M.Sc. Botany
(Semester) SYLLABUS

Course Structure under CBCS (From the academic year 2022-23onwards)

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005

1. **Introduction to the Programme:** Life science deals with the dynamics of living organisms. Plants are the autotrophs and responsible for the animal diversity on the earth. In the current scenario, bioactive natural products, medicinal plant are given greater importance and value in our day-to-day life. Comprehensive knowledge of modern and fundamental aspects of non-flowering and flowering plants is essential for understanding the plant kingdom. Sustainability and conservation of biodiversity is critically important for protecting our mother land and endangered bioresources.

2. **Eligibility for Admission:** A candidate who has passed the B.Sc., degree examination in Botany/ Plant Science/ and Plant Biology & Plant Biotechnology of the University or an Examination of any other University accepted by the Syndicate as equivalent thereto shall be eligible to appear and qualify for the M.Sc. Degree in Botany of this University after a course of study of two academic years.

   Duration of the Course

   The course for the degree of Master of Science in Botany shall consist of two academic years divided in to four semesters. Each semester consists of 90 working days.

3. **Objectives of the programme:**

   - To provide comprehensive knowledge on fundamental aspects of plant kingdom.
   - To trace the relationship and interconnectedness between the lower and higher forms of life in the plant kingdom.
   - To apply the various concepts and values of plants in day-to-day life.
   - To motivate students to pursue research in national and international level research institutions.

4. **Expected outcomes**

On successful completion of the M.Sc. Botany programme, the students will be:

- Competent enough in the fundamental aspects of Botany.
- Able to apply the knowledge of modern techniques while pursuing research.
- Competent enough to create entrepreneurship skill and opportunities in Botany and be self-employed.

Course Structure:

The course is organized on semester basis with a total of four semesters. A student must secure 90 credits to get the degree.

Semester	Course	Course Title	Ins. Hrs./ week	Credits	Exam Hrs.	Marks		Total
						Internal	External	
I	Core Paper I	Plant Diversity I (Algae, Fungi & Lichens)	6	4	3	25	75	100
	Core Paper II	Plant Diversity II (Bryophytes, Pteridophytes & Gymnosperms)	6	5	3	25	75	100
	Core Paper III	Bioinstrumentation and Biotechniques	6	4	3	25	75	100
	Practical I	Practical related to theory paper I, II & III	6	4	4	40	60	100
	Major Elective I	Ecology and Biodiversity/ Ethano Botany and Bioresources	6	5	3	25	75	100
II	Core Paper IV	Cell and Molecular Biology	6	5	3	25	75	100
	Core Paper V	Genetics and Evolution	6	5	3	25	75	100
	Core Paper VI	Plant Anatomy and Embryology of Angiosperms	6	4	3	25	75	100
	Practical II	Practical related to theory paper IV, V & IV	6	4	4	40	60	100
	Major Elective II	Fermentation Biotechnology/Biofertilizer	6	5	3	25	75	100
III	Core Paper VII	Taxonomy of Angiosperms	6	4	3	25	75	100
	Core Paper VIII	Microbiology and Plant Pathology	6	4	3	25	75	100
	Core Paper IX	Biochemistry	6	5	3	25	75	100

	Practical III	Practical related to theory paper 7, 8 & 9	6	4	4	40	60	100
	Major Elective III	Herbal Technology/ Home Gardening	6	5	3	25	75	100
IV	Core Paper X	Plant Physiology	6	5	3	25	75	100
	Core Paper XI	Research Methodology & Bioinformatics	6	4	3	25	75	100
	Core Paper XII	Project Work	6	5	3	25	75	100
	Practical IV	Practical related to theory paper X,XI,XII	6	4	4	40	60	100
	Major Elective IV	Plant Biotechonolgy/ Herbal Cosmetics	6	5	3	25	75	100

7. Non-subjectElective

Herbal Botany

8. <u>Unitization</u>

Semester-wise List of Papers, Hours & Credits

	Papers	**Hours**	**Credit**
Semester I	5	30	22
Semester II	5	30	23
Semester III	5	30	22
Semester IV	5	30	23
Total	**20**	**120**	**90**

9. Semester Examination

The examinations shall be conducted separately for theory and practical to assess the knowledge acquired during the study. There shall be two systems of examinations *viz*., internal and external examinations. The internal examinations shall be conducted as continuous Internal Assessment tests, Peer Team teaching, assignments and seminar. The internal assessment shall comprise of maximum 25 marks for each subject.

The external examination shall be three hours duration to each paper at the end of each semester. The external examinations shall comprise of maximum of 75 marks for each subject. The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examination. Practical examinations for M.Sc. Course in Botany should be conducted at first, second and third semester. At the end of fourth semester viva- voce will be conducted on the basis of the Dissertation report

submitted by the student.

Distribution of marks

Theoretical Examinations

S.No	Component	Marks
1	Internal examination*	25
2	External examination	75
3	Total	100

10. Internal examination*: The following procedure shall be followed for awarding internal marks.

S.No	Component	Marks
1	Internal Test	15
2	Seminar	5
3	Assignment	5
	Total	25

Practical examinations

S.No	Component	Marks
1	Internal examination*	40
2	External examination	60
3	Total	100

Internal examination*: The following procedure shall be followed for awarding internal marks.

S.No	Component	Marks
1	Continuous assessment	25
2	Record	10
3	Viva	5
4	**Total**	40

11 and 12. External Examination Question Paper Pattern

Time: 3 Hours Max. Marks: 75

Part A- 10 x 1 Marks = 10 Marks (Answer all questions; 2 questions from each unit)

Part B -5 x 7 Marks = 35 Marks (Answer all questions; either/or pattern; equal weightage for all units)
Part C- 3 x 10 Marks = 30 Marks (answer any three from five questions; equal weightage for all units)

13. Scheme for Evaluation

The Internal and External marks will be in 25:75

External exam

The pattern of Question Paper
(External) will be Time: 3 Hours
and Max. Marks: 60
Section A: (10 x 1 = 10 marks)
Question No. 1 to 10 (Multiple choice or Objective type)
Section B: (5 x 7 = 35 marks)
Answer all questions choosing either (a) or (b)
Section C: (3 x 10 = 30 marks)
Answer any three out of five (one question from each unit)

14. Passing Minimum

Passing minimum –
50% (aggregate) No
pass minimum for
internal
27/60 (45%) is the minimum in External

15. Teaching Methodologies

The classroom teaching would be through conventional lectures and use of OHP and Power Point presentations. The lecture would be such that the student should participate actively in the discussion. Periodic field visit enable the student for gathering the practical experience and up to date industrial scenario. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skill.

In the laboratory, instruction would be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

Periodic tests would be conducted and for the students of slow learners would be given special attention.

16. Retotalling and revaluation provision

Revaluation means to re evaluate the paper of a particular subject completely. Under this, Student has to surrender his/her original marks of particular paper and accept the final marks when declared by the University as a result of Revaluation. Application form available at Examination Section and University Website. Fee Structure Rs. 500/ per subject for Revaluation Rs. 250/ per subject for Retotalling.

Condition- Application for Revaluation is to be made within 15 days from the date of publication of result on University website. Application form is to be completely filled and signed by the student (concerned) only. Select the paper carefully in which you wish to seek revaluation. No second application for additional papers shall be accepted. The fees once paid shall not be refunded. The application is to be made by the student in his/her own handwriting and under his/her own signature and not by anyone else on his/her behalf.

Rules for Revaluation - Revaluation shall be available only for the paper of end term examination. Revaluation for the paper of end term examination shall be sent to two external evaluators for evaluation. The average of the marks awarded by two external evaluators shall be taken as final marks and the original marks obtained by the student shall have no value.

17. Transitory provision

PG syllabus revision once in 2 years and afterwards 2 years under transitory provision.

Programme: M.Sc., **Subject:** Botany

Semester: I **Course:** Plant Diversity - I

Course Type: Core Paper - I **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 4

CIA: 25 **CE:** 75

COURSE OBJECTIVES

The main objectives of this course are to:

- To acquire knowledge on diverse groups of Thallophytes.
- To gain knowledge on the diversity, structural organization and reproduction of algae, fungi and lichens.
- To understand the ecology and economic importance of algae
- To acquire knowledge on thallus organization and structure of different class of fungi
- To understand the mechanism of reproduction in fungi
- To gain knowledge on characteristics and ecological significance of lichens
- To obtain knowledge on the life cycle patterns of thallophytes and their significance.

COURSE OUTCOMES

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

CO1	Grasp the basic concepts of lower life forms	K1
CO2	Understand the diversity in habits, habitats and organization of various groups of lower plants K2 Apply their knowledge to culture and cultivate fresh water and marine water algae K4	K2
CO3	Inherit knowledge on the exploitation of useful products from lower forms for the betterment of human welfare	K3
CO4	Apply their acquired knowledge to improve the economic quality of the	K4

	lower life forms.	

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit I: Classification of Algae (F.E. Fritsch, 1945). Criteria used for algal classification. Range of thallus structure, Life cycle patterns of algae, Phylogeny and Evolutionary trends in algae. General account on the structure and reproduction of algae belonging to Cyanophyceae, Chlorophyceae, Bracillariophyceae, Phaeophyceae and Rhodophyceae.

Unit II: Ecology of Algae: freshwater algae, marine algae, soil algae, symbiotic algae and parasitic algae. Algae as pollution indicators, algal blooms, algicides. Culture and cultivation of fresh water and marine algae. Economic importance of algae: Food and Feed, Agar-agar, Carrageenan, Diatomaceous earth, Iodine, Vitamin, Medicine, Single cell protein and Industrial products.

Unit III: Fungi: General features, occurrence and distribution, mode of nutrition in fungi, culture of fungi, classification of fungi (Alexopoulous and Mims, 1979), recent trends in the classification of fungi. General characters of major classes: Myxomycetes, Oomycetes, Zygomycetes, Ascomycetes, Basidomycetes and Deuteromycetes (Thallus organization, cell structure and fruiting bodies)

Unit IV: Homothallism and heterothallism in fungi. Homokaryon and heterokaryon. Sex hormones in fungi. Reproduction – Life cycle types, parasexual cycle, reduction in sexuality in fungi. Spore dispersal mechanism. Ecological and Economic importance of fungi.

Unit V: Lichens: A general account of lichens with special reference to their mode of life. Gross and fine structure, nutrition, reproduction, classification; micro-chemical tests for their classification; their economic importance and ecological significance; role of lichens in biological estimation of pollution. Lichens -*in vitro* culture– a detailed study of one or two available species of lichens belonging to *Ascolichen* and *Basidiolichen*.

Practical

1. Critical examination of algal and fungal samples of different classes
2. Micro preparation of lichens
3. Field visit for 2 days for collection of specimen
4. Preparation of herbarium sheets (minimum20)
5. Spotters related to theory

Text Book(s)

1. Round, F.E, (1973), The Biology of Algae.
2. Kumar, H.D, (1988), Introductory Phycology.

3. Fritsch, F.E. (1935-1945). Structure and reproduction of the Algae. Vol. II III & I.

4. Alexopoulos, C.J. and C.W. Mims (1985). Introductory Mycology.

5. Smith, G.M. (1971). Cryptogamic Botany Vol. Algae and Fungi.

6. Hale, M.E. (1961). A Hand Book of Lichens.

Reference Books

1. Bold. H.C. and H.J. Wyne (1978) Introduction to the Algal structure and reproduction,Prentice Hall, Englewood Cliffs, New Jersey.

2. Chapman. V.J and P.J. Chapman (1973). The algae. The English language book society and Macmillen.

3. Anisworth, S.C., Sparrow, F.E. and A.D. Sussman. The fungi and advanced treatise. Vol. I, II, III, IV A & IV B.

4. Bessey, E.A. (1950), Morphology and Taxonomy of Fungi.

5. Webster, J. (1985), Introduction to Fungi. 6 Hale, M.E. (1970). The Biology of Lichens.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 https://swayam.gov.in/nd2_cec20_bt11/preview

2 https://www.classcentral.com/course/swayam-plant-groups-19787

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	M	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: I **Course:** Plant Diversity - II

Course Type: Core Paper - II **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

COURSE OBJECTIVES

The main objectives of this course are to:

- To earn knowledge on diverse groups of Bryophyes and Vascular plants.
- To procure knowledge on the diversity, structural organization and reproduction of Bryophytes, Pteridophytes and Gymnosperms.
- To comprehend on the life cycle patterns of Bryophytes and Vascular plants with their import.
- To know about that merits of Paleobotany.

COURSE OUTCOMES

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

CO1	Grasp the knowledge on phylogeny of Bryophytes, Pteridophytes and Gymnosperms.	K1
CO2	Assume the alternation of generations of Vascular Cryptogams and Phanerogams.	K2
CO3	Appeal the knowledge on identification of living fossils from the fossils and the role of fossils in oil exploration and coal excavation.	K3
CO4	Discriminate various kinds of fossilization process and Radio carbon dating.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit I: Bryophytes: General features, distribution and classification of Bryophytes (Rothmaler, 1955). Structure, reproduction and life cycle of major groups –Marchantiales, Jungermanniales, Anthocerotales and Polytrichales. Range of vegetative structure, Evolution

of gametophytes and sporophytes. Spore dispersal mechanisms in Bryophytes – spore germination patterns in Bryophytes. Ecological and economical mportance of Bryophytes.

Unit II: General characters, origin and classification of Pteridophytes (K. R. Sporne).Morphology, reproduction and evolution of gametophytes and Sporophytes of the following groups: Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

Unit III: Phylogenetic trends – Stelar evolution, Sporangial organization – Heterospory and Seed habit – Apospory, Apogamy and Parthenogenesis. Fossil forms – Calamitales and Sphenophyllales.

Unit IV: General characteristics and classification of Gymnopserms (Coulter and Chamberlin). Morphology and reproduction in orders Pteridospermales, Pentoxylales, Cordaitales, Cycadales, Coniferales andGnetales.

Unit V: Economic importance of Gymnosperms. Living fossil – Affinities with Angiosperms and Pteridophytes. Fossil Gymnosperms – Lyginopteris and Lagenostoma.

Practical

1. Critical examination of Bryophytes and Pteridophytes, Gymnosperms of different classes.
2. Study of fossils forms in Pteridophytes and Gymnosperms
3. Permanent slide preparation of Pteridophytes
4. Spotters related to theory

Text Book(s)

1. Shukla, A. C. and Mishra, S. P. (1982). Essentials of Paleobotany. 2nd ed. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Eames, A. J. (1936). Morphology of Vascular Plants - Lower Groups. Tata McGraw Hill, New Delhi.
3. Parihar, N. S. (1985). The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
4. Rashid, A. (1986). An Introduction to Pteridophyta. Vani Educational Books, New Delhi.
5. Sharma, O. P. (1990). Text Book of Pteridophyta. Macmillan India Ltd., India.
6. Smith, G. M. (1971). Cryptogamic Botany. Vol. II. Bryophytes and Pteridophytes. Tata McGraw Hill, New Delhi.
7. Sundararajan, S. (2007). Introduction to Pteridophyta. New Age International Publishers, New Delhi.
8. Vashishta, P. C. et al. (2008). Botany for Degree Students: Pteridophyta. S. Chand and Co. Ltd., New Delhi.
9. Vasishta, P. C. et al. (2006). Botany for Degree Students: Gymnosperms. S. Chand and Co. Ltd., New Delhi.

Reference Books

1. Nikias, K. J. (1981). Paleobotany, Paleoecology and Evolution. PraegerPublishers, USA.
2. Seward, A. C. (1919). Fossil Plants. Vol. I, II, III and IV. Cambridge University Press,London.
3. Seward, A. C. (1931). Plant Life through the Ages. Cambridge University Press, London.
4. Ingold, C. T. (1939). Spore Discharge in Land Plants. Oxford, UK.
5. Coultar, J. M. and Chamberlin, C. J. (1967). Morphology of Gymnosperms. Central Book Depot, Allahabad.
6. Foster, A. S. and Gifford, E. M. (1965). Morphology and Evolution of Vascular Plants. W. H. Freeman & Co.
7. Maheswari, P. and Vasil, V. 1960. Gnetum: A Monograph. CSIR Publication, New Delhi.
8. Sporne, K. R. (1974). The Morphology of Gymnosperm. B.I. Publications, NewDelhi.
9. Sporne, K. R. (1972). The Morphology of Pteridophytes. B. I. Publications, Madras
10. Chamberlain, C. J. (1957). Gymnosperms Structure and Evolution. University Chicago Press, New York.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://swayam.gov.in/nd2_cec20_bt11/preview
2. https://www.classcentral.com/course/swayam-plant-groups-19787

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: I **Course:** Bioinstrumentation and Biotechniques

Course Type: Core Paper - III **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 4

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- The course is aimed to acquaint the students with various techniques used in biological sciences.
- The emerging areas of biotechnology along with underlying principles.
- To make students learn about modern instruments for various analytical works.

Course Outcomes:

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

CO1	To apply the concepts of bioanalytical techniques in biotechnology research	K1
CO2	To handle these bioanalytical techniques in industry	K2
CO3	To operate and optimize the experimental conditions of different analytic techniques	K3
CO4	To implement knowledge for the separation of bioentities.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit I: Principle and uses of various microscopes: Simple, Compound, Phase Contrast, TEM, SEM, Atomic Force Microscope. Principles and applications of Micrometer, Haemocytometer and Microtome. Biological sample preparation techniques for microscopy.

Unit II: pH meter–basic principles, Types of electrodes, Preparation of buffers.

Centrifugation: Principle, Types of Rotors. Types of Centrifuges – Clinical, Refrigerated and Analytical centrifuges and their applications.

Unit III: Chromatography – Principles (Absorption, Partition, Ion exchange and Affinity), components, methodology and applications of Column chromatography, GC – MS, HPLC. Electroporation – Principle, Procedure and application of AGE, SDS – PAGE separation of proteins. Blotting techniques – Principles and types (Northern, Western and Southern)

Unit IV: Radiometry – Isotopes – Measurement of Radioactivity. Radioactive detectors: Scintillation and Geiger Mueller Counter. Autoradiography and its application.

Unit V: Spectroscopy – Principles, Components and Working mechanism of spectrophotometer, Flame photometer, Bomb calorimeter and Atomic absorption spectrophotometer.

Practical

1. Calibration of stage and ocular micrometer
2. Measurement of plant cells using micrometer
3. Counting of yeast cells using Haemocytometer
4. Measurement of PH of different solution
5. Preparation of buffer
6. Demonstration of the working mechanism of various instruments mentioned in the syllabus
7. Spotters related to theory

Text Book(s)

1. M.Daniel (2003). Basic Biophysics for Biologist. Agrobios (India), Jodhpur.
2. L.Veerakumar (2006). Bioinstrumentation. MJP Publisher, Chennai
3. Dwivedi, J. N. and Singh, R. B. (1985). Essential of Plant Technique. Scientific Publications, Jodhpur.
4. Jayaraman, J. Laboratory Manual in Biochemistry. Wiley Eastern Ltd., New Delhi
5. Krishnamurthy, K. V. (1988). Methods in Plant Histochemistry. S. Viswanathan & Co.,Madras
6. Sass, J. E. (1967). Botanical Microtechnique. 3rd ed. Oxford & IBH Publishing Co., New Delhi.

Reference Books

1. Christian, G. D. (1979). Atomic Absorption Spectroscopy - John Fredric, J. Fieldman Wiley & Sons, New York.
2. Jensen, W. A. (1962). Botanical Histochemistry: Principles and Practice. W. H. Freeman and Co., San Francisco, USA.
3. Johansen, D. A. (1940). Plant Microtechnique. McGraw Hill, New York.
4. Skoog, A. and West, M. (1980). Principles of Instrumental Analysis - W. B. Saunders Co., Philadephia, USA.
5. Wilard, H. H., Meritt, L. L. Jr. and Dean, J. A. (1965). Instrumental Methods of Analysis. 4th ed.

Van Nostrand Inc. Princeton, New Jersey.
6. Williams, B. L. and Wilson, K. (1983). A Biologist's Guide to Principles Techniques of Practical Biochemistry. Edward Arnold, London

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://swayam.gov.in/nd2_cec20_bt22/preview
2. https://www.swayam.gov.in/explorer?category=BIO_TECH
3. https://swayam.gov.in/nd1_noc20_bt31/preview
4. https://swayam.gov.in/nd1_noc20_bt31/preview
5. https://swayam.gov.in/NPTEL

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: I **Course:** Ecology and Biodiversity

Course Type: Major Elective - I **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To acquire knowledge on biodiversity and its importance
- To understand the causes and effects of algal blooms
- To make students learn about the impact of exotic species
- To obtain knowledge on the importance of conservation of biodiversity
- To understand the technologies in biotechnology and its impacts

Course Outcomes:

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

CO1	To understand the methods used for the evaluation of biodiversity	K3
CO2	To apply their knowledge on different diversities in marine environment	K3
CO3	To create methods to prevent biodiversity from extinction	K6
CO4	To understand different conservation methods	K3
CO5	To apply knowledge on intellectual property rights	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit I: Biodiversity definition, concept, scope, Levels of biodiversity Genetic, species and ecosystem diversity, Magnitude of biodiversity; Concept of Hot Spots; distribution of hotspots in India and the world; values of biodiversity; Island biogeography theory; Endemic diversity, Measures of biodiversity – alpha, beta and gamma diversity – Diversity indices – dominance and Evenness – methods of studying diversity.

Unit II: Marine biodiversity – plankton – nekton – benthos – classification – classification of marine environments benthic and pelagic – neritic and oceanic system – littoral and deep – sea system – features, primary, secondary and territory production – methods for measuring the productivity – factors affecting primary production – general account of productivity in different oceans – red tide – harmful algal blooms –

causes and effects.

Unit III: Causes and consequences of loss of biodiversity; Impact of exotic species on local biodiversity; extinction of species; Key stone species and their significance. Climate Change mediated Impacts on Biodiversity – El-Nino Southern Oscillation phenomenon (ENSO) and its impacts-sea surface water temperature (SST) elevation and coral reef bleaching, impacts of coral bleaching on coral biodiversity; Red Data Book and its importance.

Unit IV: Wildlife Conservation and management - need for conservation – *insitu* conservation; Sanctuaries, National parks, biosphere reserves – *exsitu* conservation, Zoological parks, gene banks and cryopreservation –Role of indigenous people in conservation – sacred species, sacred groves; role of remote sensing in biodiversity conservation; Biodiversity conservation – human animal conflicts.

Unit V: Indigenous knowledge, Bioprospecting, Biopiracy, Intellectual property rights and its impact on biodiversity; Impact of new technologies biotechnology and genetic engineering.

References

1. Gadgil, M., Ghate, U, and Pramod, P.1996 Biodiversity resource materials, center for ecological sciences.Indian Institute of Sciences, Bangalore and Biodiversity Unit, Jawaharlal Nehru, Centre for AdvancedScientific Research,Bangalore.
2. Gillson, L. 2015. **Biodiversity Conservation and Environmental Change**, Oxfrd University Press,Oxford,.
3. Krishnamoorthy, K.V. 2009. **An advanced Text book on Biodiversity –Principles and practice,** Oxford & IBH Publishing co, PVT. Ltd., NewDelhi.
4. Kumar, H.D. 1999. **Biodiversity and sustainable conservation**. Oxford and IBM publishing Company,NewDelhi.
5. Melchias, G.2001, **Biodiversity and Conservation**, Oxford and IBM publishing company Pvt., Ltd. NewDelhi.
6. Ronald H. Karlson. **Dynamics of Coral Communities**. 1999. Kluwer Academic Publishers,Boston.
7. Rosenberg. E and Loya. Y. (eds.) 2004 **Coral health and Diseases**, Springer, Berlin, Heidelberg, NewYork.
8. Schulze,E., Beck,E., & Muller-Hohenstein, 2005. **Plant Ecology,** Springer, Berlin- Heidelberg.

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: I **Course:** Ethanobotany and Bio-Resources

Course Type: Major Elective - I **Course Code:**

Contact Hours: 5 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To attain knowledge about the concept of ethanobotany
- To understand the methods and techniques used in ethanobotany
- To know the value of NTFPs
- To understand the importance of ethnopharmacology
- To acquire knowledge on Ethnobotanical databases and TKDL

Course Outcomes:

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

CO1	To understand the role of Ethnobotany in conservation and sustainable development	K3
CO2	To apply their knowledge on documentation of herbal medicine	K3
CO3	To apply their knowledge to describe the plants which used as traditionally	K3
CO4	To analyze the role of ethnopharmacology in drug development	K5
CO5	To create the knowledge for biological screening of herbal drugs	K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I **(18 hrs)**

Concept of Ethnobotany: Introduction Concept, scope, sub-disciplines, Role of ethnomedicine and its scope in modern times. Role of Ethnobotany in conservation and sustainable development. Centres of Ethno botanical studies in India, AICRPE-All India Coordinated Research Project on Ethno biology, FRLHT Foundation for the Revitalisation of Local Health Traditions. Contributions of AICRPE and FRLHT to ethno biology of India.

UNIT II **(18 hrs)**

Ethnobotany Techniques: Methods and techniques used in Ethnobotany, Field level activities for data collection- Approach, Documentation, Forest productivity check by

analysing the log books of Forest, EDC, VSS etc), Impact of Ethnobotany in herbal-medicine industry, land-use development, agriculture, forestry, betterment of rural livelihoods and education. Biodiversity and conservation of some useful medicinal 10 plants. Sharing of wealth concept with few examples from India.

UNIT III **(18 hrs)**

Indigenous/Traditional Knowledge: Plant used in ethno medicine preparation and their uses of following plants: *Justicia adhatoda*, *Ocimum tenuiflorum*, *Aegle marmelos*, *Phyllanthus amarus*, *Andrographis paniculata*. Nontimber forest products (NTFPs) as a source of livelihood option for tribals: Economic potential of NTFPs, Gender role in harvesting NTFPs, Good sustainable harvesting practice of some selected NTFPs, Role of society, herbal industries and government agencies for sustainable harvest and value addition. Types of Tamil Nadu Tribes.

UNIT IV **(18 hrs)**

Bioprospecting: Introduction, scope and relevance. Brief account of Phytochemistry, pharmacodynamics and pharmacokinetics. Difference between herbal/botanicals and pharmaceutical medicine. Classification and sources of crude drugs. Quality, safety and efficacy of herbal medicines/ neutraceuticals. Role of ethnopharmacology in drug development. Biopiracy, Intellectual Property Rights (IPR). Ethnopharmacology and IPR issue.

UNIT V **(18 hrs)**

Value Addition: Bioprospecting of drug molecules derived from Indian traditional plants; Methods for bio prospecting of natural resources; From folk Taxonomy to species confirmation - evidences based on phylogenetic and metabolomic analyses; Ethnobotanical databases and Traditional knowledge Digital Library (TKDL). Biological screening of herbal drugs-introduction and need for phytopharmacological screening. In vitro and in vivo Screening, methods used for herbal drugs.

TEXTBOOKS

1. Gokhale, S.B., Kokate, C.K. and Gokhale, A. Pharmacognosy of Traditional Drugs. 1st ed. Nirali Prakashan, Pune. 2016.

2. Joshi, S.G. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi. 2018.

3. Kumar, N. A Textbook of Pharmacognosy. Aitbs Publishers, India. 2018.

4. Premendra Singh. Medicinal Plants: Conservation, Cultivation and Utilization. Daya Publishing House, New Delhi. 2013.

REFERENCES BOOKS

1. Albuquerque, U. P., Ramos, M. A., Júnior, W. S. F., and De Medeiros, P. M. Ethnobotany for beginners. Springer International Publishing, US. 2017.

2. Qadry, J.S. A textbook of Pharmacognosy Theory and Practicals. 17th ed. CBS Publishers & Distributors, New Delhi. 2014.

3. Balick, M. J., and Cox, P. A. Plants, people, and culture: the science of ethnobotany. Scientific American Library, US. 1996.

4. Singh, V. Ethnobotany and Medicinal Plants of India and Nepal (Vol. 3). Scientific Publishers. New Delhi. 2009.

Web Sources

1. https://shodhganga.inflibnet.ac.in/bitstream/10603/116454/7/07_chapter %201.pdf
2. https://libstore.ugent.be/fulltxt/RUG01/002/217/123/RUG01002217123_2015_0001_AC.pdf
3. https://www.researchgate.net/publication/237405658_Ethnobotany_and_phytomedicine_of_the_upper_Nyong_valley_forest_in_Cameroon

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: II **Course:** Cell and Molecular Biology

Course Type: Core Paper - IV **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
- To understand how these cellular components are used to generate and utilize energy in cells.
- To understand the cellular components underlying mitotic cell division.
- Students will apply their knowledge of molecular biology such as DNA packaging replications, protein synthesis and regulation of gene expression.

Course Outcomes:

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

CO1	Understand the structure and function of basic components of prokaryotic and eukaryotic cells, especially its membrane organization and organelles	K1
CO2	Examine the DNA damage and mechanism	K2
CO3	Basic organization of genetic material and the realms of events associated with replication and gene expression will be examined	K3
CO4	Acquire the knowledge of protein synthesis and regulation of gene expression	K4

K1 - Remember; K2 - Undestand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Unit I: Prokaryotic and Eukaryotic Cell – Ultra structure and functions of cell wall. Plasma membrane fluid mosaic model and functions. Ultrastructure and functions of cell organelles – Chloroplast, Mitochondria, Ribosomes, ER, Golgi bodies, Peroxisomes and tonoplast.

Unit II: Ultrastructure of Nucleus and Chromosomes, Special types of chromosomes – Giant, Lampbrush and Polytene chromosomes. Molecular basis of mutation – Physical and Chemical mutagens – DNA damage and repair mechanism, cell cycle and itsregulation.

Unit III: Structure of DNA and RNA. Topology of nucleic acids – levels of DNA packaging, repeat sequences in DNA. C-Value paradox, DNA denaturation kinetics, DNA replication types and mechanism. Difference betweenreplication in prokaryotes and eukaryotes.

Unit IV: Central Dogma of protein synthesis. Transcription in prokaryotes and eukaryotes. Post-transcriptional and Post-translational changes.

Unit V: Regulation of gene expression in Prokaryotes (Operon concepts – Lac and Trp). Lambda phage. Prokaryotic and Eukaryotic gene expression.

Practical

1. Onion root tip preparation for microscopic observation of Mitosis
2. *Tradescantia* flower bud preparation for Meiosis
3. Colorimetric estimation of DNA,RNA
4. Isolation of autotrophic UV mutants by replacement planting technique
5. Spotters related to theory.

References

1. Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D. Johnson, Julian Lewis,KeithRoberts, 2014. **Essential Cell Biology**, Garland SciencePublishers.
2. David Freifelder, 1985. Essentials of Molecular Biology. NarosaPublishingHouse. New Delhi.
3. David. E. Sadava. 1993. Cell Biology. Jones and Bartlett Publishers, Boston.
4. De Robertis and De Robertis 1998. Cell and Molecular Biology. B.1. Waverly Pvt. Ltd. New Delhi.
5. Geoffrey M. Cooper, Robert E. Hausman, 2009. The Cell - A Moleeular approach. ASM Press, Washington.
6. Gerald Karp. 1984. Cell Biology. McGraw Hill. New Delhi.
7. Gupta, P.K. 1999. Elements of Biotechnology. Rastogi Publications, Meerut.
8. Krebs, J.E., Goldstein, E.S., and Kilpatrick, S.T. 2014 Lewin's Genes
9. XI. Jones & Bartlett Learning, Burlington..
10. Kumar, H.D. 1999. Molecular Biology. Vikas Publishing House Pvt. Ltd. NewDelhi.
11. Lodish, et al. 2000. **Molecular and Cell Biology**. W. H. Freeman & Co. NewYork
12. Satyesh Chandra Roy and Kalyan Kumar De. 1999. **Cell Biology**. New CentralBook Agency (P) Ltd.Calcutta.
13. Thomas D. Pollard, William C. Earnshaw, Jennifer Lippincott-Schwartz,Graham
14. Johnson, 2016. **Cell Biology** (3rd Edition), Elsevier Health Sciencespublication.
15. William D. Stansfield et al., 1996. **Schaun'sout line of theory and problems of Molecular and Cell biology**. McGraw Hill, NewYork.

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: II **Course:** Genetics and Evolution

Course Type: Core Paper - IV **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To understand the basics of Mendelian genetics
- To learn the recombination genetics in Prokaryotes
- To acquire knowledge on sex determination inplants
- To learn about chromosomal aberrations
- To comprehend the concept of evolution and theories of evolution

Course Outcomes:

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

CO1	Understand Mendelian genetics and expression of alleles	K2
CO2	Evaluate the cytological basis for crossing over in corn	K5
CO3	Create knowledge on determination of sex and abnormalities of chromosomes	K6
CO4	Acquire the knowledge population genetics	K4
CO5	Analyze natural selection and speciation in evolution process	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Unit I: Introduction – Mendelism - Monohybrid cross- Dihybrid Cross, Interaction of genes– incomplete, co dominance lethal genes. Complementary genes, supplementary genes, epitasis, duplicate genes, Multiple alleles with reference to Blood groups Polygenic inheritance with reference to wheat linkage – Types, Theories related to linkage.

Unit II: Recombination Genetics in Prokaryotes - Transduction, Transformation, Conjugation Eukaryotes – Reciprocal – crossing over – Types , Mechanism, various theories, significance – Cytological basis for crossing over in corn. Non Reciprocal recombination – gene conversion, Transposans position effect.

Unit III: Sex Determination in plants – different types – sex determination in Melandrium –

sex linked inheritance color blindness- sex limited; Sex influenced traits Cytoplasmic inheritance – antibiotic resistance in chlamydomonas and male sterility in Maize,

Unit IV: Chromosomal aberrations - Population Genetics – frequency of genes in population – Handy Weinberg'slaw

Unit V: Evolution: Various theories of Evolution – Lamarckism, Darwinism – Modern synthetic theories of Evolution – Natural selection and speciation; Role of RNA in organic Evolution.

Practical

1. Solving problems related to monohybrid, dib rid crosses, Test cross, Multiplealleles.
2. Solving problems related to gene interaction mentioned in thesyllabus
3. Calculating gene frequency using Hardy-WeinbergLaw
4. Chromosomal mapping

References

1. Blackie, 1983. **Evolutionary Principles**. Oxford & 1BH, NewDelhi.
2. Brooker, R.J. 2017. **Genetics: Analysis and Principles.** McGraw-HillEducation**.**
3. Briggs. D. and Walters. S.M. 1984.**Plant variation and Evolution**. Cambridge University Press.London.
4. Dyansager.V.R. 1986. **Cytology and Genetics**. Tam Mc Graw-Hill. NewDelhi.
5. Echrlich& Holm. 1974. **Process of Evolution**. Oxford & IBH. NewDelhi.
6. Futuyma,D.& Kirkpatrick, M., 2017. **Evolution**,Sinauer
7. Goodenough, U. **Genetics**. III edn. Holt. Saunders. NewYork.
8. Gupta, P.K. **Genetics**. Rastogi Publications.Meerut.
9. Hall, B.K. &Hallgrimsso, B., 2014. **Strickberger's Evolution**. Jones and Bartlett Publishers, NewYork.
10. Jha, A.P. 1997. **Genes and Evolution**. Macmillan India ltd. Delhi.
11. Jurgen Schulz Scalier. 1985. **Cytogcnertics-Plants, Animals and Humans**. Springer-veriag.Berlin.
12. Kiichi Fukui and Shigeki Nakayam (Eds.) **Plant Chromosomes – Laboratory Methods**. CRC Press. NewYork.
13. Mitra.S. 1994. **Genetics - A blue print of life**. Tata McGraw Hill.NewDelhi.
14. Savage J.M. 1969. **Evolution**. Oxford & IBH, NewDelhi.
15. Singh. B. D. 2000. **Fundamentals of Genetics**. Kalyani Publishers. NewDelhi.

16. Snustad,D.P., Simmons, M.J. 2015. **Principles of Genetics**, John Wiley &Sons
17. Strick berger . M. W. 1985. **Genetics**. Macmillan India. NewDelhi.
18. Strickberger. M. W. 1999. **Genetics**. Prentice Hall of India Pvt. Ltd. NewDelhi.
19. Swanson. C.P. (Ed.) 1980. **Cytogenetics**. PrenticeHall.
20. Theodosius Dobozhanskyetal., 1986. **Evolution**. Surjeet Publications.Delhi.
21. Wooley.P. 1983. **Molecular theory of Evolution**. Springer - Verlag,Ber

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: II **Course:** Plant Anatomy and Embryology of Angiosperms

Course Type: Core Paper - IV **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To classify meristems and to identify their structures, functions and roles of apical vs lateral meristems in plant growth.
- To describe the function and organization of woody stems derived from secondary growth in dicot and monocot plants.
- To highlight the physiological role of endosperm in the morphogenesis of embryo.
- To assess the process of seed setting.

Course Outcomes:

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

CO1	Understand the intricacies involved in the reproduction of plants.	K1
CO2	Gain awareness about the various process of compatibility involved in plant reproduction	K2
CO3	To explain the importance of secondary growth and to state the location of tissues involved in secondary growth in dicot and monocot plants	K3
CO4	To state the types of growth and to compare their structure and functions and processes of florisitic growth	K4

K1 - Remember; K2 - Undestand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Unit I: Meristems – characters, classification and theories – Apical cell theory, Tunica – Corpus theory and Korper - Kappe concept. Vascular Cambium – Types, divisions, arrangement and seasonal activity, Factors affecting cambial activity. Origin, Structure, development and ontogeny of xylem and phloem. Reaction wood – structure and properties. Identification of common timbers in Tamilnadu. Heart wood and sap wood-strength, ability, grains, texture and defects. Anomalous secondary growth in Dicots and Monocots.

Unit II: Leaf ontogeny – initiation, apical, intercalary, marginal and adaxial growth, plate meristem and development of vascular tissues plastochronic index. Transfer cells –Structure, development and functions. Classical concept of flower; Floral anatomy and its role in classification. Plant galls; Types, structure and development. Role of polarity in cell differentiation and symmetry. Role of sucrose in Vascular tissue differentiation.

Unit III: Development of microspores and megaspores – types and factors involved. Development of micro gametophyte – pollen wall development - vegetative and generative cell; pollen viability test. Development of megagametophyte – structure and types of ovule. Development of monosporic, biosporic and tetrasporic types of embryosac and their cellular organization.Endosperm – Origin , types, structure, development : Haustorialendospen.

Unit IV: Pollen-Pistil interaction and fertilization, types of stigma and style events on stigmatic surface, pollen tube growth, guidance and entry into ovule and embryo sac. Double fertilization – significance. Incompatibility – interspecific – homomorphic and heteromorphic, Causes and methods to overcome incompatibility. Classification of embroyo development in Dicots and Monocots. Development of fruit wall anddifferentiation.

Unit V: Polyembryony – causes – Apomixis, Apospory.Their role in plant improvement programmes and seed development. Biochemical and physical factors in fruit development. Parthenocarpy. Prospects and significance of embryo and endosperm culture.

Practical

1. Anomalous secondary thickening in stems in Antigonon, Achyranthes, Nyclanthes, Aristolochia andBougainville
2. Preparation of 5 permanent slides using double stainingtechnique
3. Observation of pollen types and pollengermination
4. Section of anther (observation of differentstages)
5. Endosperm and embryo mounting

Text Book(s)

1. Pandey, B. P. (1989). Plant Anatomy. S. Chand and Co. Ltd., New Delhi.
2. Singh, V., Pande, P. C. and Jain, D. K. (1987). Anatomy of Seed Plants. Rastogi Publications, Meerut.
3. Easu, K. (1953). Plant Anatomy. John Wiley & Sons Inc., New York.
4. Agarwal, S. B. (1990). Embryology of Angiosperms - a fundamental approach. Sahitya Bhawan, Agra
5. Bhojwani, S. S. and Bhatnagar, S. P. (1981). Embryology of Angiosperms. Vikas Publishing House Pvt. Ltd., New Delhi
6. Maheswari, P. (1963). An Introduction to Embryology of Angiosperms. International Society of Plant Morphologies, University of Delhi.
7. Bonner, J. T. (1965). Morphogenesis. Oxford & IBH Publications, Bombay.
8. Burgess, J. (1985). An Introduction to Plant Cell Development. Cambridge University Press, London.

Reference Books

1. Clowers, F. A. L. (1961). Apical Meristems. Blackwell Scientific Publication, Oxford
2. Cutter, E. G. (1978). Plant Anatomy. Edward Arnold Publishers Ltd., London.
3. Fahn, A. (1989). Plant Anatomy. Maxwell Pvt. Ltd., Singapore.
4. Metcalfe and Chalk (1950). Anatomy of the Dicotyledons and Monocotyledons. Vol. I and II. Clarendon Press, Oxford, UK.
5. Dwivedi, J. N. (1998). Embryology of Angiosperms. Rastogi and Co., Meerut.
6. Raghavan, V. (1976). Experimental Embryogenesis in Vascular Plants. Academic Press, London.
7. Bard, J. (1990). Morphogenesis. Cambridge University Press, London.
8. Brouder, L. W. (1986). Development Order: A Comprehensive Treatise. Vol.2. The Cellular Basis of Morphogenesis. Plenum Press, New York.
9. Bryant, J. A. and Francis, D. (1985). The Cell Division Cycle in Plants. Cambridge University Press, London
10. Ebert, J. D. *et al*. (1970). Interacting Systems in Development. Holt, Reinhart & Win Inc., New York.
11. Murphy, T. M. and Thompson, W. F. (1988). Molecular Plant Development. Prentice Hall of India Pvt. Ltd., New Jersey

Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://swayam.gov.in/nd1_noc20_bt35/preview
2. https://www.researchgate.net/publication/318394791_Plant_Anatomy_and_Embryology
3. http://www.uou.ac.in/sites/default/files/slm/BSCBO-202.pdf

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: II **Course:** Fermentation Biotechnology

Course Type: Major Elective - II **Course Code:**

Contact Hours: 5 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To know about the various industrially important microorganisms
- To understand the principles and process of fermentation
- To acquire knowledge on large scale fermentation
- To learn major products of industrial microbiology
- To comprehend the concept of fermentation of food

Course Outcomes:

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

CO1	Understand the screening industrially important microorganisms	K2
CO2	Evaluate the design of various fermentors	K5
CO3	Understand various processing in fermentation	K2
CO4	Acquire the knowledge on biogas production	K4
CO5	Apply the knowledge for the production of various fermented products	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit I: Industrially important microorganisms – Screening industrially important microorganisms, thermophilic microorganisms- strain improvement by classical and recombinant methods. Principles fermentation – liquid and solid-state fermentations, medium development and industrial scale fermentation.

Unit II: Design of fermenters and bioreactors – Basic fermenter and control of basic fermenter, various designs of fermenters – lift – fixed – bed reactor, fluidized bed reactor, batch, fed batch and fermentation cell and enzyme immobilization.

Unit III: Large scale fermentation and downstream processing – scale up of microbial fermentation. Growth kinetics, effect of pH, temperature, nutrient concentrations. Downstream processing, precipitation, centrifugation, filtration, solvent extraction, chromatographic purification, affinity purification, fermentation economics – cost analysis.

Unit IV: Major products of industrial microbiology – single cell protein and industrial enzymes – analyses & proteases, alcoholic fermentation – beer and wine , antibiotics – penicillin – organic acid – citric acid , amino acid – glutamate, vitamins B12 , biogas production

Unit V: Fermentation of foods, Fermented milk and milk products – food spoilage and methods of preservation.

References

1. Demain, A.L. (et.al) 1999. **Manual of Industrial Microbiology and Biotechnology**. 2nd Edition ASM press.
2. Gerald Reed E/e. 1981. **Prescott and Dunn's Industrial Microbiology**. Chapman & Hall.
3. Michael , J. Waites, 2001. **Industrial Microbiology: An introduction (Illustration)**. Blackwell ScienceInc.
4. Stanbury, P.F., Whitaker, A. &Hall, S.J. 2016. **Principles of Fermentation Technology**, Butterworth-Heinemannpublications.

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: II **Course:** Biofertilizers

Course Type: Major Elective - II **Course Code:**

Contact Hours: 5 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To know about the scope and importance of Biofertilizers
- To understand isolation, characterization, identification of nitrogen fixing bacteria
- To acquire knowledge on structure and morphology of Azolla
- To understand isolation, characterization, identification of phosphate solubilizing bacteria
- To know the scope and importance of mycorrhizal fungi

Course Outcomes:

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

CO1	Apply knowledge on mass cultivation of biofertilizers	K3
CO2	Understand the mechanism of nitrogen fixation	K3
CO3	Create ideas for mass cultivation of Azolla	K6
CO4	Analyze the biochemistry of phosphate solubilization and mobilization	K4
CO5	Evaluate the isolation and method of inoculation of AM fungi	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit I: Biofertilizers - Introduction, scope. A general account of plant growth promoters and regulators – Cyanobacterial Biofertilizer: Algalization – mass cultivation of cyanobacterial biofertilizers.

Unit II: Nitrogen fixing Bacteria: Isolation, characterization, identification, mass cultivation and inoculation method of *Rhizobium* and *Azospirillum*. Mechanism of nitrogen fixation (free-living and symbiotic) - Biochemistry and molecular basis of nitrogen fixation.

Unit III: Azolla – Structure and Morphology – Mass cultivation method and Application. Economic and Ecological importance of Azolla.

Unit IV: Phosphate solubilizing Bacteria: Isolation, characterization, identification, mass

cultivation and inoculation method of Phosphobacteria. Biochemistry of Phosphate solubilization and mobilization.

Unit V: Mycorrhizal fungi as biofertilizers - Introduction, scope. A general account of Ecto, Endo and Arbuscular mycorrhizae (AM). Isolation and method of inoculation of Arbuscular mycorrhizae (AM), Legume - AM interactions. Carrier based inoculum production methods and Field application

References

1. **A text book of microbiology**, second reprint. S. Chand and Company Ltd., New Delhi. Refernce Books Ann Larkin Hansen ,2010,
2. Dubey, R. C. 2008. **A Textbook of Biotechnology**. S. Chand & Co., NewDelhi.
3. Kannaiyan, S. 2002 **Biotechnology of Biofertilizers**. Narosa publishing house, New Delhi. Dubey, R.C.2001.
4. Subba Rao, N. S. 2002. **Soil Microbiology**. 4th ed. Soil Microorganisms and Plant Growth. Oxford & IBH Publishing Co. Pvt. Ltd., NewDelhi.
5. **The Organic Farming Manual:** A Comprehensive Guide to Starting and Running a Certified Organic Farm. Storey PublishingLLC.
6. Niir Board, 2004. **The Complete Technology Book On Bio-Fertilizer And Organic Farming,** National Institute Of Industrial Research,Delhi.

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: III **Course**: Taxonomy of Angiosperms

Course Type: Major **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To acquire knowledge on different systems of classification
- To know rules and regulations of ICN
- To acquire knowledge on modern concepts and trends in plant taxonomy
- To understand the salient features of various families belonging to Dicotyledons
- To know the vegetative and reproductive characters of families belonging to Monocotyledons

Course Outcomes:

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

CO1	Remember the different systems of classification	K1
CO2	Evaluate effective and valid publications	K5
CO3	Apply the modern concepts and trends in plant taxonomy	K3
CO4	Analyze the characteristics of different plant families	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit I: History of Plant Taxonomy, Definition, Aims, importance and scope of Taxonomy Development and phases of classification, systems of classification. Artificial- Linnaean system. Natural – Bentham and Hooker system. Phylogenetic – Engler, Prantl and Hutchinson, Tautajhan and Cronquist system (Comparative study).

Unit II: ICN – Norms, New Regulations, Morphology of Angiosperms, Herbarium techniques, Digital Herbarium, Botanical museums, Botanical libraries, Botanical Garden, Effective and valid publication, Type concept and Author citation retention of names, publication of names: rules of priority.

Unit III: Modern concepts and trends in plant taxonomy: Elementary treatment of Cytotaxonomy, Chemotaxonomy, Numerical Taxonomy, Molecular Taxonomy, Cladistics.

Unit IV: Study of important taxonomic character and popular examples of the following natural order of Benthem and Hooker classification – Ranunculaceae - Magnoliaceae, Nymphaeceae, Caryophyllaceae, Rhamnaceae, Sapindaceae, Rosaceae, Lythraceae, Aizoaceae, Sapotaceae, Gentianaceae, Convolvulaceae, Scrophulariaceae, Bignoniaceae, Verbenaceae, Loranthaceae, Araceae.

Unit V: Monochlamydeae and Monocotyledonae -Nyctaginaceae, Arutolocheace, Piperaceae, Hydrocharitaceae, Amaryllidaceae, Commelinaceae, Palmaceae, Cyperaceae, Lilliaceae.

Practical

1. Identification of families mentioned in the syllabus with the help of salient features
2. Preparation of dichotomous key
3. ICN problems
4. Name of the plant using Gamble
5. Submission of 30 herbarium sheets
6. Field trip for minimum of 3 days for collection of plants and preparation of herbarium
7. Study of local flora
8. Spotters related to theory

References

1. Bhattacharya, B and Johri, B.M. 1996. **Flowering plant-Taxonomy and Phylogeny**. Narosa Publishing House, New Delhi.1996
2. Cole, A.J. 1969. **Numerical Taxonomy**. Academic Press,London.
3. Gurcharan Singh, 2016. **Plant Systematics:** An Intergrated Approach, Third Edition, CRC Press, Taylor & Francisgroup.
4. Heywood, V.H. and Moore, DN 1994. **Current concepts in plant taxonomy**. Academic PressLondon.
5. Lawrence, GHM 1959. **Taxonomy of vascular plants**. Mac Millan, NewYork.
6. Nalki, V.N.1993. **Taxonomy of Angiosperms**. Tata Mc-Graw-Hill Publishing Company Ltd., NewDelhi.1993
7. Pascale Besse, 2014. **Molecular Plant Taxonomy: Methods and Protocols**, Humana Press, NewYork.
8. Sharma, O.P., 2011. **Plant Taxonomy** (2nd Edition), Tata McGraw-Hill Education, Delhi.
9. Sivarajan V. V. 1991. **Principle of Plant Taxonomy**. Oxford &

IBH Publishing Co. Pvt. Ltd. NewDelhi.

10. Sokal R.R. and Sneath P.H.A 1963. **Principles of numerical taxonomy**. Fremen& Co. San Francisco.USA.
11. Stace, C. 1985. **Plant taxonomy and biosystematics**, Edward Arnold, London.
12. Subrahmanyam, N.S. 2009. **Modern Plant Taxonomy**. Vikas Publishing House Pvt. Ltd. NewDelhi
13. Takhtajan, A.L. 1997. **Diversity and classification of flowering plants**. Columbia Univ. Press, NewYork.
14. Woodland, D.W. 2009. **Contemporary Plant Systematics**. Prentice Hall, NewJersey.
15. Walter S. Judd, Christopher S. Campbell, Elizabeth A. Kellogg, Peter F. Stevens, Michael J. Donoghue, 2015. **Plant Systematics: A Phylogenetic Approach,** Sinauer,USA.

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany
Semester: III **Course:** Microbiology and Plant Pathology
Course Type: Major **Course Code:**
Contact Hours: 6 Hours/Week **Credits:** 5
CIA: 25 **CE:** 75

Course Objectives:
The main objectives of this course are to:

- To know the morphological and biochemical characteristics of bacteria
- To understand different sterilization techniques
- To acquire knowledge on the role of microbes in industry
- To understand the defense mechanism in plants
- To acquire knowledge on different plant diseases and its symptoms

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

CO1	Analyze the isolation and purification of plant viruses	K4
CO2	Remember the preparations of different media	K1
CO3	Understand the role of microbes in dairy industry	K3
CO4	Create knowledge on biological control of plant diseases	K6
CO5	Understand the causative agents and transmission of various plant diseases	K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit I: History of Microbiology, Bergey's classification of Bacteria, General Characteristics of bacteria; Morphological, Cultural and Biochemical characteristics, ultra-structure of bacterial cell. Bacterial cell wall: Nature - Chemistry and Biosynthesis, Isolation and purification of plant viruses, overview of structure of virus and life cycle (Lytic and Lysogenic), Virions, Prions.

Unit II: Sterilization – Incubation – pure culture, spread plate, pour plate & streak plate techniques. Media preparation, Growth and multiplication, Growth curve, measurement of Growth. Staining technique: simple & differential.

Unit III: Role of microbes in industry – Vinegar, Ethanol, Penicillin. Antibiotics – source and mode of action of penicillin and streptomycin. Food Microbiology - Microflora of milk,

role of microbes in the dairy industry. Food spoilage and preservation methods. Single cell protein. Environmental Microbiology – Bioleaching – Sewage treatment.

Unit IV: Plant Pathology – General Principles – Classification of plant diseases – Symptoms– Defense mechanisms – Chemical and biological control - Integrated pest management.

Unit V: Study the following organisms with special reference to causative organisms, symptoms, host-pathogen interaction and control measures: Red rot of Sugarcane, Tikka disease of ground nut, Blast of Paddy, Rust disease of Wheat, Cotton Wilt, Late blight of Potato, Citrus canker. Viral diease - Bunchy top of Banana, Mosaic disease, Leaf roll of Potato. Mycoplasma – Little leaf disease of Brinjal.

Practical

1. Sterilization methods
2. Preparation of media
3. Isolation of microbes using serial dilution technique
4. Staining of bacteria – simple and differential
5. Standard analysis of water for the presence of coliforms
6. Isolation of plant pathogen from infected tissues
7. Observation of infected plant specimens mentioned in the syllabus
8. Spotters related to theory

References

1. Alexopoulos, C.J., Mims. C.W. Blackwell, M. 1996. **Introductory mycology**. John Wiley & Sons., NewYork.
2. Atlas. M. and Bartha, R. 2000. **Microbial Ecology**. Addison Wesley Longman,Inc. NewYork.
3. Black, J.G. & Black, L. J. 2014. **Microbiology: Principles and Explorations,** John Wiley.
4. Brock, T.D. 1996. **Biology of Micro-organisms**. Prentice Hall.
5. Casida, 1997. **Industrial Microbiology**. New Age International Publishers. New Delhi.
6. Dubey, R.C. and Maheswari, D.K. 2000. **A Text Book of Microbiology**. S Chand& Co. Ltd. NewDelhi.
7. Kumar, H.D. and Swati Kumar, 2001. **Modern Concepts of Microbiology**. Vikas Publishing House Pvt. Ltd. NewDelhi.
8. Marshall, H. 1999. **Diseases of Plants**. Anmol Publications Pvt. Ltd. NewDelhi.
9. Mathew. R.E F. 1981. **Plant Virology**. Academic Press, London
10. Mehrotra, R.S.2000. **Plant Pathology**. Tata McGraw Hill Publishing Co. NewDelhi.

11. Nicklin. J el 4, 1999. **Instant notes in Microbiology**. Viva Books Pvt. Ltd.New Delhi.
12. Pelezar, M.J. Chan. E.C.S and Kreig, N.R. 1993. **Microbiology-Concepts and Applications**. McGraw Hill, Inc. NewYork.
13. Pommerville, J. &Pommerville, 2017**. Fundamentals of Microbiology,** Jones & Bartlett Learning,Burlington.
14. Rangaswamy, G. 1992. **Diseases of Crop Plants in India**. Prentice Hall of India. New Delhi. Singh, R.S. 1991. **Plant Diseases**. Oxford IBEL New Delhi.
15. Singh. R.S. 1994. **Introduction to the Principles of Plant Pathology**. Oxford IBH. NewDelhi.
16. Stainer, R. Y. et al.; 1990. **The Microbial World**. PrenticeHall.
17. Swarup et al., 1999. **Plant Diseases**. Anmol Publications Pvt. Ltd., NewDelhi.
18. Tortora,G,J., Funke, B.R. & Case, C.L. 2015. Microbiology: AnIntroduction, Pearson publications.
19. Vashishta, P.C. and Gill, P.C. 1998. **Plant Pathology**. Pradeep Publications, Jalandhar. Wheeler. B.E. 1972. **An Introduction to Plant Diseases**. JohnWiley.

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: III **Course:** Biochemistry

Course Type: Major **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To acquire knowledge about classification of enzymes
- To know about amino acids and proteins
- To acquire knowledge on metabolism of carbohydrates
- To understand the metabolism of lipids
- To define vitamins, hormones and alkaloids

Course Outcomes:

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

CO1	Understand the mechanism of enzyme action	K2
CO2	Evaluate the properties of proteins	K5
CO3	Remember the derivatives of monosaccharide	K3
CO4	Create knowledge on the importance of cholesterol and plant lipids	K6
CO5	Analyze biologically important alkaloids	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit I: Chemistry of Enzymes: Classification and nomenclature of enzymes: IUB, Isolation and purification of enzymes: Concept of active site, mechanism of enzyme action: Michaelis Menton equation and Km value. Enzyme modifiers – activators, inhibitors, allosteric enzymes: Regulation of enzyme action: Isozymes – diagnostic applications.

Unit II: Amino acids and Proteins: biosynthesis of amino acids: properties and chemical reaction concerned with amino acids: Proteins: primary, secondary, territory structure of protein, 3 D structure and protein folding, physiochemical properties of proteins.

Unit III: Metabolism of Carbohydrates: chemical reactions & derivatives of monosaccharide: Glycolsis– T.C.A. Cycle. E.T Chain- ATP synthesis: Glycogenolysis - H.M.P. Pathway: Glyconeogenesis.

Unit IV: Metabolism of Lipids: Oxidation of any one fatty acids and its bioenergetics: Biosynthesis of any one fatty acid: palmitic acid unsaturation: biosynthesis of cholesterol: Importance of cholesterol and plant lipids

Unit V: Chemistry of vitamins, hormones and alkaloids: Vitamins as Co-enzymes : Chemistry and biosynthesis of hormones- thyroxin. Catecholamine's. steroidal hormones. Biologically important alkaloids: intermediary metabolism : integration of metabolic pathways.

Practical

1. Qualitative tests for carbohydrates, lipids, proteins and aminoacids
2. Estimation of glucose, starch, protein and aminoacids
3. Determination of enzymes activity – effect of enzyme concentration, pH temperature, substrate, concentration of analyze
4. TLC separation of dyes/pigments

Reference

1. Campbell, M.K.& Farrell, S.O. 2011. **Biochemistry**, 7th Reprint, Cengage Learning Publishers.
2. Conn. E.E. and stumpf P.K. 2009. **Outlines of Biochemistry**. John Wiley and Sons, NewDelhi
3. David T. Dennis and David H. Turupin (Eds.) 1993**. Plant Physiology, Biochemistry and Molecular Biology**. Longmann Scientific and Teachnical Singapore.
4. Fisher J. & Arnold,2003. **BIOS Instant notes in chemistry for Biologists**. Garland Sciencepublications.
5. Goodwin and Mercer 1996. **Introduction to plant Biochemistry**. CBS Publishers and Distributors, NewDelhi.
6. Hames, B.D. et. Al. 1999**. Instant notes in Biochemistry**. Viva books Pvt. Ltd., NewDelhi
7. Dey, P. M. Harborne, J. B. 1997**. Plant Biochemistry**, Elsevierpublications.
8. Jain J.L. 2000. **Fundamentals of Biochemistry**. S. Chand & co. NewDelhi.
9. Plummer, D.T. 1996. **An introduction to practical Biochemistry**. McGrawHill
10. Satyanarayana, U, 1999. **Biochemistry. Books and Allied** (P) Ltd. Calcutta.

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: III **Course:** Herbal technology

Course Type: Major **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To define the importance of medicinal plants
- To explain the phytochemistry and pharmacological aspects of medicinal plants
- To utilize the medicinal plants for biological activity
- To separate phyto compounds through chromatographic techniques
- To elucidate structure of phytocompounds

Course Outcomes:

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

CO1	Create knowledge on cultivation and harvesting of medicinal plants	K6
CO2	Apply the isolation and purification of various phytocompounds	K3
CO3	Remember natural plant products with various biological activities	K1
CO4	Create knowledge on different solvent extraction methods	K6
CO5	Evaluate the isolation of volatile oils from various plant parts	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I : Commercial cultivation, harvest technology, importance and utilization of following medicinal plants-Aswagantha (*Withania somnifera*), Opium (*Papaver somniferum*), Senna (*Senna alexandrina*), Lemon grass (*Cymbopogon citratus*), Toothache plant(*Acmella oleracea*), Turmeric(*Curcuma longa*), Zinger(*Zingiber officinale*).

UNIT II: Phytochemical and pharmacological aspects of *Ocimum tenuiflorum,Gymnema sylvestre* and *Stevia rebaudiana*. Isolation and purificatiotechniques of Piperine from *Piper nigrum*, Caffeine from *Coffea arabica*, Quinine from *Cinchona officinalis*, Strychnine and Brucine from *Strychnosnux-vomica*, Eugenol from *Syzygium aromaticum*.

UNIT III: Natural plant products derived from marine source with special refer to cardiovascular, anti-cancer, antiviral, anti-microbial,anti- parasitic, anticoagulant and anti-

inflammatory agent.

UNIT IV: Preliminary phytochemical analysis –Different solvent extraction, Quality analysis(Alkaloids,Flavanoids,Phenols,Steroids,saponins.Steroids,TanninsTerpenoids);Sampl e preparation and procedure of TLC, HPTLC, GLC, Paper chromatography, Super critical chromatography, chiral separation, Circular counter current chromatography and Iron exchange chromatography.

UNIT V: Methods of Isolation of Volatile oil; Structure elucidation of chemical components by UV, FTIR, GC,GC-MS and NMR(Principles and Applications)

References

1. Arnason,Jone,T.Mata,Rachel,Romeo,John,T.Phytochemistryofm edicinalplants.2000.
2. James,AandDuke.*Handbook of phytochemical constituents of GRA Sherbs and other economicplants*.2001
3. Duddeck,Detrich, and Toth.*Structure elucidation by modern NMR,a workbook*.1998.
4. Atta-Ur-RahmanandMuhammadIqbalChoudhary.*SolvingproblemswithN MRspectroscopy*.1996.
5. Chukwuebuke,E.,Jonathan,C.I.,Stanley,C.U.andShashank,S.*Phyt ochemistry*.Volume1:Fundamentals,Moderntechniquesandapplic ation.2019.
6. Sethi,PD.*QuantitativeAnalysisofDrugsinPharmaceuticalformulat ion*-,3rdEdition,CBSPublishers,New Delhi,1997.
7. DoglasA Skoog, F. James Holler,TimothyA. Nieman. *Principlesof InstrumentalAnalysis*.5thedition,Easternpress,Bangalore.1998.
8. Farooqui, A.A . and Sreeramu, B.S. *Cultivation of medicinal and aromatic crops*.University Press.2001.
9. Choudhary,R.D.*HerbalDrugIndustry*.EasternPublisher,New Delhi,1996.
10. PaulJ.Schewer.*ChemistryofMarineNaturalProducts*.1973.
11. PaulM.Dewick.*Medicinalnatural products(a biosyntheticapproach)* . JohnWiley &SonsLtd.,England,1998.
12. Kokate, C.K. Purohit, Ghokhale, Nirali Prakasshan. *Text book ofPharmacognosy*.199

Programme: M.Sc., **Subject:** Botany

Semester: III **Course:** Home gardening

Course Type: Major **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To define different types of gardens
- To explain the tools used in gardening
- To know the maintenance of garden
- To acquire knowledge on hydroponics
- To elucidate seasonal vegetables

Course Outcomes:

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

CO1	Create design for vegetable garden	K6
CO2	Remember the choice of plants for gardening	K1
CO3	Analyze the storing and processing of the vegetables	K5
CO4	Understand the establishment of terrace garden and it uses	K6
CO5	Apply the Process and management of kitchen waste for home garden	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I: Concept of gardening - History - Types of garden, Famous gardens in India. Gardening as a hobby and resource. Designing of vegetable garden (Garden plan - fencing, clearing the land, leveling, preparing the soil, monitoring and maintenance). Importance of soil in gardening. Compost and farmyard manure.

UNIT II: Basic gardening tools – Spading Fork, Trowel, Steel rack, Hoe, Cultivator and Hand pruner. Choice of plants - Ornamental and horticultural attributes, selection of seeds, seed germination tests, sowing, direct sowing, thinning, preparation of seed bed, weeding, transplantation, plant protection measures.

UNIT III: Schedule for maintenance: Need for maintenance, watering, furrow irrigation, sprinkler watering, drip irrigation, weed control, soil tillage, pest control, disease control. Harvesting the produce, storing and processing of the vegetables.

UNIT IV: Cultivation, Hydroponics, cultivation of tomato through hydroponics, advantages of hydroponics. Terrace garden establishment and it uses. Vertical and Roof top garden.

UNIT V: Importance of home garden, Plan of kitchen garden. Seasonal vegetables - Athalakkai, Greens, Tomato, Brinjal, Lady's finger, Cucumber, Beans, Drumstick, Banana. Rose, Jasmine, Papaya and Crotons. Process and management of kitchen waste for home garden.

TEXT BOOKS

1. Gordon-Wells Jr, E. Successful Home Gardening. 2nd Volume, CA, USA, 2010.

2. Gordon-Wells Jr, E. Successful Home Gardening. 3nd Volume, CA, USA, 2014.

3. Smith M. Advanced Home Gardening, Creative. Homwowner, USA, 2001.

REFERENCES BOOKS

1. FAO. A Vegetable garden for all, 5th Edition, Rome, Italy, 2014.

2. Davis KC. School and home gardening, JB Lippincott Company, Philadelphia, 1918.

3. Palmer I. The House Gardener, Ryland Peters & Small, UK. 2014

Web Sources

1. https://www.youtube.com/watch?v=WNrggnnkkWM

2. https://www.youtube.com/watch?v=ufBy2Hpzr0s

3. https://www.youtube.com/watch?v=cLM-Rbju71

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: III **Course: Plant physiology**

Course Type: Major **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To familiarize the plant water relationship
- To explain mineral nutrition in plants
- To know about the mechanism of photosynthesis
- To understand respiration mechanism in plants
- To acquire knowledge on plant growth regulators

Course Outcomes:

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

CO1	Remember the mechanism of transpiration	K1
CO2	Understand the mechanism of Nitrogen fixation	K2
CO3	Remember pathways in photosynthesis	K1
CO4	Analyze aerobic and anaerobic respiration in plants	K4
CO5	Evaluate different stress condition in plants	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit I: Water relations of plants: Physicochemical properties of water, chemical potential and water potential in the plant, bulk movement of water, soil – plant atmosphere continuum. Transpiration: Types, cuticular, lenticular and stomatal. Factors affecting transpiration. Stomatal physiology and regulation.

Unit II: Mineral nutrition: Macronutrients and Micronutrients. Modern concepts of mineral salt absoption and translocation. Active and passive absorption of minerals. Mechanism of Nitrogen fixation, physiological role, Nitrogen uptake and assimilation.

Unit III: Photosynthesis: Photophysical and photochemical phase: light reactions, sequence of photosynthetic pathway – Electron Transport Chain, Photophosphorylation. Pathways of CO_2 fixation in C3, C4 plants and CAM pathway.

Glycolate pathway. Factors affecting photosynthesis

Unit IV: Respiration: Aerobic and Anaerobic, fermentation, respiratory quotient, Glycolysis, Kreb's cycle.Oxidative phosphorylation. Factors affecting respiration. Photorespiration.

Unit V: Plant growth regulators: Auxin, Gibberellin, cytokinin, Ethylene and Abscisic acid their physiological role and mode of action. Flowering : Photoperiodism – short day plants, Long day plants and Day neutral plants. Role of phytochrome in flowering. Seed dormancy, cause and methods of breaking dormancy. Progammed cell death – Physiological and biochemical change. Water and salt stress.

Practical

1. Determination of water potential – plasmolytic,Chardkov's and Gravimetricmethod
2. Quantifications of non photosynthetic figments (chla, chlb,chla+b)
3. Quantifications of photosynthetic fragments (Anthocyanin andflavones)
4. Absorption and Action spectra of Chlorophyllpigment
5. Effect of pH, temperature and detergents on membrane permeability
6. Effect of hormones on seed germination
7. Seed viability test (Tetrazoline blue dyereduction)
8. Smith's fermentation (Kuhn's fermentation tube)

References

1. Brett. C.T. and Waldron. K.W. 2012.**Physiology and Biochemistry of Plant Cell Walls.** Springer Science & BusinessMedia.
2. Osborne, D.J. Micheal. B.J. 2013. **Cell separation in Plant**Physiology, Biochemistry and Molecular Biology. Springer Science & BusinessMedia.
3. David T. D. and David H. T. (Eds.) 1993. Plant Physiology, Biochemistry and Molecular Biology. Longmann Scientific and Technical, Singapore.
4. Devlin and Witham. 1997. Plant Physiology. CBS Publishers and Distributors. New Delhi.
5. Fitter. A.H. and Hay R.K.M. 2012. Environmental physiology of plants. Academic Press.
6. Hall, D.O. and Rao. K.K. 1999. Photosynthesis. Cambridge UniversityPress.
7. Hess. D. 1975. Plant physiology. Narosa Publishing House. New Delhi
8. Lincoln Taiz and EduardoZeiger. 1991. Plant Physiology. The Benjamin/Cummings publishing Company.Inc.
9. Noggle and Fritz. 1999. IntroductoryPlantphysiology.Prentice hall,London.
10. Salisbury. E.B. and Ross. C.2000.Plantphysiology.John Wiley &Sons.New Delhi.
11. Stratford, G.A. 1979. Essentials of Plant Physiology. Heinemann

PublishingCo. NewYork.
12. Verma, V. (2016) Plant Physiology. 2nd ed. Ane Book Publishers, New Delhi
13. Wilkins, M.B.(Ed)1984.AdvancedPlantPhysiology.Pitman PublishingCo. New York.
14. Willey, N. 2016. Environmental Plant Physiology, Garland Science, Taylor and Francis,London
15. William G. Hopkins.1999. Introduction to Plant Physiology.John Wiley &Sons. Inc. New York.

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: III **Course:** Research methodology and Bioinformatics

Course Type: Major **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To familiarize methods of collection of data for research
- To explain the analysis and interpretation of data
- To know the format for thesis writing
- To understand the basic components of computer
- To acquire knowledge on types of data and data sets

Course Outcomes:

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

CO1	Remember the types of diagrams and graphs	K1
CO2	Evaluate the interpretation of statistical data	K5
CO3	Apply the preparation for oral and poster presentation	K3
CO4	Analyze application of Bioinformatics	K4
CO5	Understand about submission of sequences	K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit I: Population and Sample – Methods of Sampling. Collection of data: primary and secondary data – methods of collecting data. Presentation of data: tabulation – types of table. Diagrams and graphs: simple – multiple and subdivided diagrams – pie diagram – histogram and frequency polygon.

Unit II: Data analysis and data interpretation – measures of central tendency – Mean, Median, and Mode. Measures of deviation – Range, Quartile deviations, Correlation, Regression, Probability, T-test, Standard deviation, ANOVA.

Unit III: Thesis writing: General format of thesis, certificates, introduction, review of literature, materials and methods, results, discussion, summary and bibliography. Sources of literature – primary and secondary. Literature citation in text and bibliography. Standard proof correction marks. Preparation for oral and poster

presentation. Preparation of research article and publication in peer-reviewed journals. Research ethics and Plagiarism.

Unit IV: Bioinformatics – Definition, objectives, basic components of computers – Internet, Website. Application of Bioinformatics– Transcriptomics, Metabolomics and Pharmacogenomics.

Unit V: Types of data and data sets: Genomic DNA – cDNA – rDNA – Expressed sequence tags (ESTs) – Genomics survey sequences. Primary nucleotide databases: NCBI – EMBL – DDBJ. Primary protein databases: SWISS PROT – PDB. Sequence submission – Storage – Sequence annotation databases.

Practical

1. Frequency distribution
2. Histogram, frequency polygon, frequency curves and cumulative frequency curves. 3.Graphic location of median and mode
4. Bar and pie diagrams
5. Computation of mean, median, mode, quartile deviation, standard deviation and coefficient and correlation co-efficient
6. Regressive equation of X on Y on and Y on X
7. Problems connected with probability rules
8. Chi square test problems. Test of goodness off it
9. Calculation of probability using bi normal and normal distribution
10. Test for significance of means of random sample
11. Calculation of standard deviation / standard error
12. Demonstration of Bioinformatics tools
13. Visit to Bioinformatics centers

References

1. ArthurM.Lesk,2014.**Introduction to Bioinformatics,** 4thEdition, Oxford University Press, Oxford. AttwoodT.KandParry-Smith.1999.**Introduction to bio-informatics.** A.W.Longman Ltd.UK
2. Baxevanis AD and Francis B.J 1998 Bioinformatics. A practicalGuide to the analysis of genes and proteins. John Wiley & sons. Inc.
3. Bliss CI. 1970. Statistics in Biology. Vol. Iand II. McGraw-Hill Inc. USA. Hoboken.
4. Daniel WW, 1995. Biostatistics. 7th edition. John Wiley and Sons. NewYork. USA.
5. Chap T.Le., Eberly, L.E., 2016. Introductory Biostatistics, 2nd Edition, Wiley and Sons,Hodgmen, T.C., French, A., 2010. Bioinformatics, 2nd Edition, Taylor and Francis, New York.

6. K. Shanmughavel. P. 2006. Trends in Bioinformatics, Pointer Publishers. Jaipur, India.
7. Khan and Khan. 1904. Biostatistics. VikasPublising House Pvt. Ltd. New Delhi
8. Shanmughavel. P. 2005. Principles of Bioinformatics. Pointer Publishers. Jaipur, India.
9. Stryer L. Biochemistry. 4th Ed. W H Freeman and company. New York.

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: III **Course:** Plant biotechnology

Course Type: Major **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To understand the scope and importance of plant biotechnology
- To familiarize gene transfer techniques
- To understand the structure and organization of plant genome
- To explain micropropagation technique
- To acquire knowledge on DNA finger printing

Course Outcomes:

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

CO1	Remember the characteristics of restriction enzymes	K1
CO2	Evaluate genetic engineering in plants	K5
CO3	Analyze the expression of cloned genes	K4
CO4	Understand about transgenic plants	K2
CO5	Evaluate the production of secondary metabolites	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit I: Scope – definition multidisciplinary approach of biotechnology, Recombinant DNA technology - molecular tools – nomenclature and characteristics of Restriction enzymes, ligases and DNA modifying enzymes. Plasmids vectors – properties and classification – PBR322, pUC 18. lambda (gt 10) and M13 phage vector. Cosmids (pJB 8), Yeast vectors – cloning genes using above vectors. Genomic library and cDNA library – construction, screening libraries by colony. Plaquehybridization.

Unit II: Methods of gene delivery – Agrobacterium and CaMV mediated gene transfer; direct gene transfer using PEG, electroporation, biolistics, microinjection and liposome mediated. Transposons as vectors; use of mixed vectors. Agrobacterium and genetic engineering in plants – Ti plasmid (Octopine and Nopaline) – Disarmed Ti plasmid vectors- Ri plasmid. Gene maps and expression of T-DNA. Incorporation of T-DNA into the nuclear DNA of plant cells – role of virulent genes.

Unit III: Plant genome – Nuclear, Chloroplast and Mitochondrial: Structure, organization and expression. Analysis and expression of cloned genes – DNA sequencing, DNA markers Southern, Northern and Western Blotting: PCR – types and applications.

Unit IV: Micro propagation – Somatic hybridization, Cybrids, Artificial seeds and Somaclonal variation. Transgenic plants – Herbicide resistant plants. Virus resistant plants. Development of Bt cotton. Golden rice and FlavrSavrTamato, Agricultural Biotechnology – Biofertilizers – BGA, Mycorrhiza, bacterial Rhizobium, Azospirillum, Azotobacter, Biopesticides, BC NPV. IPR, patent right Social and ethical considerations – India scenario – a brief account. Case studies on Neem, Turmeric, Basmati.

Unit V: Applications of rDNA technology – DNA finger printing – DNA vaccines – plants as edible vaccines – Hybridoma. Production of secondary metabiolites, Cell immobilization, bio-reactor technology; conservation of germplasm in vitro strategies.

Practical:

1. Isolation of Bacterial chromosomalDNA
2. Isolation of plant chromosomal DNA
3. Isolation of bacterial plasmid – Demonstration
4. Agarose gel Electrophoresis and visualization ofDNA
5. Plant tissue culture, suspension culture induction –Demonstration
6. Demonstration of regeneration from calluscultures
7. Demonstration of isolation of plantprotoplasts.
8. Photographs of DNA on Agarose gel, Blue/white clones, plant tissue cultures, protoplasts, Transgenicplants.
9. Diagram of vectors. Southern blot, Western blotsetups.
10. Amplification of DNA using PCR procedure –demonstration**.**

References

1. Brown, C.M. Campbell. I. and Priest, F.G. 1990. **Introduction to Biotechnology.**Blackwell Scientific Publications, Oxford, London.
2. Brown. T.A. 2007. **Genomes 3**. Garland Science Publications.
3. Chawla, H.S. 2009. **Introduction to Plant Biotechnology.** Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
4. Gamborg, O.L and Phillips, G.C. 2013. **Plant Cell, Tissue Organ Culture.** Springer Science & Business Media.
5. Govil, C.M., Aggarwal, A. & Sharma, J. 2017. **Plant Biotechnology and Genetic Engineering.** PHI Learning, PVT Ltd**.,** New Delhi.
6. Griffiths et al., 1999. **Modern Genetic Analysis.** W.H. Freeman & Co. NewYork. Hopkins, W.G. 2007. **Plant Biotechnology**, Chelsea house

publishers, New York.

7. Jefrey.M.Backerelal.,1996.**Biotechnology-ALaboratoryCourse**.Academic Press, New York.
8. KeshavTrehan, 2002. **Biotechnology** (reprint). New Age International Ltd., Publishers, NewDelhi.
9. Kumar, H.D. 2000. **Modern concepts of Biotechnology.** Vikas Publishing House Pvt. Ltd. NewDelhi.
10. Pamela Peters. 1993. **Biotechnology- a guide to** GeneticEngineering**.** Wim.C. Brown Publishers,USA.
11. Primrose, S.B. 1989. **Modern Biotechnology**. Blackwell Scientific Publications.
12. Thorpe, T.A. 1981. **Plant Tissue Culture.** Academic Press,London.
13. Trivedi. P.C. (Ed.) 2000. **Plant Biotechnology - Recent Advances**. PanimaPublishing Co.NewYork.

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Programme: M.Sc., **Subject:** Botany

Semester: IV **Course:** Herbal Cosmetics

Course Type: Major **Course Code:**

Contact Hours: 6 Hours/Week **Credits:** 5

CIA: 25 **CE:** 75

Course Objectives:

The main objectives of this course are to:

- To understand the importance of herbal cosmetics
- To familiarize face care products from plants
- To understand skin care products from plants
- To explain preparation of herbal oils
- To acquire knowledge on preparation of foot cream

Course Outcomes:

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

CO1	Remember the advantage of herbal cosmetics	K1
CO2	Evaluate the preparation of face pack	K5
CO3	Understand the preparation of Herbal Bathing powder and soaps	K2
CO4	Apply the preparation of Herbal Shampoo and Hair dyes	K2
CO5	Remember megandi decoration on feet	K1

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit: I

Introduction of herbal cosmetics – Need and advantages of Herbal cosmetics – Adverse effect of chemical cosmetics.

Unit : II

Face care : Face cleanser, Ache – Pimple cream, Anti- marks lotion- Preparations of Face pack

Unit : III

Skin care : Skin beauty through panchakarma, Turmeric – Milk lotion, Anti-Wrinkle cream , Preparation of Herbal Bathing powder and soaps.

Unit : IV

Hair care : Hair oil components and preparation of oil, Neeli Bringhadi oil- (Karisalankanni thailam) – Amla Hair oil (Ashwini hair oil) – Amaranthus oil (Arsikeeraithailam) – Herbal Shampoo and Hair dyes.

Unit : V

Foot care : Preparation of foot cream- senna, caster oil, turmeric; Megandi decoration on feet.

Reference Books :

- Faroqi A.A. Sree ramu.B.S. 2005 , cultivation of medicinal and crops
- Asha Ram – 2002 Herbal Indian Perfumes and cosmetics sriSatguru Publications New Delhi.
- Babu .S.S. , Herbal cosmetics Pushkal Publishers.
- Pharmacognosy – SS. Handa and V.K. Kapoor, Second Edition ,publishersVattubh Prakasan, Delhi.
- Pharmacognosy – C.K.Kokate, a.p.durohit and s.r.gokhaletwelth edition – publishers niraliprakasan, pune.
- Text Book of Pharmacognocy T.E. Wallis 5th edition Publishers CBS publishers and Distributors Delhi.

Mapping with Programme Outcomes						
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	S	M	S
CO2	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

- *S-Strong; M-Medium; L-Low