxonomic evidences.
2. Understand the diversity of flowering plants including dicots and monocots, their economic importance.
3. Identify scientifically the plants up to species level around their locality.

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M.Sc. BOTANY THIRD SEMESTER			
COURSE CODE:BOT-320		**COURSE TYPE: CCC**	
COURSE TITLE: PLANT ECOLOGY- I (ECOSYSTEM AND VEGETATION ECOLOGY) PAPER- II			
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	

OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of importance, distribution and applications of Plants for healthy environment.

UNIT –1	• **Ecosystem organisation:** Structure and functions, primary production (Methods of measurement, global pattern, controlling factors), Energy dynamics (trophic organization, energy flow pathways, ecological efficiencies), Litter fall and decomposition, (mechanism, substrate quality, and climatic factors), global biogeochemical cycles of C, N, P, and S, mineral cycles (pathways, processes and budgets) in terrestrial and aquatic ecosystems.
UNIT –2	• **Ecosystem stability and management:** Concept (resistance and resilience), Ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems, ecology of plant invasion, environment impact assessment, ecosystem restorations. Concept of Sustainable development, sustainability indicators.
UNIT –3	• **Vegetation organization:** Concepts of community and continuum, analysis of communities (analytical and synthetic characters), Community coefficients, inter specific associations, ordination, and concept of ecological niche.
UNIT –4	• **Vegetation development**: Temporal changes (cyclic and non-cyclic), mechanism of ecological succession (relay floristic and initial floristic composition, facilitation, tolerance and inhibition models), change in ecosystem properties during succession.

LIST OF PRACTICALS

1. To determine minimum size and number of quadrats required for reliable estimate of biomass in grassland.
2. To compare protected and unprotected grassland stands using community coefficients (similarity indices).
3. To analyze plant communities Bra Curtis ordination method.

4. To estimate IVI of the species in a woodland using point centered quarter method.
5. To calculate mean, variance, standard deviation, standard error, coefficient of variations and to use t test for comparing two means related to ecological data.
6. To find out the relationship between two ecological variables using correlation and regression analysis.
7. To find out important grassland species using chi square test.
8. Scientific visits to a protected area, a wet land, a mangrove, NBPGR, BSI, CSIR, ICAR labs and a recognized botanical garden or a museum.

REFERENCE BOOKS:

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

Course Outcome:

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

1. Understand about the various ecosystem organizations like, structure and function, energy dynamics, global biogeochemical cycles.
2. Develop insights about the concepts of populations, community and ecosystems and can use in management of natural resources for sustainable development.
3. Acquire knowledge about the vegetation organizations and concepts of ecological niche .in ecosystems.
4. Learn about the mechanisms of ecological succession and change ecosystem properties during succession

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M.Sc. BOTANY THIRD SEMESTER			
COURSE CODE: BOT-330		**COURSE TYPE: CCC**	
COURSE TITLE: BIOTECHNOLOGY AND GENETIC ENGINEERING OF PLANTS AND MICROBES		**PAPER- III**	
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	

OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of importance, and applications of biotechnology techniques, genetic engineering of plants and microbes.

UNIT –1	• **Biotechnology** - Basic concepts, principles and scope. • **Recombinant D.N.A. technology:** Gene cloning principles, Tools - Restriction Endonucleases, DNA modifying enzymes, Choice of Vectors, Plasmid, Cosmids, Bacteriophage vectors, phasmids, Artificial chromosomes. Shuttle vectors, Yeast vectors, Expression vectors and techniques, construction of genomic / cDNA libraries.
UNIT –2	• **Microbial genetic manipulation:** Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology. • **Genetic Engineering of Plants:** Aims, strategies for development of transgenies (with suitable examples), Gene transfer methods - Vector mediated gene transfer- Agrobacterium the natural genetic engineer. t-DNA mediated DNA transformation. Virus mediated gene transfer, Vectorless or direct DNA transfer.
UNIT –3	• **DNA Synthesis and Sequencing:** Chemical synthesis of gene, Polymerase chain reaction, its variation, application, advantages and limitations, DNA sequencing - Sanger and Coulson method, Maxam Gillbert method, High throughput DNA sequencing, DNA finger printing.
UNIT –4	• **Genomics and Proteomics:** Genetic and physical mapping of genes, molecular markers for integression of useful traits, Transposon mediated gene tagging, genome projects, bioinformatics, functional genomics, microarrays, protein profiling and its significance.

Suggested Laboratory Exercises:

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

Suggested Reading:

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

Suggested Reading (for laboratory exercise)

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

Course Outcome:

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

1. Understand about Basic principles, concept and applications of recombinant DNA technology.
2. Understand the techniques of gene cloning and its various applications. They will also learn the gel electrophoresis, blotting, DNA sequencing, PCR, creation of DNA libraries.
3. Understand the strategies for development of transgenics, alternative DNA delivery methods and its role in plant transformation.
4. Understand about the role of molecular markers for introgression of useful traits, High throughput sequencing, Genome projects, Bioinformatics, Functional genomics, and Protein profiling techniques.

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M.Sc. BOTANY THIRD SEMESTER			
COURSE CODE:340-A		**COURSE TYPE: ECC**	
COURSE TITLE: ELECTIVE COURSE-I: MOLECULAR PLANT PATHOLOGY-I PAPER- IV			
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Plant diseases and their control.			

UNIT –1	• Introduction and history of plant pathology. • General Principles of plant pathology and classification of plant diseases. • Diseases inciting organisms - Animate Pathogens- fungi, Bacteria, Mycoplasma, Viruses, Nematodes, their general characteristics, heterotrophic behaviour with emphasis on parasitism ability and virulence.
UNIT –2	• **Disease Syndrome and General Symptoms of plant diseases:** Pathogenic and nonpathogenic; Symptoms caused by fungi, Bacteria, Viruses, Mycoplasma and Nematodes. • **Sources of Infection:** Seeds, soil, water and airborne diseases of plants; Significance of phyllosphere and rhizosphere studies. • Pathogenesis - Dissemination of plant pathogens; Mode of infection; Inoculum potential.
UNIT –3	• **Effect of environment on disease development:** Predisposing factors; Survival of fungi; Germination of spores; Disease initiation and Epidemics. • **Host Parasites relationship:** Mechanism and physiology of infection, Path of infection, Role of enzymes, growth regulators and toxins in pathogenesis. • **Physiological specialization:** General account; Physiological specialization with special reference to smuts and rusts.
UNIT –4	• Recurrence of disease with special reference of recurrence of rust disease in India. • **Methods of Studying Plant Diseases:** General account, Macroscopic study, microscopic study, Koch postulates, Culture technique, Preparation of culture tubes, media preparation, Inoculation, Isolation, Pure culture, Parasitism of obligate parasites, Methods in bacteriology, Techniques required in

	introductory bacteriology

Suggested Laboratory Exercises:

1. Symptomatological study: Study of symptoms of plant diseases caused by fungi/bacteria/viruses/mycoplasma.
2. Study of instruments used during plant pathological experiments.
3. Sterilization Techniques: Principles and methods of sterilization.
4. Culture Techniques:
   - Preparation of culture media: Nutrient broth, Nutrient agar, Potato Dextrose agar.
   - Adjustment of pH of Media, Preparation of stabs and slants, Pouring of plates, Inoculation techniques.
   - Isolation of bacterial strains/fungi by serial dilution method.
5. Methods of Bacteriology:
   - Methods of obtaining pure culture of bacteria.
   - Methods of Bacteria-gram staining for differentiation of Bacteria.
   - Identification of various structures like endospores.
6. Study of fungal/bacterial/viral/mycoplasmal diseases of plants through field visit/museum specimens/photographs.

SUGGESTED READINGS:

1. Plant Pathology - J.C. Walkar
2. Fungi and plant diseases - B.B. Mundkar
3. Plant Pathology – G.N. Agrios
4. Plant Pathology (Vol.1-3) – Horsfall & Dimon
5. A text book of Modern Plant Pathology – K.S. Bilgrami and H. S.Dubey
6. Plant Pathology – R.S.singh
7. An introduction to Principles of Plant pathology - R.S.singh
8. Plant Disease of Crop plants in India – N.G. Rangaswamy.
9. Plant Pathology problems and progress- Honfall
10. Essentials of Plant Pathology- V.N. Pathak
11. Plant Pathology – Butter and Jones.
12. Plant Pathology- R.S. Malhotra
13. Crop plant Disease Colender- IARI-India.
14. Physiology of Fungus- – K.S. Bilgrami and H. S.Dubey
15. Micro-organisms in laboratory – G.P. Agarwal and S.K. Hasija.
16. Physiology of fungi – V.G.Lily and H.L.. Barnet.
17. Illustrated Genera of Imperfecti fungi- H.L.. Barnet and.B.B. Hunter.
18. Microbiology and Plant Pathology- P.D.Sharma
19. Plant Pathology- P.D.Sharma
20. Microbiology – P.D.Sharma
21. The Fungi – G. Sumbali
22. Fungicides and crop protection- H.G.Mewitt

23. Fungal diseases of plants- B.M. Duggar
24. Virus and Plant diseases S.R.Mishra
25. Bacterial Diseases- V. Kumar
26. Biotechnology and Plant Pathology- V.K.Jain
27. Laboratory manual of Plant Pathology- D.K.Jha.
28. Modern technology of Plant Pathology- V.Suri.

Course Outcome:

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

1. Know about history, principle, classification of plant diseases and various diseases inciting organisms.
2. Understand the disease syndrome, symptoms and causal agents of plant diseases, identification methods and pathogenesis.
3. Understand about environmental effects of disease development, host parasite relationship and physiological specializations of rusts and smuts.
4. Understand the recurrence of rust disease in India and also know the techniques used in study of plant diseases.

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M.Sc. BOTANY THIRD SEMESTER			
COURSE CODE: BOT-340-B		**COURSE TYPE: ECC**	
COURSE TITLE: ELECTIVE COURSE-II: LIMNOLOGY-I PAPER- IV			
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of limnology.			

UNIT –1	• Limnology–Definition, historical development and scope of Limnology. • The characteristics of water, Hydrological cycle, Global water balance. • Types of fresh water habitats and their ecosystem- • (a) Ponds, Streams and rivers. (b) Lakes– General characteristics of lakes and classification of lakes. Definition depth of lakes. Retention and replacement of water in lakes, origin of lakes.
UNIT –2	• Morphometry–Use of various morphometric parameters and Zonation. Food Chains, Food webs, Trophic levels and Energy flow in freshwater ecosystems. Eutrophication: Causes, mechanism and significance, Management of freshwater bodies.
UNIT –3	• Physical Characteristics of Lake water and their role. • 1.Light and Temperature- • (a)Transmission and absorption of Light, Colour and Transparency of light • (b)Distribution of heat in lakes, Temperature Radiation, Stratification and Heat Budget. Comparative analysis of river, reservoir and lakes. • 2.Water movements: Flow of water, surface and internal water movements. Turbidity, Salinity and Total Dissolved Solids
UNIT –4	• Chemical characteristics of fresh water with special reference to different parameters-Dissolved gases (Oxygen, Carbon di oxide, Hydrogen Sulphide), Seasonal changes in dissolved gases and pH, Hardness, Alkalinity, Sulphates, Nitrogen, Phosphorus, Iron, Sulphur and Silica cycle, Arsenic, and Fluoride.

Suggested Laboratory Exercises

1. Construction of morphometric maps of aquatic systems.
2. Measurement of transparency and temperature.
3. Analysis of different dissolved gases: Dissolved oxygen and Carbon dioxide.
4. Analysis of lake water for bicarbonates, carbonates, total alkalinity, chlorides etc.

Suggested Readings:

1. Anathakrishnan: Bioresources Ecology
2. Goldman: Limnology
3. Odum: Ecology
4. Pawlosuske : Physico-chemical methods for water LimnologyWetzal : Chemical and biological methods for water pollution studies
5. Trivedi&Goyal : Chemical and biological methods for water pollution studies
6. Welch: Limnology Vols.I-II
7. Perkins: Ecology
8. Arora: Fundamentals of environmental biology
9. Ghoshe: Toxicology
10. Sood: Toxicology

Course Outcome:

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

1. Understand of Historical development, scope of Limnology and fresh water habitat and ecology with reference to water crisis and development of lakes.
2. Understand the various morphometric parameters and tropic level, energy flow in fresh water ecosystem. Reflect upon the process of eutrophication and management of water bodies.
3. Understand the seasonal variations of temperature, turbidity, salinity, total dissolved solid and stratification & heat budget.
4. Analyze the chemical properties of fresh water and seasonal changes of dissolved gases & heavy metals.

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M.Sc. BOTANY THIRD SEMESTER			
COURSE CODE: BOT-340-C		**COURSE TYPE: ECC**	
COURSE TITLE: ELECTIVE COURSE-III: ETHNOBOTANY I PAPER- IV			
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of ethnobotanical utilizations of plants.			

UNIT –1	• Ethnobotany: History, general account and its sub disciplines. • Interdisciplinary approaches & aim of ethno botany. • Main world centres of Ethnobotanical studies, workers & literature of Ethno botany • Ethnobotany with special reference to Chhattisgarh. • Ethnobotanical Research done in India: • Ethnobotany in relation to national priorities and health care programme. • Practical application of ethnobotany for tribal development programme.
UNIT –2	• Methods and techniques in ethnobotany. • General account of major and minor tribes of Chhattisgarh with special reference to Gond, Kamar, Baiga, Abujhmaria. • Ethnobotanical aspect of Art & literature. • Abstract ethnobotany with special reference to folklore, Taboos, Magico-religious beliefs.
UNIT –3	• Ethnobotanical importance of Bacteria, Algae, Fungi, Bryophyta, Pteridophyta and Gymnosperm. • Ethnoveterinary medicines from plants. • Major & Minor Forest Products (NWFPs)of Chhattisgarh. • Ethnobotany in relation to livelihood security reference to tribes.
UNIT –4	• Ethnobotanical study of following plants with special reference to their medicinal importance 1. Azadirachta indica (Neem) 2. Emblica officinalis (Amla) 3. Ricinus conmunis (Andi) 4. Madhuca indica (Mahua) 5. Cassia fistula (Amaltash) 6. Ficus religiosa (Pipal) 7. Ocimum sanctum (Tulsi) 8. Asparagus racemosus (Satavar) 9. Aloe vera (Ghrit kumari) 10. Andrographis paniculata (Bhui neem).

Suggested Laboratory Exercises: -

1. Description and identification of medicinal plants and its medical properties.
2. Preparation of medicinal plants herbarium and photographs.
3. Herbal preparation: -
    a. Extract of Tulsi leaves.
    b. Ointment from Neem Leaves.
    c. Ayurvedic tooth powder.
    d. Face pack preparation from various herbs.
    e. Preparation of Triphala.
    f. Kwath of Triphala.
    g. Preparation of diabetes-controlled powder.
    h. Preparation of herbal shampoo.
4. To cultivate at least two medicinal plants in earthen pot.
5. Field Study of Forest area or Tribal area.
6. Documentation technique of Ethnobotanical knowledge.
7. To separate active principles from the extract of Medicinal plant.

Suggested Readings: -

1. Baker, H.G. 1978. Plants and Civilization (3 rd edition). C.A. Wadsworth, Belmont.
2. Chandel, K.P.S., Shukla, G.& Sharma, N. 1996. Biodiversity in medicinal and Aromatic Plants in India: Conservation & Utilization. National Bureau of Plant Genetic Resources, New Delhi.
3. Chrispeels, M.J. & Sadava, D. 1977. Plants , Food & People. W.H Freeman and Co., San Francisco.
4. Ambasta S.P. (ed.) (1986). The Useful Plants of India. Publications & Information Direxorate, CSIR, New Delhi India.
5. Anon. (1978). The tribes of Madhya Pradesh. Dept. of Tribal Welfare, Govt. of M.P. Bhopal.
6. Arnold. J. E. M. & Ruiz Perez, M, (1998). The role of non-timber forest products in conservation and development. In: Wallenberg, Eva. & Andrew Ingles (Eds.) Income from the Forest, CIFOR 1998, Indonesia, pp-17 to 41.
7. Asolkar, L.V. (1992). Second Supplement to Glossary of Medicinal Plants, (CSIR) NISCOM, New Delhi, India.
8. Bal, S.N. (1984). Catalogue of Medicinal Plant Exhibits. BSI. Bishne Singh Mahendra Pal Singh, Cannaught Place, Dehra Dun, India.
9. Chopra, R.N.; Badhwar, R.L. & Ghosh, S. (1965). Poisonous Plants of India. Vol. I. 2nd Ed. ICAR, New Delhi, India.
10. Cotton C.M, (1996). Ethnobotany: Principals and Applications, John Willey & Sons, Chichester. New York.
11. Faulks. P.J. (1958) An Introduction to Ethnobotany: Moredale Publications Ltd. London, England.
12. Harshberger, J.W. (1896). Purposes of Ethnobotany Bot. Gaz. 21: 146-154.
13. Jain S.K. and Phuipps, R.D. (1991). Medicinal Plants of India Rec. Pub.Algonac USA

2Vols. 1-849.
14. Jain, S. K. (1991). Dictionary of India folk medicine and Ethnobotany. Deep publications. NEW DELHI, pp. 1-311.
15. Jain, S. K. (1995). In Manual of Ethnobotany (edt. S.K. Jain,) Scientific Pubisher, Jodhpur. 128-134.
16. Jain, S.K. & Rao, R.R. (1977). A handbook off field and herbarium methods. New Delhi: Today & Tomorrow's Printers and Publishers.
17. Jain, S.K. (1981). Glimpses of Indian Ethnobotany. Oxford & IBH New Delhi, India.
18. Jain, S.K. (1989). Methods and Approaches in Ethnobotany. Society of Ethnobotanist. Lucknow.
19. Jain, S.K. and Mudgal, Hand Book of Ethanobotany. Bisen pal Singhm Mahendra Pal Singh Publication.
20. Vaishnaw T.K. (2004). Chhattisgarh ki Anusuchit Janjatiyan, Adim Jati Anusandhan Avam Prshikshan Sansthan Raipur. Prakashan kramank 2, pp. 1-120
21. Varghese, E. S. V D. (1996). Applied Ethnobotany - A case study among the Kharias of Central India. New Delhi. Deep Publications
22. Jajoria, E, V.K. (1998); "The Kamar [A way of life.] Vanya Prakashan., Tribal Research and Development Institute. 35, Shamla Hills, Bhopal., ethnobot. Res.2:303- 3 15.
23. Joshi, S.G. (2000). Medicinal Plants, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, India.
24. Kirtikar, K. R. & Basu, B.D. (1933-1935). Indian Medicinal plants. Vol.I to VIII (4 Vols. text & 4 vols. plates) Reprint 1994, Dehradun U.P.
25. Maheshwari, J.K. Ed. (2000). Ethnobotany and Medicinal Plants of Indian Subcontinent. Scientific Publishers, Jodhpur
26. Martin, G.J. (1995). Ethnobotany. Chapman and Hall, London.

Course Outcome:

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

1. Understand the historical development and basic concepts about ethnobotany.
2. Understand the relationship between plants & people and also learn methodology of ethnobotanical studies.
3. Recognize the ethnobotanically important plants species and learn about which parts of these plants are important for usage.
4. Understand the sustainable use of plant resources and their conservation.

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M.Sc. BOTANY THIRD SEMESTER			
COURSE CODE:		**COURSE TYPE: CBCS**	
COURSE TITLE: ENVIRONMENTAL SCIENCE			
CREDIT:3		**HOURS: 105**	
THEORY:2	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of environmental factors.			

UNIT –1	• Definition, principles and scope of Environmental Science. • Earth, Man and Environment. Ecosystems, Pathways in Ecosystems. • Physico-chemical and biological factors in the Environment. • Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. • Natural resources, conservation and sustainable development. Restoration and rehabilitation technologies. Concept and strategies of sustainable development. • Environmental priorities in India and sustainable development.
UNIT –2	• Chemical composition of Air: Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermo chemical and photochemical reactions in the atmosphere. Oxygen and ozone chemistry, Chemistry of air pollutants, Photochemical smog. • Water Chemistry: Chemistry of water, concept of DO, BOD, COD, sedimentation, coagulation, filtration, Redox potential. • Soil Chemistry: Inorganic and organic components of soil, Nitrogen pathways and NPK in soils. • Toxic Chemicals in the environment – Air, Water: Pesticides in water. Biochemical aspects of Arsenic, Cadmium, Lead, Mercury, Carbon Monoxide, Os and PAN Pesticides, Insecticides, MIC, carcinogens in the air.
UNIT –3	• Definition, Principles and scope of ecology, Human ecology and Human settlement, Evolution, Origin of life and speciation. • Ecosystems: Structure and functions, Abiotic and Biotic components, energy flows, Food chains, Food web, Ecological pyramids, types and diversity.

	• Ecological Succession, Population, Community ecology and Parasitism, Prey – predator relationships. • **Common flora and fauna in India:** • Aquatic: Phytoplankton, Zooplankton and Macrophytes. • Terrestrial: Forests, Endangered and Threatened Species: • Biodiversity and its conservation: Definition, 'Hotspot's of Biodiversity, Strategies for Biodiversity conservation. National Parks and Sanctuaries. Gene pool. Biodiversity conservation and Agenda – 21. • Microflora of Atmosphere: Air Sampling techniques. Identification of aeroallergens. Air – borne diseases and allergies. • Environmental Biotechnology: Fermentation Technology, Vermiculture technology, Biofertilizer technology.
UNIT –4	• Earth's major ecosystems terrestrial and aquatic. General relationship between landscape, biomes and climate. Climates of India, Indian Monsoon, El Nino, Droughts. Tropical cyclones and Western Disturbances. • Environmental implication of energy use; C02 emissions, global warming; air and thermal pollution; radioactive waste and radioactivity from nuclear reactors; impacts of large-scale exploitation of Solar, Wind, Hydro and Ocean energy. • Introduction to environmental impact analysis. Impact Assessment Methodologies. • Environment protection-issues and problems, International and National efforts for Environment Protection, Provision of Constitution of India regarding Environment (Article 48A and 58A). • Public Policy Strategies in Pollution Control, Wildlife Protection Act, 1972 amended 1991, Forest Conservation Act, 1980, Indian Forests Act (Revised) 1982, Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act, 1987 and Rule 1982, Motor Vehicle Act, 1988, The Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988 and Rules 1975, The Environment (Protection) Act, 1986 and Rules 1986. • Scheme of labelling of environmentally friendly products (Ecomark), Public Liability Insurance Act, 1991 and Rules 1991.

UNIT-5	• Air : Natural and anthropogenic sources of pollution. Primary and Secondary pollutants. Transport and diffusion of pollutants. Methods of monitoring and control of air pollution SO2, NO2, CO, SPM. Effects of pollutants on human beings, plants, animals, materials and on climate. Acid Rain. Air Quality Standards. • **Water :** Types, sources and consequences of water pollution. Physico – chemical and Bacteriological sampling and analysis of water quality. Standards, sewage and waste water treatment and recycling. Water quality standard. • **Soil:** Analysis of soil quality. Soil Pollution Control. Industrial waste effluents and heavy metals, their interactions with soil components. Soil micro – organisms and their functions, degradation of different insecticides, fungicides and weedicides in soil. Different kinds of synthetic fertilizers (NP & K) and their interactions with different components of soil. • **Noise**: Sources of noise pollution, measurement of noise and Indices, effect of meteorological parameters on noise propagation. Noise exposure levels and standards. Noise control and abatement measures. Impact of noise on human health.

RECOMMENDED BOOKS

1. Smith, R.L. 1996. Ecology and field biology, Harper Collins, New York. Odum, E.P. 1971. Fundamentals of Ecology, Saunders, Philadelphia.
2. Odum, E.P. 1983. Basic ecology, Saunders, Philadelphia.
3. Kormondy, E.J. 1996. Concepts of Ecology, Prentice Hall of India Pvt.Ltd. New Delhi. Moldan, B. and Billharz, S. 1997 Sustainability indicators, John Wiley and Sons, New York. Begon M, Harper, J.L. Townsend, C.R.1996. Ecology, Blackwell science, Cambridge, USA. Chapman, J.L. and Reiss, M.J.1988 Ecology principles and applications,
4. Cambridge University press, Cambridge, U.K.
5. Threshow, M1985. Air pollution and plant life, Wiley interscience. Mason C.F. 1991. Biology of fresh water pollution, Longman.
6. Hill, M.K. 1997. Understanding Environmental pollution, Cambridge University press.
7. Frankel, O.H., Brown, A.H.D. and Burdon, J.J. 1995. The conservation of Plant biodiversity, Cambridge University press, Cambridge, U.K.
8. Kothari, A. 1997.Understanding Biodiversity: Life sustainability and Equity, Orient Longman.

9. Nair, M.N.B. 1998. Sustainable management of non wood forest products, Faculty of forestry, University Putra Malaysia.
10. Paroda, R.S. and Arora R.K. 1991.Plant resources conservation and management, IPGRIP USA Campus, New Delhi.
11. Heywood, V.H. and Watson, R.T.1995. Global biodiversity assessment, Cambridge University press Cambridge, U.K.
12. Brady, N.C. 1990. The nature and properties of soils, MacMilan.
13. Falk, D.A. Olwell, M Millan, C. 1996. Restoring biodiversity, Island press, Columbia, USA.
14. Gaston, K.J. Biodiversity: a biology of numbers and differences, Blackwell science Ltd. Oxford, U.K.
15. Heywood, V. 1995 Global biodiversity assessment. United nations environment programme, Cambridge University Press, Cambridge, U.K.

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<table>
<tr><td colspan="4">M.Sc. BOTANY FOURTH SEMESTER</td></tr>
<tr><td colspan="2">COURSE CODE: BOT-410</td><td colspan="2">COURSE TYPE: CCC</td></tr>
<tr><td colspan="4">COURSE TITLE: PLANT REPRODUCTION AND UTILIZATION OF RESOURCES PAPER- I</td></tr>
<tr><td colspan="2">CREDIT:6</td><td colspan="2">HOURS: 105</td></tr>
<tr><td>THEORY:5</td><td>PRACTICAL:1</td><td>THEORY:70</td><td>PRACTICAL:30</td></tr>
<tr><td colspan="4">MARKS</td></tr>
<tr><td colspan="2">THEORY:100(30+70)</td><td colspan="2">PRACTICAL:70</td></tr>
<tr><td colspan="4">OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of reproduction process and utilization of plant resources.</td></tr>
<tr><td>UNIT –1</td><td colspan="3">• Reproduction: Vegetative reproduction, Methods of propagation. Pollination, Pollination- mechanism and vector, Structure of pistil, Pollen stigma interaction, Sporophytic and gametophytic Self-incompatibility (Cytological, biochemical and molecular aspects), Fertilization, double fertilization, in-vitro fertilization.</td></tr>
<tr><td>UNIT –2</td><td colspan="3">• Male gametophyte: Structure of anther, Microsporogenesis, Role of tapetum, pollen development, male sterility, sperm dimorphism and hybrid seed production, Pollen germination, Pollen tube growth and guidance, Pollen storage, Pollen allergy, Pollen embryo sac.
• Female gametophyte: Ovule development, Organization of embryo sac and Structure of embryo sac cells.</td></tr>
<tr><td>UNIT –3</td><td colspan="3">• Seed and Fruit development: Endosperm development during early, maturation and desiccation stages. Embryo genesis, Storage proteins of endosperm, Ultra structure and nuclear cytology, Cell lineage during late embryo development, Polyembryony, Apomixes, Embryo culture, Endospermic and non-endospermic seeds, Dynamics of fruit growth, biochemistry and biology of fruit maturation.</td></tr>
<tr><td>UNIT –4</td><td colspan="3">• Utilization of resources: Plant used as avenue trees for shade, Pollution control and aesthetics, Innovation for meeting world food demands Origin of Agriculture. Green revolution; benefits and adverse consequences. Ethnobotanically important plants of Chhattisgarh. World centers of primary diversity of domesticated plants.</td></tr>
</table>

SUGGESTED LABORATORY / FIELD EXERCISES

1. Study of microsporogenesis and gametogenesis in sections of anthers.
2. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (Maize, Grasses, Cannabis Sativa Crotalaria, Tradescantia, Brassica, Petunia, Solanum melongena etc.)
3. Estimating percentage and average pollen tube length in vitro.
4. Role of transcription translation inhibitors on pollen germination and pollen tube growth.
5. Pollen storage, Pollen-pistil interaction, self-incompatibility in vitro pollination.
6. Study of ovule in cleared preparations, study of monosporic, bisporic and terrasporic types of embryo sac development through examination of permanent, stained serial sections.
7. Field study of several types of flowers with different pollination mechanisms (wind pollination thrips pollination bee/butterfly pollination, bird pollination.
8. Emasculation, bagging and hand pollination to study of pollen germination, seed set and fruit development using self-compatible and obligate out crossing system. Study of cleistogamous flowers and. Their adaptations.
9. Study of nuclear and cellular endosperm through dissections and staining.
10. Isolation of zygotic, globular, heart shaped, torpedo stage and nature embryo from suitable seeds and polyembryony in citrus, jamun (Syzygium cumin) etc. by dissections.
11. Study of endospermic and non-endospermic seed.
12. Study of seed dormancy and methods to break dormancy.
13. Medicinal and Aromatic plants; Depending on the geographical location College/University select five medicinal and aromatic plants each from a garden, crop field or from the wild only if they are abundantly available. Papaver somniferum, Atropa belladonna, Catharanthus roseus, Adhatoda ceylanica, Allium sativum, Rauwolfia serpentina, Withania somnifera, Phyllanthus amarus, Andrographis paniculata, Aloe barbadense, Mentha arvesis, Rosa sp. Pogostemon cablins, Origanum vulgare, Vetivera zizanioides, Jasminum grandiflorum, Cymbopogon sp., Pandanus odoratissimus.
14. Study of live or herbarium specimens or other visual materials to become familiar with these resources.
15. Vegetable oils; Mustard, Groundnut, Soya bean, Coconut, Sunflower and Castor.
16. Gums, Resins, Tannins and Dyes; Perform simple tests for gums and resins. Prepare a water extract of vegetable tannins (Acacia. Terminalia, Mangroves. Tea. Cassia sp. Myrobalans) and dyes (Turmeric, Bixa orellana, Indigo, Butea monosperma, Lawsonia intermis) and perform tests to understand their chemical nature.

SUGGESTED READINGS:

1. Bhojwani, SS. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4 revised and enlarged edition) Vikas publication House, New Delhi.
2. Fageri, K. and Vander Pijl, L. 1979. The Principles of Pollination Ecology Pergamon Press, Oxford.
3. Proctor, And Yeo, P. 1973. The Pollination of Flowers. William Collins, London.
4. Raghavan. V. 1997. Molecular Embryology of Flowering Plants. Cambridge University, Press, Cambridge.

5. Raghavan, V. 1999 Developmental Biology of Flowering Plants. Springer-Verlag, New York.
6. Raven, P.H. Evert, R.F. and Eichhorn, and S.E. 1992. Biology of plants (5 edition), Worth, New York.
7. Sedgely, M. and Griffin, A.R. 1989. Sexual Reproduction of Tree Crops. Academic Press, London.
8. Shivanna, K.R. and Sawhney, V.K. 1997. Pollen Biotechnology for crop Production and Improvement.
9. Shivanna, K.R. and Rangaswamy, N.S. 1992. Pollen Biology : A Laboratory Manual. Springer-Verlag, Berlin.
10. Shivanna, K.R. and Johri, B.M. 1985. The Angiosperm Pollen : Structure and Function. Wiley Eastern Ltd., New York.
11. Chandel, K.P.S., Shukla, G. and Sharma N. 1996. Biodiversity in Medicinal and Aromatic Plants in India; Conservation and Utilization. National Bureau of Plant Genetic Resources, New Delhi.
12. Chrispeels, M.J. and Sdava, D. 1977. Plants, Food and People. W.H. Freeman and CO., San Francisco.
13. Council of Scientific and Industrial Research 1986. The Useful Plants of India. Publications and directorate, CSIR, New Delhi.
14. Kochhar, S.L. 1998. Economic botany of the Tropics, 2nd edition. Macmillan India Ltd., Delhi.
15. Thakur, R.S., Puri, H.S. and Hussain, A., 1989. Major Medicinal Plants of India. Central Institute of Medicinal and Aromatic Plants, CSIR, Lucknow.
16. Swaminathan, M.S. and Kocchar, S.L.1989. Plants and Society. Macmillan Pub. London.

SUGGESTED READINGS FOR LABORATORY EXERCISE:

1. Adriance, W. and Brison, R. Propagation of horticultural plants. Tata McGraw Hill pub. New Delhi.
2. Sen. N. David, 1977. Environmental and seed germination of Indian plants. The chronica botanica co. New Delhi.
3. Shivanna, K.R. and Rangaswamy, N.S. 1992 Pollen Biology: A Laboratory Manual. Springer-Verlag, Berlin.
4. Shivanna, K.R., Johr, B.M. And Sastri, D.C. 1979. Development and physiology of angiosperm pollen. Today and tomorrow's printers and pub. New Delhi.
5. Vargheese, T.M. Experimental and applied embryology of angiosperms. Oxforc & IBS pub. Co. New Delhi.

Course Outcome

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

1. Identify plant vegetative and reproductive structures and understand the propagation methods.

2. Understand processes and functions of plant growth and reproduction, including development of male and female gametophyte.
3. Understand the processes of Seed & fruit development.
4. Understand the different types of bioresources e.g., in service of mankind (as medicine, as food, as timber, as fibre and dye yielding plants etc.)
5. Explore the regional diversity in food crops and other plants and their ethno-Botanical importance as well.
6. Important avenue, pollution and aesthetically beautiful plants of the city and adjoining area is shown to the students.

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M.Sc. BOTANY FOURTH SEMESTER			
COURSE CODE: BOT-420		**COURSE TYPE: CCC**	
COURSE TITLE: POLLUTION AND BIODIVERSITY CONSERVATION PAPER- II			
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of pollution control and conservation strategies of local flora and fauna.			
UNIT –1	• Climate, Soil and Vegetation Patterns of the World: • Life zones, major biomes, major vegetation types and soil types of the world, barren land.		
UNIT –2	• Pollution, Climate Change and Ecosystems: • Air, water and soil pollution: - kinds, sources, quality parameters, effects on plants and ecosystem. • Greenhouse gases (Caron dioxide, methane, nitrous oxide, Chloro-fluorocarbons: sources, trends and role), ozone layer, ozone hole, consequences of climate change) Carbon dioxide fertilization, global warming, seal level rise, UV radiation).		
UNIT –3	• Biological Diversity: Concepts and levels, status in India, Utilization and concerns, role of biodiversity in ecosystem functions and stability, speciation and extinction, IUCN categories of threat, distribution and global patterns, terrestrial biodiversity hot spots, inventory. • World centers of primary diversity of domesticated plants; The Indo Burmese center, plant introductions and secondary centers.		
UNIT –4	• Conservation Strategies: Principles of conservation, extinctions, environmental status of plants based on international union for conservation of Nature. • In situ conservation, international efforts and Indian initiatives, protected areas in India- sanctuaries, national parks, biosphere reserves, Wetlands, Mangroves and coral reefs for conservation of wild biodiversity. • Ex situ conservation: Principles and practices, botanical gardens, field gene bank, seed banks, in vitro repositories, cryobanks, general account of the activities of Botanical survey of India (BSI), National Bureau of plant genetic resources (NBPGR), Indian council of Agriculture research (ICAR), Council of scientific and Industrial research (CSIR), and the department of Biotechnology (DBT) for conservation and non-formal conservation efforts.		

LIST OF PRACTICALS:

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

REFERENCE BOOKS:

1. Threshow, M1985. Air pollution and plant life, Wiley interscience. Mason C.F. 1991. Biology of fresh water pollution, Longman.
2. Hill, M.K. 1997. Understanding Environmental pollution, Cambridge University press.
3. Anonymous, 1987. National gene bank, Indian heritage on plant genetic resources, National bureau of plant genetic resources.
4. Directory of Indian wet lands, 1993 WWF India and AWB, Kualalumpur.
5. Frankel, O.H., Brown, A.H.D. and Burdon, J.J. 1995. The conservation of Plant biodiversity, Cambridge University press, Cambridge, U.K.
6. Kothari, A. 1997. Understanding Biodiversity: Life sustainability and Equity, Orient Longman.
7. Nair, M.N.B. 1998. Sustainable management of non-wood forest products, Faculty of forestry, University Putra Malaysia.
8. Paroda, R.S. and Arora R.K. 1991. Plant resources conservation and management, IPGRIP USA Campus, New Delhi.
9. Heywood, V.H. and Watson, R.T.1995. Global biodiversity assessment, Cambridge University press Cambridge, U.K.
10. Brady, N.C. 1990. The nature and properties of soils, MacMilan.
11. Chandel, K.P.S., Shukla, G. and Sharma, N., 1996. biodiversity in medicinal and aromatic plants in India, conservation and utilization. National bureau of plant genetic resources, New Delhi.

12. Falk, D.A. Olwell, M Millan, C. 1996. Restoring biodiversity, Island press, Columbia, USA.
13. Gaston, K.J. Biodiversity: a biology of numbers and differences, Blackwell science Ltd. Oxford, U.K.
14. Heywood, V. 1995 Global biodiversity assessment. United nations environment programme, Cambridge University Press, Cambridge, U.K.
15. Heywood, V.H. and Wyse Jakon, P.S. 1991. Tropical botanical gardens, their role in conservation and development, Academic press San. Diego.
16. Walter, K.S. and Gillett H.J. 1998. 1997 IUCN Red list of threatened plants.
17. IUCN The World conservation union, IUCN, Gland, Switzerland and Cambridge, U.K.

REFERENCE BOOKS FOR LABORATORY EXERCISE:

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

Course Outcome:

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

1. Understand the climate, soil and vegetation patterns of the world.
2. Understand the types and sources of pollution and various green house gases and their effects on ecosystem.
3. Understand different types of biological diversity, concept & status, IUCN category of threats and importance of biodiversity hotspots.
4. Learn about the national and international strategies for the conservation and sustainable use of essential ecological diversity to preserve the continuity of the food chains.

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<table>
<tr><td colspan="4">M.Sc. BOTANY FOURTH SEMESTER</td></tr>
<tr><td colspan="2">COURSE CODE: BOT-430</td><td colspan="2">COURSE TYPE: CCC</td></tr>
<tr><td colspan="4">COURSE TITLE: BIOTECHNOLOGY-II (PLANT CELL, TISSUE CULTURE AND ORGAN CULTURE)
PAPER- III</td></tr>
<tr><td colspan="2">CREDIT:6</td><td colspan="2">HOURS: 105</td></tr>
<tr><td>THEORY:5</td><td>PRACTICAL:1</td><td>THEORY:70</td><td>PRACTICAL:30</td></tr>
<tr><td colspan="4">MARKS</td></tr>
<tr><td colspan="2">THEORY:100(30+70)</td><td colspan="2">PRACTICAL:70</td></tr>
<tr><td colspan="4">OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of various techniques used in the development of plants through tissue culture.</td></tr>
<tr><td>UNIT –1</td><td colspan="3">• Plants Cells and Tissue Culture: General introduction, history, scope, concept of cellular differentiation, cellular totipotency.
• Tissue Culture Media: Introduction, Media constituents, Media selection, Media preparation.
• Cell Culture: Introduction isolation of single cells. Suspension cultures, Culture of Single cell, Plant cell reactors, Applications of cell culture.
• Clonal Propagation - Auxillary bud proliferation, Meristem and shoot tip culture, bud culture.
• Organogenesis and Adventive Embryogenesis: Fundamental aspects of morphogenesis; organogenesis via callus formation, direct adventive organ formation.</td></tr>
<tr><td>UNIT –2</td><td colspan="3">• Somatic Embryogenesis and Androgenesis: Mechanisms, techniques and utility.
• Somatic Hybridization: Methods of Protoplast isolation, Spontaneous and induced methods of protoplasm fusion, identification and selection of hybrid cells. Regeneration of hybrid plants. Verification and Characterization of somatic hybrids, Cybrids, possibilities, achievements and limitations of protoplast research.</td></tr>
<tr><td>UNIT –3</td><td colspan="3">• Cryopreservation and Germplasm Storage: Raising sterile tissue cultures, Addition of cryoprotectants and pretreatment, freezing, storage, thawing, determination of survival viability. Plant growth and generation, verification, encapsulation and dehydration. Slow growth method, Applications.
• Intellectual Property Rights: Possible ecological risks and ethical concerns.</td></tr>
</table>

UNIT –4	• **Application of Plant Tissue Culture**: Artificial seeds, Production of hybrids and Soma clones. • **Production of Secondary Metabolites / Natural Products:** Morphological and chemical differentiations, medium composition for secondary product formation. Growth production patterns, Environmental factors. Selection of cell lines producing high amounts of a useful metabolite, Problems associated with secondary metabolite production Immobilized cell system. • **Transgenics in Crop Improvement:** Transgenic for Resistance to biotic and abiotic stresses, Transgenics for quality modification, Terminator seed technology. Chloroplast transformation and its utility.

Suggested Laboratory Exercise:

1. Isolation protoplast from various plant tissues and testing their viability.
2. Effect of physical (e.g. temperature) and chemical (e.g. osmoticum) factors on protoplast yield.
3. Demonstration of protoplast fusion employing PEG.
4. Organogenesisand somatic embryogenesis using appropriates explants and preparations of artificial seed.
5. Demonstration of androgenesis in Datura.
6. Electroporation of protoplasts and checking of transient expression of the reporter gene.
7. Co-cultivation of the plant material (e.g. Leaf discs) with Agrobacterium and study GUS activity histochemically.

Suggested Reading:

1. Bhojwani, S.S. and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice revised edition). Elsevier Science Publishers, New York, U.S.A.
2. Bhojwani, S.S. 1990, Plant Tissue Culture; Application and Limitations. Elsevier Science Publishers, New York, USA.
3. Collins, H.A. and Edwards, S., 1998. Plants cell Culture Bio Scientific Publishers, Oxford UK.
4. Jain, S.M. Sopory, S.K. and Veilleux, R.E. 1996. In Vitro Haploid Production in Higher Plants, Vois. Fundamental Aspects and Methods Kluwer Academic Publishers. Dordrecht. The Netherlands.
5. Kartha, K.K. 1985. Cryopreservation of Plants Cells and Organs. CRC Press, Boca Raton, Florida, USA.
6. Raghavan, V. 1986. Embryogenesis, in Angiosperms: A Development an Experimental Study Cambridge University Press, New York, USA.
7. Vasil, Ikssshorpe, T.A. 1994. Plant Cell and Tissue Culture, Kluwer ACADEMIC publishers, The Netherlands.

Suggested Reading (for laboratory exercise) :

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

Course Outcome:

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

1. Understand the basic properties of plant cell, tissues and with apply the their basic
2. Understanding of various plant tissue culture techniques.
3. Understand the methods of somatic embryogenesis, androgenesis and hybridization in plants.
4. Understand the ex-situ and in-situ germplasm conservation strategies of rare plant species and importance of Intellectual property rights.

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M.Sc. BOTANY FOURTH SEMESTER			
COURSE CODE: BOT-440-A		**COURSE TYPE: ECC**	
COURSE TITLE: ELECTIVE PAPER-I: MOLECULAR PLANT PATHOLOGY II PAPER- IV			
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of various plant diseases caused by microbes and their control.			

UNIT –1	• **Epidemiology and disease forecasting:** Types of epidemics, factors responsible for the establishment of an epidemic, disease forecasting. • **General principles of plant disease control:** General account; Prophylactic. chemical (including fungicides, systemic fungicides, fumigants, antibiotics, growth regulators etc.) and biological control; Breeding for disease resistance varieties of host plants, Plant quarantine.
UNIT –2	• **Defense Mechanism:** Defense of host against pathogen, Structural defense; Physiological defense, Biochemical defense-role of phenolic compounds; Phytoalexins Defense through hyper-sensitive reactions. • **Resistance and susceptibility:** General account, types of resistance, vertical and horizontal resistance; breeding for disease resistance.
UNIT –3	• **Wilt diseases:** General account, systems of diseases, Mechanism of wilting. • **Diseases due to fungi:** Rusts, smuts, Downy mildews powdery mildew diseases, Wilts, Leaf blight, Ergots, Tikka, necrosis, Rots-red rot of sugarcane, Damping off and warts diseases of economically important plants. • **Diseases due to Bacteria:** Bacterial blight of Rice, Tundu disease, citrus canker, Crown galls of stone fruits, Angular leaf spots.
UNIT –4	• **Diseases due to Viruses**: Mosaic of tobacco, Potato and tomato, Leaf curl of tomato & papaya, yellow vein mosaic of Bhindi, Bunchy top of banana, Grassy shoot disease of sugarcane. • **Diseases due to Mycoplasma:** Sandal spike, little leaf of Brinjal, Grassy shoot disease, Sesamum, phyllody, Citrus greening. • **Diseases due to Nematodes:** General characteristics of plants nematodes, Root knot, Malaya disease of Barley, wheat, Citrus nematodes, Ear cockle of wheat.

Suggested Laboratory Exercise

1. Collection and preservation of diseased plant parts through field visit.
2. Study of stages for the demonstration of Koch's postulate for identification of pathogenicity of an organism.
3. Study of fungal diseases of important crop and vegetable plants- Study of symptoms and host parasite interactions through field visit/museum specimens/photographs.
4. Symptomatological study of important bacterial/viral/mycoplasmal diseases of economically important plants.
5. Special features of some plant pathogens through slide preparation/permanent slides.
6. Plant Pathological Methods.
    a. Isolation of fungal pathogens/microorganisms from leaves.
    b. Isolation of fungal pathogens/organisms from rhizosphere.
    c. Isolation of fungal pathogens/microorganisms from air by exposure plate techniques.
7. Q.R. coding for disease inception (Field visit)- Geo tagging.
8. Apps and software for plant disease prediction.
9. Application of ICT for identification of microbes.

SUGGEST READINGS:

1. Plant Pathology - J.C. Walkar
2. Fungi and plant diseases - B.B. Mundkar
3. Plant Pathology – G.N. Agrios
4. Plant Pathology - Whecler
5. Plant Pathology (Vol.1-3) – Horsfall & Dimon
6. A text book of Modern Plant Pathology – K.S. Bilgrami and H. S.Dubey
7. Plant Pathology – R.S.Singh
8. An introduction to Principles of Plant pathology - R.S.singh
9. Plant Disease of Crop plants in India – N.G. Rangaswamy.
10. Plant Pathology problems and progress- Honfall
11. Essentials of Plant Pathology- V.N. Pathak
12. Plant Pathology – Butter and Jones.
13. Plant Pathology- R.S. Malhotra
14. Crop plant Disease Colender- IARI-India.
15. Physiology of Fungus- – K.S. Bilgrami and H. S.Dubey
16. Micro-organisms in laboratory – G.P. Agarwal and S.K. Hasija.
17. Physiology of fungi – V.G.Lily and H.L.. Barnet.
18. Illustrated Genera of Imperfecti fungi- H.L.. Barnet and.B.B. Hunter.
19. Microbiology and Plant Pathology- P.D.Sharma
20. Plant Pathology- P.D.Sharma
21. Fungicides and crop protection- H.G.Mewitt
22. Fungal diseases of plants- B.M. Duggar
23. Plant Pathology – P.C. Trivedi
24. Plant Pathology – G.P. Gupta

25. Virus and Plant diseases S.R.Mishra
26. Bacterial Diseases- V. Kumar
27. Biotechnology and Plant Pathology- V.K.Jain
28. Laboratory manual of Plant Pathology- D.K.Jha.
29. Modern technology of Plant Pathology- V.Suri.

Course Outcome:

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

1. Understand the epidemiology and disease forecasting, principle and plant disease control strategies.
2. Understand the defense mechanisms of plants against pathogens and types of disease resistance & susceptibility.
3. Understand the identification and etiology of various plant diseases caused by fungi and bacteria.
4. Understand the general characters and control measures of plant diseases caused by viruses, Mycoplasma and Nematodes.

Pt. Ravishankar Shukla University, Raipur (Chhattisgarh)

M.Sc. BOTANY FOURTH SEMESTER			
COURSE CODE: BOT-440-B		**COURSE TYPE: ECC**	
COURSE TITLE: ELECTIVE PAPER-II: LIMNOLOGY-II PAPER- IV			
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of phytoplankton, their conservation and utilizations.			

UNIT –1	• **Study of Biota** ▪ **Phytoplankton flora**-classification of phytoplankton, special distribution of phytoplankton, seasonal distribution and species composition of phytoplankton. Algal blooms effects of salinity and climatic stresses on the distribution of phytoplankton, Phyto benthos-classification. ▪ Phytoplankton and their inter-relationship with Zooplanktons. • (c) Aquatic insects, birds and their environmental significance.
UNIT –2	• **Lake Flora**-Higher Plants. Categories of aquatic higher plants, zonation of rooted higher plants, some peculiarities of aquatic higher plants. • **Lake Bacteria**-occurrence, characteristics and importance. • Ecological classification of aquatic higher aquatic plants and their significance. • **Biotic relationship and interaction among organisms**: Symbiosis, competition among algae, Parasitism of algae, predation of algae, impact of human being on algae.
UNIT –3	• **Concept of Productivity:** Seasonal variation, Primary productivity in freshwater lakes, Estimation of Primary Productivity. • **Bio indicators-**Aquatic flora and fauna in relation to water quality in an aquatic environment., Use and misuse of inland waters. • Methods of water quality testing BOD and COD.
UNIT –4	• **Sewage**–Definition, composition and its treatment. • Pollution by Domestic and Agriculture sewage, Industrial effluent. • Causes of pollution of Aquatic Resources, their management and conservation. **Resource Conservation**–Aquatic pollution, control, legislation, regulation on discharge of industrial effluents and domestic wastes in rivers and reservoirs.

Suggested laboratory Exercise

1. Sampling of phytoplankton and their qualitative and quantitative analysis.
2. Sampling of pteridophytes and macrophytes, and their qualitative and quantitative analysis.
3. Sampling of Zooplankton and their qualitative and quantitative analysis. 4.Primary production: Experiment-in-situ by light and dark bottle method.
4. Short-term productivity experiments for the understanding of diel variation in aquatic ecosystems.
5. Analysis of sediments for benthic fauna and flora.

Suggested Readings:

1. Adoni, A.D. et al. 1985. Workbook on Limnology. Pratibha Pub. Sagar 216 p.
2. APHA 1981. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Washington.
3. Arber, A. 1920. Water Plants. Cambridge University Press.
4. Barnes, A.K. and K.H. Mann, 1980. Fundamentals of Aquatic Ecosystems. Blackwell Scientific Publication, Oxford.
5. Brown, A.L. 1971. Ecology of Fresh Water. Heinemann, London, 129 p. nd
6. Cole G.A., 1979. Text book of Limnology. 2
7. De, A.K., 1989. Environmental Chemistry. Wiley Eastern Limited, New Delhi.
8. Goldman, C.R. and A.J. Horne, 1983. Limnology. McGraw Hill Inc. Tokyo,464 p.
9. Golterman H.L., 1975. Physiological Limnology. Elsevier Scientific PublishingCo., Amsterdam, The Netherlands, 489 p.
10. Hutchinson G.E. 1957. A Treatise on Limnology. Vol. I,II,III, John Wiley &Sons, NY.
11. Mackereth, F.J.H., 1963. Some methods of water Analysis for Limnologists. Fresh Water Biological Association. Scientific Publication, No. 21, Ambleside England.
12. Mackereth, F.J.H., J. Heron and J.F. Talling. 1978. Water Analysis : Some Revised Methods for Limnologists. Freshwater Biological Association, Sci. Pub. No. 36.
13. Moss, B., 1980. Ecology of fresh waters. Blackwell Scientific Publications, Oxford, 417 p. rd
14. Odum, E.P. 1971. Fundamentals of Ecology. 3
15. Ruttner, F., 1963. Fundamentals of Limnology, 3 p.
16. Schwoerbel, I. 1987. Handbook of Limnology. Gustav fisher, Verlag.
17. Strickland J.D.H. and T.R. Parson. 1972. A Practical Handbook of Sea Water Analysis. Fisheries Research Board of Canada, Ottawa.
18. Subramanyam, K. 1962. Aquatic Angiosperms C.S.I.R., New Delhi.
19. Welch, P.S. 1935. Limnology. McGraw Hill Co. N.Y., 472 p.
20. Welch, P.S. 1948. Limnological methods. Philadelphia, Blakiston Co. 381p.
21. Wetzel, R.G. 1975. Limnology0. W.B. Saunders Co., Phildalelphia, 743 p.

Course Outcome:

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

1. Acquire knowledge about classification, distribution of phytoplankton flora and their interrelationship with Zooplanktons.
2. Understand the Lake flora of higher plants, bacteria, biotic relationship and interaction among other organisms.
3. Know the concept and estimation of productivity of aquatic flora in relation to water quality and methods of water quality testing including BOD and COD.
4. Understand the causes of pollutions of aquatic resources, their treatment & management and conservatory regulations of aquatic pollutions.

Pt. Ravishankar Shukla University, Raipur (Chhattisgarh)

M.Sc. BOTANY FOURTH SEMESTER			
COURSE CODE: BOT-440-C		**COURSE TYPE: ECC**	
COURSE TITLE: ELECTIVE PAPER: ETHNOBOTANY II PAPER- IV			
CREDIT:6		**HOURS: 105**	
THEORY:5	**PRACTICAL:1**	**THEORY:70**	**PRACTICAL:30**
MARKS			
THEORY:100(30+70)		**PRACTICAL:70**	
OBJECTIVES: This course is aimed towards generating fundamental knowledge, concepts and dimensions of medicinal importance of plant resources.			

UNIT –1	• Plant Conservation by Tribes & role of Joint Forest Management Programme in Plant Conservation specially People's Protected Area • Ethnobotany and its role in domestication and conservation of native plant and genetic resources. • The protection of plant varieties and Intellectual Properties Rights. • General account of conservation of medicinal plants. • General role of Aromatic plants.
UNIT –2	• General ideas of various system of medicine using plants. • Basic knowledge of Ayurvedic, Homeopathic, Allopathic system of medicine. • General idea of active principles of Plants. • Herbal Cosmetics. • General account of toxic plants and Harmful effect of plants on human society with special reference to allergic plants of Chhattisgarh.
UNIT –3	• Endemic and Endangered plants of Chhattisgarh. • Techniques of cultivation and marketing of Aromatic plants –Podina, Lemon grass Kasturi bhindi, Palmarosa. • Techniques of cultivation, marketing and importance of mushroom • Techniques of cultivation, extraction of juice and importance of wheat grass.
UNIT –4	• Ethnobotanical study of the following plants with special reference to their medicinal importance- 1. Allium sativum (Lahsun) 2. Aegle marmelos (Bel) 3. Terminalia arjuna (Arjun) 4 T. bellerica (Bahera) 5. T. chebula (Harra) 6. Calendula officianallis (Calendula) 7. Thuja occidentalis (Vidhya) 8 Datura alba (Dhatura) 9. Argemone maxicana (Pili kateli) 10. Ephedra sps. (Ephedra).

Suggested Laboratory Exercises: -

1. Description and identification of medicinal plants and its medical properties.
2. Extraction of phytochemicals from various medicinal plants.
3. Preparation medicinal plants herbarium and photographs.
4. Herbal preparation –
    a. Preparation of digestive powder.
    b. Mouth freshener of Ajwain.
    c. Beverage of Tulsi, Bel, Tikhur, Mango.
    d. Ayurvedic tea preparation.
    e. Tablet of amla vati.
    f. Murabba of Awla/Bel.
    g. Herbal dye
    h. Shitopladi powder.
5. Identification and study of Ethnobotanical importance of some plants of Raipur.
6. To cultivate at least two medicinal plants in earthen pot.

Suggested Readings:

1. Baker, H.G. 1978. Plants and Civilization (3 rd edition). C.A. Wadsworth, Belmont.
2. Chandel, K.P.S., Shukla, G.& Sharma, N. 1996. Biodiversity in medicinal and Aromatic Plants in India: Conservation & Utilization. National Bureau of Plant Genetic Resources, New Delhi.
3. Chrispeels, M.J. & Sadava, D. 1977. Plants, Food & People. W.H Freeman and Co., San Francisco.
4. Ambasta S.P. (ed.) (1986). The Useful Plants of India. Publications & Information Direxorate, CSIR, New Delhi India.
5. Anon. (1978). The tribes of Madhya Pradesh. Dept. of Tribal Welfare, Govt. of
6. M.P. Bhopal.
7. Arnold. J. E. M. & Ruiz Perez, M, (1998). The role of non-timber forest products in conservation and development. In: Wallenberg, Eva. & Andrew Ingles (Eds.) Income from the Forest, CIFOR 1998, Indonesia, pp-17 to 41.
8. Asolkar, L.V. (1992). Second Supplement to Glossary of Medicinal Plants, (CSIR) NISCOM, New Delhi, India.
9. Bal, S.N. (1984). Catalogue of Medicinal Plant Exhibits. BSI. Bishne Singh Mahendra Pal Singh, Cannaught Place, Dehra Dun, India.
10. Buch, M.N. (1991). Forest of Madhya Pradesh, Madhya Pradesh Madhyam Bhopal.
11. Cotton C.M, (1996). Ethnobotany: Principals and Applications, John Willey & Sons, Chichester. New York.
12. Faulks. P.J. (1958) An Introduction to Ethnobotany: Moredale Publications Ltd. London, England.
13. Harshberger, J.W. (1896). Purposes of Ethnobotany Bot. Gaz. 21: 146-154.
14. Jain S.K. and Phuipps, R.D. (1991). Medicinal Plants of India Rec. Pub.Algonac USA 2Vols. 1-849.
15. Jain, S. K. (1991). Dictionary of India folk medicine and Ethnobotany. Deep

publications. NEW DELHI, pp. 1-311.
16. Jain, S. K. (1995). In Manual of Ethnobotany (edt. S.K. Jain,) Scientific Pubisher, Jodhpur. 128-134.
17. Jain, S.K. & Rao, R.R. (1977). A handbook off field and herbarium methods. New Delhi: Today & Tomorrow's Printers and Publishers.
18. Jain, S.K. (1981). Glimpses of Indian Ethnobotany. Oxford & IBH New Delhi, India.
19. Jain, S.K. (1989). Methods and Approaches in Ethnobotany. Society of Ethnobotanist. Lucknow.
20. Jain, S.K. and Mudgal, Hand Book of Ethanobotany. Bisen pal Singhm Mahendra Pal Singh Publication.
21. Vaishnaw T.K. (2004). Chhattisgarh ki Anusuchit Janjatiyan, Adim Jati Anusandhan Avam Prshikshan Sansthan Raipur. Prakashan kramank 2, pp. 1-120
22. Varghese, E. S. V D. (1996). Applied Ethnobotany - A case study among the Kharias of Central India. New Delhi. Deep Publications
23. Jajoria, E, V.K. (1998); "The Kamar [A way of life.] Vanya Prakashan., Tribal Research and Development Institute. 35, Shamla Hills, Bhopal., ethnobot. Res.2:303-3 15.
24. Joshi, S.G. (2000). Medicinal Plants, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, India.
25. Kirtikar, K. R. & Basu, B.D. (1933-1935). Indian Medicinal plants. Vol.I to VIII (4 Vols. text & 4 vols. plates) Reprint 1994, Dehradun U.P.
26. Maheshwari, J.K. Ed. (2000). Ethnobotany and Medicinal Plants of Indian Subcontinent. Scientific Publishers, Jodhpur
27. Martin, G.J. (1995). Ethnobotany. Chapman and Hall, London.

Course Outcome:

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

1. Understand the domestication, conservation of native plant resources by tribes and Intellectual properties Rights of traditional knowledge.
2. Knowledge about various systems of medicine using plants, herbal cosmetics and harmful effects of plants on human society.
3. Understand the endemic & endangered flora of Chhattisgarh and also know about cultivation, marketing of plants and mushrooms.
4. Understand the ethnomedicinal importance of various plant species available on local inhabitants.