St Aloysius College (Autonomous)

Mangaluru

Re-accredited by NAAC "A++" Grade

Course structure and syllabus of

B.Sc.
BOTANY

Under NEP Regulations, 2021

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www.staloysius.edu.in

ST ALOYSIUS COLLEGE (AUTONOMOUS)
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Re-accredited by NAAC with '**A++**' Grade with CGPA 3.67/4 (Cycle 4)
Recognised as Centre for Research Capacity Building under UGC-STRIDE Scheme
Recognised under DBT – BUILDER Scheme, Government of India
College with "STAR STATUS" Conferred by DBT, Government of India
Recognised by UGC as "College with Potential for Excellence"

Date: 21-02-2022

NOTIFICATION

Sub: Syllabus of **B.Sc. BOTANY** under NEP Regulations, 2021.
(As per Mangalore University guidelines)

Ref: 1. Decision of the Academic Council meeting held on 18-12-2021 vide Agenda No: 6
2. Decision of the Academic Council meeting held on 09-07-2022 vide Agenda No: 14
3. Decision of the Academic Council meeting held on 02-09-2023 vide Agenda No: 3
4. Office Notification dated 21-02-2022
5. Office Notification dated 17-08-2022
6. Office Notification dated 26- 09-2023

Pursuant to the above, the Syllabus of **B.Sc. BOTANY** under NEP Regulations, 2021 which was approved by the Academic Council at its meeting held on 18-12-2021, 09-07-2022 & 02-09-2023 is hereby notified for implementation with effect from the academic year **2021-22**.

PRINCIPAL

ST ALOYSIUS COLLEGE MANGALORE 575 003 AUTONOMOUS

REGISTRAR

To:

1. The Chairman/Dean/HOD.
2. The Registrar Office
3. Library

A meeting of the Board of Studies in BOTANY was held on 19 – 11 – 2021 (Online)
Members present:
External Members :

Vice Chancellor nominee -

1. Dr Raju Krishna Chalannaver - Professor, Department of Applied Botany, Mangalore University

Subject Experts -

2. Dr Giby Kuriakose - Asst Professor ,PG Dept of Botany, Sacred Heart College, Thevara, Kochi, Kerala
3. Dr Vijayalaxmi C Bhat - Asst Professor, Dept of Botany, Poorna Prajna College, Udupi

Meritorious Alumnus

4. Dr Madhumathi B. S - Programme Manager, Perfect Day India Pvt. Ltd, Electronic City, Bangalore

Internal Members :

1. Dr Jyothi Miranda, Chairperson & HOD
2. Ms Shilpa B
3. Dr Sana Sheik
4. Ms Akshitha Ramachandra Amin

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A meeting of the Board of Studies in BOTANY was held on 18 – 06 – 2022 at 10: 00 AM in X 209 (Online)

Members present:

External Members :

Vice Chancellor nominee -

1. Dr Raju Krishna Chalannaver - Professor, Department of Applied Botany, Mangalore University, Mangalagangothri – 574199

Subject Experts -

2. Dr Giby Kuriakose - Asst Professor ,PG Dept of Botany, Sacred Heart College,Thevara , Kochi , Kerala ,India – 682013
3. Dr Vijayalaxmi C Bhat - Asst Professor, Dept of Botany, Poorna Prajna College, Udupi – 576101

Meritorious Alumnus -

4. Dr Madhumathi B. S - Programme Manager, Perfect Day India Pvt. Ltd, Electronic City, Bangalore – 100

Internal Members :

5. Dr Jyothi Miranda, Chairperson & HOD
6. Dr Sana Sheik
7. Ms Akshitha Ramachandra Amin
8. Vishal Moger- II BSc (BcBZ) Reg No (192802) -Student Representative

A meeting of the Board of Studies in BOTANY was held on 06 – 02 – 2023

Members present:

External Members :

Subject Experts -

Dr Giby Kuriakose , Asst Professor & HOD , PG Studies & Research in Botany, Sacred Heart College, Thevara , Kochi , Kerala ,India – 682013

Mr Muhammed Haneef KA , Assistant Professor, Dept of Botany. Government Brennen College ,Thalassery, Kannur. Kerala -670106

Meritorious Alumnus -

Dr Bhagya N, Assistant Professor, Yenepoya Research Centre, Yenepoya Deemed to be University, Deralakatte , Mangaluru -575018

Internal Members :

1. Dr Jyothi Miranda, Chairperson & HOD
2. Ms Shilpa B
3. Dr Sana Sheik
4. Ms Akshitha R. Amin

PREAMBLE

St Aloysius College is named after St Aloysius Gonzaga. It is a Jesuit premier institute in Mangaluru, Karnataka, known for its rich heritage and quality education with a history of 140 years. The institution over the years has trained thousands of young men and women preparing them for life and presenting them to the nation. The institution has been able to redefine and reinforce the purpose of various innovations that have been initiated every year. The College has set high expectations and goal for all its learners and then tries in every possible way to help them to reach those goals. The College affiliated to Mangaluru University, was granted Autonomous status in the year 2007-2008.

In the field of Biological sciences, at the undergraduate level, the optional Botany has carved a niche from times immemorial. Many subjects like Biotechnology, Pharmacognosy, Microbiology, and Biochemistry have got their contributions and share from the traditional subject Botany. Botany with its strong fundamentals can only make the allied combinations more meaningful, fruitful and complete. In this context St Aloysius College has designed the course content of Botany to meet the needs of the present day students and enable them to join jobs, higher studies and research.

PROGRAMME SPECIFIC OUTCOMES:

On Completion of this Course students will be able to

- get an opportunity in further studies, research and employment in various areas of plant sciences.
- receive the updated subject matter, both theoretical as well as practical, such a way to foster their core competency, creative thinking and analytical learning . A botany graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment.
- enhance their knowledge in the field of life sciences and are able to handle laboratory equipments and experimentation for higher education leading to research
- become a responsible citizen who is aware of the most basic domain-independent knowledge, including critical thinking and communication.
- enhance the scope of employability by obtaining all-round knowledge in the allied subjects along with Botany.
- develop an awareness towards the environment, biodiversity, conservation and their significance.
- promote and popularize the study of Botany for its importance and its social relevance
- equip themselves for competitive examinations enabling the graduates to prepare for national as well as international competitive examinations, including UGC-CSIR NET and UPSC Civil Services Examination.
- inculcate an interest for nature and the need to preserve the nature by maintaining greenhouse, herbal gardens in the campus and environs

Programme structure for the under-graduate programs in Universities and Colleges

SEMESTER-I								
Group	Course Code	Title of the Course	Instruction Hours / week	Duration of Exam (Hours)	Marks			Credits
					IA	Exam	Total	
Discipline Specific Course	G 507 DC1.1	MICROBIAL DIVERSITY AND TECHNOLOGY	4	2.5	40	60	100	4
Discipline Specific Course	G 507 DC 2.1P	MICROBIAL DIVERSITY AND TECHNOLOGY -PRACTICALS	4	3	25	25	50	2
Open Elective Course	G 507 OE 1.1	PLANTS FOR HUMAN WELFARE	3	2.5	40	60	100	3

[subjects with practicals] [With major Botany]

SEMESTER- II								
Group	Course Code	Title of the Course	Instruction Hours / week	Duration of Exam (Hours)	Marks			Credits
					IA	Exam	Total	
Discipline Specific Course	G507 DC1.2	DIVERSITY OF NON-FLOWERING PLANTS	4	2.5	40	60	100	4
Discipline Specific Course	G507DC 2.2P	DIVERSITY OF NON-FLOWERING PLANTS - PRACTICALS	4	3	25	25	50	2
Open Elective Course	G 507 OE 1.2	PLANT PROPAGATION, NURSERY MANAGEMENT AND GARDENING	3	2.5	40	60	100	3

Programme structure for the under-graduate programs in Universities and Colleges [subjects with practicals] [With major Botany]

SEMESTER-III								
Group	Course Code	Title of the Course	Instruction Hours / week	Duration of Exam (Hours)	Marks			Credits
					IA	Exam	Total	
Discipline Specific Course	G507 DC 1.3	Plant Anatomy and Developmental Biology	4	2.5	40	60	100	4
Discipline Specific Course	G 507 DC 2.3P	Plant Anatomy and Developmental Biology -Practicals	4	3	25	25	50	2
Open Elective Course	G 507 OE 1.3	Medicinal and Aromatic plants	3	2.5	40	60	100	3
SEMESTER- IV								
Group	Course Code	Title of the Course	Instruction Hours / week	Duration of Exam (Hours)	Marks			Credits
					IA	Exam	Total	
Discipline Specific Course	G507 DC1.4	Ecology and Conservation Biology	4	2.5	40	60	100	4
Discipline Specific Course	G507DC 2.4P	Ecology and Conservation Biology - Practicals	4	3	25	25	50	2
Open Elective Course	G 507 OE 1.4	Plant Biodiversity and Conservation	3	2.5	40	60	100	3

FOR SEMESTER V & VI

Programme structure for the under-graduate programs in Universities and Colleges [subjects with practicals] [With major Botany]

SEMESTER- V								
Group	**Course Code**	**Title of the Course**	**Instruction Hours / week**	**Duration of Exam (Hours)**	**Marks**			**Credits**
					IA	**Exam**	**Total**	
Discipline Specific Course	G 507 DC1.5	Plant Taxonomy and Resource Botany	4	2.5	40	60	100	4
Discipline Specific Course	G 507 DC2.5P	Plant Taxonomy and Resource Botany - Practical	4	3	25	25	50	2
Discipline Specific Course	G 507 DC3.5	Genetics and Plant Breeding	4	2.5	40	60	100	4
Discipline Specific Course	G 507 DC4.5P	Genetics and Plant Breeding Practical	4	3	25	25	50	2
Discipline Specific Elective	G 507 VOC 1.5	Algal and Fungal Biotechnology	3	2.5	40	60	100	3

SEMESTER- VI								
Group	**Course Code**	**Title of the Course**	**Instruction Hours / week**	**Duration of Exam (Hours)**	**Marks**			**Credits**
					IA	**Exam**	**Total**	
Discipline Specific Course	G 507 DC1.6	Plant Physiology and Biochemistry	4	2.5	40	60	100	4
Discipline Specific Course	G 507 DC2.6P	Plant Physiology and Biochemistry - Practical	4	3	25	25	50	2
Discipline Specific Course	G 507 DC3.6	Plant Biotechnology	4	2.5	40	60	100	4
Discipline Specific Course	G 507 DC4.6P	Plant Biotechnology Practical	4	3	25	25	50	2
Discipline Specific Elective	G 507 VOC 1.6	Herbal Technology	3	2.5	40	60	100	3

B.Sc. BOTANY: Semester – I

G507 DC1.1: Microbial Diversity and Technology

Number of Theory credits**: 4**	Number of lecture hours/ week **: 4**	Number of Practical Credits **: 2**	Number of practical hours / week **: 4**

Course Outcomes:

At the end of the course the student should be able to:

- ❖ understand the fascinating diversity, evolution, and significance of microorganisms.
- ❖ comprehend the systematic position, structure, physiology and life cycles of microbes and their impact on humans and environment.
- ❖ gain laboratory skills such as microscopy, microbial cultures, staining, identification and preservation of microbes.
- ❖ apply microbes in research and industry

Course content **56 Hrs**

Unit 1 **14 Hrs**

1.1 Microbial diversity: Introduction to microbial diversity; Hierarchical organization and positions of microbes in the living world: Whittaker's five-kingdom system and Carl Richard Woese's three-domain system. Habitats of microbes: soil, air, food and water. Significance of microbial diversity.

1.2 History and development of microbiology: Microbiologists and contributions of - Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Dmitri Iwanowski, Sergius Winogradsky and M W Beijerinck and Paul Ehrlich**.**

1.3 Microscopy:Working principle and applications of light, dark field, phase contrast and electron microscopes (SEM and TEM).

1.4 Microbiological stains: acidic, basic and special and Principles of staining. Simple, Gram's and differential staining.

Unit II **14 Hrs**

2.1 Culture media for Microbes: Natural and synthetic media, Routine media -basal media, enriched media, selective media, indicator media, transport media, and storage media.

2.2 Sterilization methods: Methods of disinfection: antiseptic, tyndallization and Pasteurization. **Sterilization**-Physical methods: dry heat, moist heat, UV light, ionization radiation, filtration. Chemical methods - phenolic compounds, anionic and cationic detergents.

2.3 Microbial Growth: Microbial growth and measurement. Nutritional types of Microbes- autotrophs and heterotrophs, phototrophs and chemotrophs; lithotrophs and organotrophs.

Unit III **14 Hrs**

3.1 Microbial cultures and preservation: Microbial cultures. Pure culture and axenic cultures, subculturing. Preservation methods-overlaying cultures with mineral oils, lyophilisation. Microbial culture collections and their importance. A brief account on

ITCC, MTCC and ATCC.

3.2 Viruses: General structure and classification of Viruses; ICTV system of classification. Structure and multiplication of TMV, SARS-COV-2, and Bacteriophage (T2). Cultivation of viruses. Vaccines and types. Economic importance of viruses. **Viroids & Prions:**Viroids- general characteristics and structure of Potato Spindle Tuber Viroid (PSTVd); Prions - general characters and diseases**.**

3.3 Bacteria: General characteristics and classification.(Bergey's classification) Archaebacteria and Eubacteria. Ultrastructure of Bacteria; Bacterial growth and nutrition. Reproduction in bacteria- asexual and sexual methods. Study of *Rhizobium* and its applications. A brief account of Actinomycetes , Mycoplasmas and Phytoplasmas - General characteristics and diseases

Unit IV **14 Hrs**

4.1. **Fungi:**General characteristics and classification (Alexopoulos classification). Thallus organization and nutrition in fungi. Reproduction in fungi (asexual and sexual). Heterothallism and parasexuality. Type study: Morphology of *Rhizopus, Saccharomyces, Penicillium and Puccinia.* Morphology and reproduction of *Puccinia* Economic importance of Fungi.

4.2. Symbiotic associations:

Lichens – Structure- brief account of Crustose, foliose and fruiticose and asexual reproduction .

VAM Fungi and their significance.

4.3 Microbial plant diseases- Koleroga of Arecanut, Blast Disease of Rice; Black stem rust of wheat;Red rot of sugarcane , Sandal Spike, Citrus Canker, Root Knot Disease of Brinjal.

References

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2. Arora DR. 2004. Textbook of Microbiology, CBS, New Delhi.
3. William CG. 1989. Understanding microbes. A laboratory text book for Microbiology. W.H. Freeman and Company. New York.
4. Dubey RC and Maheshwari DK. 2007. A textbook of Microbiology, S. Chand and Company, NewDelhi.
5. Dubey RC and Maheshwari DK. 2002. A Text book of Microbiology, S.C.Chand and Company, Ltd. Ramnagar, New Delhi.
6. Sharma R. 2006. Text book of Microbiology. Mittal Publications. New Delhi. 305pp.
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10. Allas RM. 1988. Microbiology: Fundamentals and Applications, Macmillan publishing co. New York.
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Eaglewood Cliffts. N.J.Prentice- Hall. New Delhi.

12. Burnell JH and Trinci APJ. 1979. Fungal walls and hyphal growth, Cambridge University Press. Cambridge.

13. Jayaraman J. 1985. Laboratory Manual of Biochemistry, Wiley Eastern Limited. New Delhi.

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15. Michel J, Pelczar Jr.EC and Krieg CR. 2005. Microbiology, Mc.Graw-Hill, New Delhi.

16. Powar CB and Daginawala. 1991. General Microbiology, Vol – I and Vol – II Himalaya publishing house,Bombay.

17. Reddy S and Ram. 2007. Microbial Physiology. Scientific Publishers, Jodhpur, 385pp.

18. Sullia SB and Shantharam S. 1998. General Microbiology. Oxford and IBH publishing Co.Pvt.Ltd. New Delhi.

19. Schlegel HG. 1986. General Microbiology. Cambridge. University Press. London, 587pp.

20. Roger S, Ingrahan Y, Wheelis JL, Mark L and Page PR. 1990. Microbial World 5th edition. Prentice-Hall India, Pvt. Ltd. New Delhi.

21. Sullia SB. and Shantharam S. 2005. General Microbiology, Oxford and IBH, New Delhi.

Practical Course G 507 DC 2.1P: Microbial Diversity and Technology

List of Experiments to be conducted

Practical 1: Safety measures in microbiology laboratory and study of equipment/appliances used for microbiological studies (Microscopes, Hot air oven, Autoclave/Pressure Cooker, Inoculation needles/loop, Petri plates, Incubator, Laminar flow hood, Colony counter, Haemocytomer, Micrometer.

Practical 2: Preparation of culture media (NA/PDA) sterilization, inoculation, incubation of *E coli / B. subtilis/* Fungi and study of cultural characteristics.

Practical 3: Enumeration of soil/food /seed microorganisms by serial dilution technique.

Practical 4: Preparation of agar slants, inoculation, incubation, pure culturing and preservation of microbes by oil overlaying.

Practical 5: Determination of cell count by using Haemocytometer and determination of microbial cell dimension by using Micrometer.

Practical 6: Simple staining of bacteria (Crystal violet /Nigrosine blue) / Gram's staining of bacteria

Practical 7: Isolation and study of morphology of *Rhizobium* from root nodules of legumes

Practical 8: Preparation of spawn and cultivation of paddy straw (Oyster) mushroom.

Practical 9: Study of vegetative structures and reproductive structures of any six of the following: *Albugo ,Phytophthora, Rhizopus, Saccharomyces, Neurospora/ Sordaria, Puccinia, Agaricus, Lycoperdon, Aspergillus/Penicillium, Trichoderma.(Depending on local availability)*

Practical 10: Study of Koleroga of Arecanut, Blast Disease of Rice; Black stem rust of wheat, Red rot of sugarcane, Sandal Spike, Citrus Canker, Tobacco mosaic virus, Root Knot Disease of Brinjal.

Practical 11: Study of well-known microbiologists and their contributions through charts and photographs.

Practical-12: Visit to water purification units/Composting/ microbiology labs/dairy and farms to understand role of microbes in day today life. Field study report is to be documented in the practical record only.

B.Sc. BOTANY: Open Elective Course
I Semester

G 507 OE 1.1: Plants for Human Welfare

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

- gain knowledge on the economic importance of diverse plants that offer resources to human life.
- know about the plants used as food, medicinal value and also plant sources of different economic value .
- understand the importance of plants in today's life, conservation, ecosystem and sustainability.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	30	0	00

30 Hrs

Unit I
Origin of Cultivated Plants. Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions. Crop domestication and loss of genetic diversity (Only conventional plant breeding methods). Importance of plant bio- diversity and conservation. 02

Unit II
Wheat and Rice (origin, evolution, morphology, post-harvest processing & uses).Green revolution. Brief account of millets and their nutritional importance. 03

Unit III
Legumes: General account (including chief pulses grown in Karnataka- red gram, green gram, chick pea, soybean). Importance to man and ecosystem. 02

Unit IV
Fruits: Mango,grapes and Citrus (Origin, morphology,cultivation ,processing and uses) 02

Unit V

Cash crops: Morphology, new varieties and processing of sugarcane, products and by-products of sugarcane industry. Natural Rubber –cultivation, tapping and processing. 03.

Unit VI

Spices: Listing of important spices, their family and parts used, economic importance with special reference to Karnataka. Study of fennel, clove, black pepper and cardamom. 03

Unit VII

Beverages: Tea,Coffee (morphology, processing & uses) 02

Unit VIII

Oils and fats: General description, classification, extraction, their uses and health implications; groundnut, coconut, sunflower and mustard (Botanical name, family & uses). Non edible oil yielding trees and importance as biofuel. Neem oil and applications. 02

Unit IX

Essential Oils: General account. Extraction methods of sandal wood oil, rosa oil and eucalyptus oil. Economic importance as medicine, perfumes and insect repellents. 02

Unit X

Drug-yielding plants: Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, *Aloe vera* and Cannabis. 03

Unit XI

Fibers: Classification based on the origin of fibers; Cotton and jute (origin morphology, processing and uses). 03

Unit XII

Forests: Forest and forest products. Community forestry. Concepts of reserve forests, sanctuaries and national parks with reference to India. Endangered species and red data book. 03

Text Books and References

1. Kochhar, S.L. (2012). Economic Botany in Tropics. New Delhi, India: MacMillan & Co.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. The Netherlands: Kluwer Academic Publishers.
3. Chrispeels, M.J. and Sadava, D.E. (1994) Plants, Genes and Agriculture. Jones & Bartlett - Publishers.

B.Sc. BOTANY: Semester – II
G507 DC1.2: Diversity of Non- Flowering Plants

Number of Theory credits**: 4**	Number of lecture hours/ week**: 4**	Number of Practical Credits **: 2**	Number of practical hours / week **:4**

Course Outcomes:
At the end of the course the student should be able to:

- ❖ understand the diversity and affinities among Algae, Bryophytes, Pteridophytes and Gymnosperms.
- ❖ understand the morphology, anatomy, reproduction and life cycle across Algae, Bryophytes, Pteridophytes and Gymnosperms.
- ❖ understand the ecological and evolutionary significance.
- ❖ obtain laboratory skills/explore non-flowering plants for their commercial applications.

Course content **56 Hrs**

Unit 1 **14 Hrs**

1.1 Algae: Introduction and historical development in algology. Distribution of Algae. General characteristics, classification of algae by Fritsch. Diversity- habitat, thallus organization, and alternation of generation in Algae.

1.2 Morphology and reproduction and life-cycles of *Nostoc, Oedogonium, Chara, Sargassum and Polysiphonia*. Diatoms and their importance.

1.3 Algal cultivation: a general account. Basic cultivation techniques of microalgae. Algal products- Food and Nutraceuticals, Feed stocks, food colorants; fertilizers, aquaculture feed; therapeutics and cosmetics; medicines; dietary fibres from algae. Algal blooms and toxins.

Unit II **14 Hrs**

2.1 Bryophytes – General characteristics and classification (Rothmaler) of Bryophytes.

2.2 Distribution, morphology, anatomy, reproduction and life-cycles of *Riccia, Anthoceros,* and *Funaria.* Ecological and economic importance of Bryophytes

2.3 Pteridophytes- General characteristics and classification (Smith); Distribution, morphology, anatomy, reproduction and life-cycle in *Selaginella, Pteris* and *Marselia.*

Unit III **14 Hrs**

3.1. Brief account of heterospory and seed habit. Stelar evolution in Pteridophytes . Affinities and evolutionary significance of Pteridophytes. Ecological and economic importance.

3.2.**Gymnosperms**- General characteristics. Distribution and classification of Gymnosperms (Sporne). Study of the habitat, habit, anatomy, reproduction and life-cycle in Cycas, Pinus and Gnetum.

3.3. Affinities and evolutionary significance of Gymnosperms. Economic importance of Gymnosperms - food, timber, industrial uses and medicines

Unit IV **14 Hrs**

4.1 Origin and evolution of Plants: Origin and evolution of plants through Geological Time scale.

4.2 Paleobotany: Paleobotanical records, plant fossils, Types of plant fossils -

impressions, compressions, incrustation, actual remains petrifaction. Radiocarbon dating. A general account of fossil Bryophytes

4.3 Fossil : Fossil taxa- *Rhynia, Lepidodendron, Cycadeoidea*. Contributions of Birbal Sahni. Birbal Sahni Institute of Paleosciences.

References

1. Chopra, G.L. 2012 A text book of Algae. Rastogi & Co., Meerut, Co., New Delhi, Depot.
   Allahabad.
2. Johri, Lata and Tyagi, 2012 A Text Book of, Vedam e Books, New Delhi.
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4. Sharma, O.P. 1992. Text Book of Thallophytes. McGraw Hill Publishing Co. New Delhi.
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10. Eams, A.J., (1974) Morphology of vascular plants - Lower groups. Tata Mc Grew-Hill Publishing Co. New Delhi, Freeman & Co., New York.
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22. Smith, G.M. 1971. Cryptogamic Botany. Vol.I Algae & Fungi. Tata McGraw Hill Publishing. New Delhi.

Practical Course G 507 DC 2.2P : Diversity of Non- Flowering Plants

List of Experiments to be conducted

Practical-1: Study of morphology, classification, reproduction and lifecycle of *Nostoc, Oedogonium.*

Practical-2: Study of morphology, classification, reproduction and life-cycle of *Chara, Sargassum, Polysiphonia*

Practical -3: Study of important blue green algae causing water blooms in the lakes.

Practical-4: Study of morphology, classification, reproduction and life-cycle of *Riccia/ Anthoceros.*

Any one locally available moss.

Practical-5: Study of morphology, classification, anatomy, reproduction and life-cycle of *Selaginella.*

Practical -6: Study of morphology, classification, anatomy, reproduction and life-cycle of *Pteris* and *Marselia.*

Practical -7: Study of morphology, classification, anatomy and reproduction in *Cycas.*

Practical -8: Study of morphology, classification, anatomy and reproduction in *Pinus.*

Practical -9: Study of morphology, classification, anatomy and reproduction in *Gnetum.*

Practical -10: Study of important ornamental ferns.

Practical -11: Preparation of natural media and cultivation of *Azolla* in artificial ponds.

Practical -12: Media preparation and cultivation of *Spirulina*.

Practical -13: Study of different algal products and fossils impressions and slides.

Practical-14: Visit to algal cultivation units/lakes with algal blooms/Fern house/ Nurseries/Geology museum/lab to study plant fossils and the report is to be documented in the practical record.

B.Sc. BOTANY: Open Elective Course

II Semester

G 507 OE 1.2: Plant Propagation, Nursery Management and Gardening

Course Outcomes:

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

- gain knowledge of gardening, cultivation, multiplication, raising of seedlings of garden plants.
- get knowledge of new and modern techniques of plant propagation.
- develop interest in nature and plant life.
- understand the application of this field in floriculture, agriculture and medicine
- practice sustainable use of plant resources

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	30	0	00

30 Hrs

Unit I

Nursery: Definition, objectives and scope and general practices and building up of infrastructure for nursery, planning and seasonal activities. Planting - direct seeding and transplants, Soil free/soilless/ synthetic growth mediums for pots and nursery. 04

Unit II

Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy. Seed storage: Seed banks, factors affecting seed viability, genetic erosion Seed production technology. Seed testing and certification. 06

Unit III

Vegetative propagation: Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings. Hardening of plants .Green house ,mist chamber, shed root, shade house and glass house. 06

Unit IV

Gardening: Definition, objectives and scope. Different types of gardening - landscape and home/terrace gardening, parks and its components. Plant materials and design. Computer applications in landscaping, Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting. 08

Unit V

Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables and flowering plants: cabbage, brinjal, lady's finger, tomatoes, carrots, bougainvillea, roses, geranium, petunia, orchids etc. Storage and marketing procedures. Developing and maintenance of different types of lawns. Bonsai technique. 06

Text Books and References

1. Agrawal, P.K. (1993). Hand Book of Seed Technology. New Delhi, Delhi: Dept. of Agriculture and Cooperation, National Seed Corporation Ltd.
2. Bose T.K., Mukherjee, D. (1972). Gardening in India. New Delhi, Delhi: Oxford & IBH Publishing Co.
3. Jules, J. (1979). Horticultural Science, 3rd edition. San Francisco, California: W.H. Freeman and Co.
4. Kumar, N. (1997). Introduction to Horticulture. Nagercoil, Tamil Nadu: Rajalakshmi Publications.

Additional Resources:

1. Musser E., Andres. (2005). Fundamentals of Horticulture. New Delhi, Delhi: McGraw Hill Book Co.
2. Sandhu, M.K. (1989). Plant Propagation. Madras, Bangalore: Wile Eastern Ltd.

SCHEME OF ASSESSMENT	
Ratio of weightage (marks) between **Internal & End Semester Examinations for THEORY: 60:40** **Practicum component marks: 50**	
Internal component of practicum: 50 (converted to 25)	
Assessment Type	**Weightage in marks**
Continuous Assessment of all practical experiments	**15**
Attendance	**05**
Model practical Test	**20**
Maintenance of Records	**05**
Viva	**05**
End semester Practicum : 50 (converted to 25)	
THEORY FORMATIVE ASSESSMENT: 40	
Assessment Type	**Weightage in marks**
Two internal tests	**10×2=20**
Assignment	**05**
Attendance	**05**
Continuous Unit wise tests (objective/MCQ)	**05**
Group/ teams of two projects:	**05**
THEORY SUMMATIVE ASSESSMENT: 60	

QUESTION PAPER PATTERN: DC & OE

Time: 2.5 HRS **Max Marks: 60**

Part – A

1) Answer **Any Five** of the following 5X2 =10

(Five to be answered out of eight)

Part – B

2) Answer **Any Six** of the following 6X5=30

(Four to be answered out of eight)

Part-C

3) Answer **any Two** of the following 2X10=20

(Two to be answered out of Four)

Question Paper will have Three Parts –**A, B, C**

Part A- Eight Questions from four units with equal weightage

Part B- Eight Questions from four units with equal weightage

Part C- Four questions from four units with equal weightage

QUESTION PAPER PATTERN: [PRACTICALS]
DC-2.1 P Microbial Diversity and Technology

Time: 3HRS **Max Marks: 50**

1. Identify the given Material **A**. Leave the preparation for inspection **6**
(Preparation-3, Labelled diagram-2, Identification with classification-1)

2. Identify **B, C** and **D** with Labelled sketch and Reasons 3x4=12

(Labelled Sketch = 1, Classification = ½, Identification ½ , Reasons =2)

3. Perform gram staining from the given sample **E** 8
(Principle- 2, Slide Preparation- 3, Procedure-2, Result-1)

4. Write Critical Notes on **F,G,H** and **I** 4x3=12
(Identification =1, Critical notes=2)

5. Determine the cell dimension of the given microbial cell using micrometer 8
(Performance- 2, Procedure-3 , Calculation & Result- 3)

6. Write a note on contributions of the given scientist **J** 4

Note to the Examiners

1. Specimen **A** (fungus)

2. Specimen **B, C** and **D** – from microfungi

3. Gram +/- **E**

4. Critical notes **F , G, H** and **I** - macroscopic specimens from viral diseases/ bacterial diseases/ mycoplasmal diseases / fungal diseases

5. Cell dimension of fungal spores

6. Contribution of any Microbiologist.

QUESTION PAPER PATTERN: [PRACTICALS]

DC -2.2 P Diversity of Non- Flowering Plants

MAX MARKS: 50 **TIME: 3 HR**

1. Prepare a Temporary mount of material **A.** Identify and leave the preparation for inspection. **5**
(Preparation-2, labelled sketch -2, identification -1)

2. Prepare a Temporary mount of material **B .** Identify and leave the preparation for inspection. **6**
(Preparation-2, labelled sketch -3, identification -1)

3. Identify Material **C** and **D**. Leave the preparation for inspection **2X6=12**

(Preparation-3, Labelled sketch-2, Identification with classification-1)

2. Write Critical Comments on **E,F , G** and **H** **4X3=12**
(Identification- 0½, Reasons-2½)

3. Identify the given Slides **I, J, and K** **3X5=15**

(Identification-1, Labelled sketch- 2 , Reasons-2)

Note to the Examiners

1. Specimen **A** – Cyanobacteria / Algae
2. Specimen **B** - Bryophyte
3. Specimen **C and D** - Pteridophyte and Gymnosperm
4. Specimen **E, F, G** and **H**- one each from the above mentioned groups.
5. Specimen **I, J** and **K –** one each from the above mentioned groups.

B.Sc. BOTANY: Semester - III

G 507 DC1.3: PLANT ANATOMY AND DEVELOPMENTAL BIOLOGY

Number of Theory credits**: 4**	Number of lecture hours/ week **: 4**	Number of Practical Credits **: 2**	Number of practical hours /week **: 4**

Course Outcomes:

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

1. Understand various levels of organization in a plant body with an outlook in the relationship between the structure and function through comparative studies.
2. Observe and classify the floral variations from the premises of college and house.
3. Understand the various reproductive methods sub-stages in the life cycle of plants
4. Observe and classify the embryological variations in angiosperms.
5. Understand evolution based on the variations in reproduction among plants.

PLANT ANATOMY

Unit I: PLANT CELL STRUCTURE AND TISSUES

14 hours

1.1 Introduction: objective and scope of Plant Anatomy, Plant cell structure – nature of plant cell wall.

1.2 Histology: Meristematic Tissues: Origin, Structure and function, Apical, intercalary & lateral meristems, Primary and secondary meristems theories of meristems- shoot apex theory- tunica corpus theory, root apex theory -histogen theory

1.3 Structure and function of root apical meristem (RAM): Root cap, quiescent centre

1.4 Permanent Tissues: Structure, distribution, types and functions of Simple permanent tissues - parenchyma, collenchyma, sclerenchyma and complex permanent tissues- xylem and phloem

1.5 Applications: in systematics, forensics and Pharmacognosy.

DEVELOPMENTAL BIOLOGY

Unit II: MORPHOGENESIS **14 hours.**

2.1 Morphogenesis in plants - Differentiation of root, stems and leaf. Types of vascular bundles and vascular cambium

2.2 Structure of Dicot root: primary and secondary structures (Tridax/Sunflower/Papaya), Structure of monocot root (Maize).

2.3 Structure of Dicot stem: Primary and secondary structures (Tridax/Sunflower), Structure of Monocot stem (Maize), Nodal anatomy.

2.4 Structure of Dicot leaf: primary structure (Tridax/Sunflower), primary structure of Monocot leaf (Maize), Stomatal types.

2.5 Anomalous secondary growth: Aristolochia / Bignonia / Boerhaavia (dicot stem), Dracaena (monocot stem)

Unit III: DIFFERENTIATION **14 hours.**

3.1 Differentiation and cell polarity in acellular (*Dictyostelium*), Unicellular (*Acetabularia*) and multicellular system (root hair and stomata formation), Cytohistological zonation and Ultrastructure of meristems.

3.2 Organogenesis: Differentiation of root, stem, leaf and axillary buds, bud dormancy, Significance of anatomy

3.3 Mechanism of leaf primordium initiation, development and Phyllotaxis (Diversity in size and shape of leaves)

3.4 Transition from vegetative apex into reproductive apex

3.5 Developmental patterns at flowering apex: ABC model specification of floral organs.

Unit IV: REPRODUCTIVE BIOLOGY **14 hours**

4.1 Introduction, Scope, interdisciplinary aspects and contributions of Indian embryologists: P. Maheshwari, K R Shivanna

4.2 Microsporangium: Development and structure of mature anther, Anther wall layers, Tapetum -types, structure and functions and sporogenous tissue. Microsporogenesis- Microspore mother cells, microspore tetrads, Pollinia. Microgametogenesis – Formation of vegetative and generative cells, structure of male gametophyte.

4.3 Megasporangium – Structure of typical Angiosperm ovule.Types of ovule- Anatropous, Orthotropous, Amphitropous, Circinotropous.Megagametogenesis – Types of development of Female gametophyte/embryosac- monosporic- *Polygonum* type. Structure of mature embryosac.

4.4 Pollination and fertilization: Structural and functional aspects of pollen (cell wall) , stigma and style. Post pollination events, Process and significance of double fertilization & triple fusion - recognition, pollen - stigma interaction, growth of pollen tube, chalazogamy, porogamy, mesogamy, Post fertilization changes.

4.5 Endosperm: Types and its biological importance. Free nuclear (*Cocos nucifera*) , cellular (*Cucumis),* helobial types. Ruminate endosperm.

4.6 Embryogenesis: Structure and composition of zygote, Dicot (*Capsella bursa-pastoris)* and Monocot (*Najas)* embryo development. A general account of seed development.

B.Sc. BOTANY: Semester - III
Practical Course G 507 DC 2.3 P
PLANT ANATOMY AND DEVELOPMENTAL BIOLOGY

LIST OF EXPERIMENTS TO BE CONDUCTED

Practical No.1

i) Study of meristem (Permanent slides/ Photographs).

ii) Study of Simple Tissues (Parenchyma, Collenchyma and Sclerenchyma) and Complex Tissues (xylem and phloem).

Practical No.2

Maceration technique to study elements of xylem and phloem, Study of primary structure of dicot root, stem and leaf

Practical No.3

Study of primary structure of monocot root, stem and leaf

Practical No. 4

Study of Normal secondary growth structure in dicot stem and root and Anomalous secondary growth

Practical No. 5

Study of stomata (any four types) with the help of locally available plant materials

Practical No. 6

Permanent slides of Young and mature anther, male gametophyte. Mounting of Pollen grains of Grass and Hibiscus and Pollinia of Calotropis

Practical No. 7

Pollen germination (hanging drop method) and Effect of Boron and Calcium on pollen germination

Practical No. 8

Permanent slides of types of ovules- orthotropous, anatropous, campylotropous, types of placentation: Axile, Marginal and Parietal types. Sectioning of ovary, for the studied types of placentation

Practical No. 09

Mounting of embryo: Tridax and Cyamopsis, Mounting of endosperm: Cucumis, Permanent slides of dicot and monocot embryo

Practical No. 10 and 11

Minor project work in groups of 3-5 students, from the following list

a) Study of pollen morphology of different flowers with respect to shape, colour, aperture etc.

b) Pollen germination of different pollen grains and calculate percentage of germination

collected from different localities/ under different conditions.

c) Study of placentation of different flowers.

d) Any other relevant study related to Anatomy / Embryology.

Note : Minor project work should be evaluated on students presentation, discussion and viva

Text Books for Reference:

1. Bhojwani and Bhatnagar, Introduction to Embryology of Angiosperms –Oxford & IBH, Delhi
2. Bhojwani Sant Saran, 2014.Current Trends in the Embryology of Angiosperms**,** Woong-Young Soh, Springer Netherlands,
3. Coutler E. G. , 1969. Plant Anatomy – Part I Cells and Tissues – Edward Arnold, London.
4. Dickison, W.C. (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA
5. Eames A. J. - Morphology of Angiosperms - Mc Graw Hill, New York.
6. Esau, K. 1990. Plant Anatomy, Wiley Eastern Pvt Ltd New Delhi
7. Evert, R.F. (2006) Esau's Plant Anatomy: Meristem, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc
8. Fahn, A.1992. Plant Anatomy, Pergamon Press, USA
9. Johri, B.M. l., 1984.Embryology of Angiosperms, Springer-Verlag, Netherlands.
10. Karp G., 1985. Cell Biology; Mc.Graw Hill Company
11. Maheshwari,P 1950. An introduction to the embryology of angiosperms. New York: McGraw-Hill
12. Mauseth, J.D. (1988). Plant Anatomy, the Benjammin/Cummings Publisher, USA.
13. Nair P .K .K - Pollen Morphology of Angiosperms - Scholar Publishing House, Lucknow
14. Pandey S.N. 1997, Plant Anatomy and Embryology .A. Chadha, Vikas Publication House Pvt Ltd;
15. Pandey, B. P., 1997. Plant Anatomy, S.Chand and Co. New Delhi
16. Raghavan, V., 2000. Developmental Biology of Flowering plants, Springer, Netherlands.
17. Saxena M. R. – Palynology – A treatise - Oxford & I. B .H., New Delhi.
18. Shivanna, K.R., 2003. Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt.Ltd. Delhi.
19. Vashishta .P.C .,1984. Plant Anatomy – Pradeep Publications – Jalandhar
20. Vashishta, P.C. 1997. Plant Anatomy, Pradeep Publications

B.Sc. BOTANY: Open Elective Course
III Semester

G 507 OE 1.3 : Medicinal and Aromatic plants **30 Hrs**

Course outcomes
On completion of this course student will be able to

- understand the concept of plant based medicine
- know the Medico-ethnobotanical sources
- identify medicinal and aromatic plants

UNIT 1 **10 hrs**

1.1 Medicinal Botany: History and Scope, Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope-Ayurveda, Siddha, Unani, Homeopathy

1.2 Promotion of medicinal plant sector at national level: National Medicinal Plant Board and State Medicinal Plant Boards - objectives and functions

1.3 Phytochemistry - active principles and methods of their testing, identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster). Primary and secondary metabolites, Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds)

UNIT 2 **10 hrs**

2.1 Bioprospecting: Introduction, a brief note on Indigenous Knowledge Systems, Indigenous people and protected areas, Community Biodiversity Registers.

Intellectual property rights including patents, copyrights, trademarks, geographical indicators and trade secrets etc. Indian Patent Act, conditions for patenting, IPRs in relation to traditional knowledge and culture; Bio-piracy.

2.2 Ethnobotany: Introduction, Scope and its Importance

Medico-ethnobotanical sources: in India, Distribution, Family, Botanical Name, Parts used and Therapeutic uses and significance of the following plants in ethno botanical practices (along with their habitat and morphology)

Holigarna ferruginea, Cynodon dactylon, Cymbopogon citratus, Achyranthus aspera, Azadiractha indica, Ocimum sanctum, Vitex negundo, Gloriosa superba, Tribulus terrestris, Pongamia pinnata, Cassia auriculata, Indigofera tinctoria, Mimosa pudica, Phyllanthus amarus, Cyperus rotundus, Aerva lanata, Anamirta cocculus, Piper longum, Garcinia indica, Plumbago indica, Terminalia chebula, Terminalia arjuna, Cyperus

rotundus, Cordia dichotoma, Strychnos nux-vomica

Role of ethnobotany in modern medicine with special reference to *Phyllanthus niruri, Rauvolfia sepentina, Trichopus zeylanicus, Artemisia vulgaris ,Withania somnifera*.

UNIT 3 **10 hrs**

3.1Aromatic plants- Important aromatic plants of India with their systematics, geographical distribution and uses. Introduction and historical background of aromatic plants. Major, minor and less known aromatic plants of India. Taxonomic descriptions and uses of important aromatic plants – citronella, damask rose, geranium, large cardamom, lavender, lemon grass, mentha, holy basil, patchouli, rosemary vetiver, artemisia, eucalyptus .

Aromatic spices - clove, cinnamon, nutmeg, ajwain, curryleaf

3.2 Flavouring and Perfumery Products: Aromatic and cosmetic products. Raw material for perfumes, Cosmetic Industries. Use of *Rosa damascena, Vanilla planifolia, Santalum album, Eucalyptus globulus, Ocimum sanctum* in Flavouring and Perfumery Products . Extraction of Essential oil.

REFERENCES

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India. 2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2 nd edn. Agrobios, India.
2. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
3. Kokate C.K. et al. 1999. Pharmacognosy, Nirali Prakashan
4. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons, Chichester
5. Trivedi P C, 2006. Indian Medicinal Plants , Agrobios, India.
6. Bhattacharjee S.K., 2004. Handbook of Medicinal and Aromatic Plants
7. A.K. Sharma, 2006, Recent Progress in Medicinal Plants Vol.12, Globalization of Herbal Health

B.Sc. BOTANY SEMESTER IV

G 507 DC1.4 Ecology and Conservation Biology

Number of	Number of	Number of	Number of
Theory credits**: 4**	lecture hours/ week**: 4**	Practical Credits**: 2**	practical hours / week**: 4**

Course outcomes:

On Completion of this Course students will be able to

1. learn various types of ecosystems and its significance in biodiversity conservation
2. understand ecological concepts like succession and plant adaptations,concept of sustainability
3. learn the practical application of research methodologies in ecology with reference to community studies
4. evaluate sustainable management related to local and global issues
5. get knowledge on the recent issues associated with the environment

Unit 1 **14 hours**

1.1 Introduction to Ecology :

Definitions, Principles of Ecology, Brief History, Major Indian Contributions, Scope and importance. Ecological levels of organisation.

1.2 Ecological factors: Climatic factors: light, temperature, precipitation and humidity.

Edaphic factors: Soil and its types, soil texture, soil profile, soil formation; physico-chemical properties of soil - mineral particle, soil pH, soil aeration, organic matter, soil humus and soil microorganisms.

1.3 Ecological groups of plants and their adaptations: Morphological and anatomical adaptations of

Hydrophytes: Morphological adaptations in *Pistia, Eichhornia, Hydrilla, Nymphaea.*

Anatomical adaptations in *Hydrilla* (stem) and *Nymphaea* (petiole).

Xerophytes: Morphological adaptations in *Asparagus, Casuarina, Acacia, Aloe vera, Euphorbia tirucalli.* Anatomical adaptations in phylloclade of *Casuarina* .

1.4 Epiphytes: Morphological adaptations in *Acampe, Bulbophyllum* Anatomical adaptations in epiphytic root of *Acampe/ Vanda.*

Halophytes: study of Vivipary in mangroves, Morphology and anatomy of Pneumatophores.

Unit II 14 hours

2.1 Ecosystem Ecology: Introduction, types of ecosystems with examples - terrestrial and aquatic, natural and artificial.

Structure of ecosystem: Biotic and Abiotic components, detailed structure of a pond ecosystem.

Ecosystem functions and processes: Food chain-grazing and detritus; Food web. Ecological pyramids -Pyramids of energy, biomass and number. Principles of Energy flow in ecosystem.

2.2 Ecological succession: Definition, types- primary and secondary. General stages of succession. Hydrosere and xerosere.

2.3 Community Ecology: Community and its characteristics – frequency, density, Abundance, cover and basal area, phenology, stratifications, life-forms. Concept of Ecotone and Ecotypes.

2.4 Ecological methods and techniques: Methods of sampling plant communities – transects and quadrats. Remote sensing as a tool for vegetation analysis, land use – land cover mapping.

2.5 Population Ecology: Population and its characteristics – Population density, natality, mortality, age distribution, population growth curves and dispersal.

Unit III 14 hours

3.1 Phytogeography :

Theory of land bridge, theory of continental drift, polar oscillations and glaciations. Centre of origin of plant – Vavilov's concept, types. Phytogeographical regions – concept, phytogeographical regions of India.

3.2 Vegetation types of Karnataka – Composition and distribution of evergreen, semi-evergreen, deciduous, scrub, mangroves, shola forests and grasslands. An account of the vegetation of the Western Ghats.

3.3 Environmental issues

Pollution: Water pollution: Causes, effect, types; water quality indicators, water quality standards in India, management of water pollution (Waste water treatment).

Water pollution disasters – National mission on clean Ganga, Minimata

3.4 Air pollution: Causes, effect, air quality standards, acid rain, control measures

Soil pollution: Causes, effect, solid waste management, control measures of soil pollution.

Unit IV

14hours

4.1 Biodiversity: Definition, types of biodiversity - habitat diversity, species diversity and genetic diversity, Sustainable Development Goals in biodiversity conservation.

Values of Biodiversity – Economic and aesthetic value, Medicinal and timber yielding plants, wild relatives of crop plants, NTFP. Threats to biodiversity.

4.2 Concept of Biodiversity Hotspots, Biodiversity hot spots of India.

4.3 Concept of endemism and endemic species.

IUCN plant categories with special reference to Karnataka/ Western Ghats.

Biodiversity Conservation- Indian forest conservation act (1980) , Biodiversity bill (2002).

4.4 Conservation methods – *In-situ* and *ex-situ* methods

*In-situ*methods –Biosphere reserves, National parks, Sanctuaries, Sacred groves.

*Ex-situ*methods-Botanical gardens, Seed bank, Gene banks, Pollen banks, Culture collections, Cryopreservation.

SUGGESTED REFERENCE BOOKS:

1. Sharma, P.D. 2018. Fundamentals of Ecology. Rastogi Publications.
2. Odum E.P. (1975): Ecology By Holt, Rinert& Winston.
3. Oosting, H.G. (1978): Plants and Ecosystem Wadworth Belmont.
4. Kochhar, P.L. (1975): Plant Ecology. (9th Edn.,) New Delhi, Bombay, Calcutta-226pp.,
5. Kumar, H.D. (1992): Modern Concepts of Ecology (7th Edn.,) Vikas Publishing Co., New Delhi.
6. Kumar H.D. (2000): Biodiversity & Sustainable Conservation. Oxford & IBH Publishing Co Ltd. New Delhi.
7. Newman, E.I. (2000): Applied Ecology, Blackwell Scientific Publisher, U.K.
8. Chapman, J.L&M.J. Reiss (1992): Ecology (Principles & Applications). Cambridge University Press, U.K.
9. Malcolm L. Hunter Jr., James P. Gibbs, Viorel D. Popescu, 2020. Fundamentals of Conservation Biology, 4th Edition. Wiley-Blackwel.
10. Saha T. K., 2017. Ecology and Environmental Biology. Books and Allied Publishers.

B.Sc. BOTANY: Semester - IV
Practical Course G 507 DC 2.4 P

Ecology and Conservation Biology

List of Practicals

1. Determination of pH of different types of Soils, water holding capacity of soil samples, soil texture of different soil samples Estimation of salinity of soil/water samples.

2. Study of Ecological instruments – Wet and Dry thermometer, Altimeter, Hygrometer, Soil thermometer, Rain Gauge, Barometer, etc

3. Hydrophytes: Morphological adaptations in *Pistia, Eichhornia, Hydrilla, Nymphaea.* Anatomical adaptations in *Hydrilla*(stem) and *Nymphaea* (petiole).

4. Xerophytes: Morphological adaptations in *Asparagus, Casuarina, Acacia, Aloe vera, Euphorbia tirucalli.* Anatomical adaptations in phylloclade of *Casuarina, Nerium leaf*

5. Epiphytes: Morphological adaptations in *Acampe, Bulbophyllum, Drynaria*.Anatomical adaptations in epiphytic root of *Acampe/ Vanda.*

6. Halophytes: study of Vivipary in mangroves, Morphology and anatomy of Pneumatophores.

7. Study of a pond/forest ecosystem and recording the different biotic and abiotic components

8. Demonstration of different types of vegetation sampling methods – transects and quadrats. Ecological studies using Simpsons Index, Importance Value Index – Relative Abundance, Relative frequency, Relative basal area and biomass

9.Application of remote sensing to vegetation analysis using satellite imageries

10. Field visits to study different types of local vegetations/ecosystems and the report to be written in practical record book.

11. Determination of Biological oxygen demand (BOD)

12. Demonstration of Chemical oxygen demand (COD)

G507 DC 2.3P PLANT ANATOMY AND DEVELOPMENTAL BIOLOGY

TIME: 3HRS **MAX MARKS: 50**

1. Perform the procedure with the specimen **A** 6
   (Mounting -3, Labelled sketch-2, identification -1)

2 Identify Material **B** and **C**. Leave the preparation for inspection 9x2=18
(Preparation-3, Labelled sketch-2, Reasons -3, Identification -1)

3. Perform the procedure and identify the type of stomata from material **D** 6
   (Preparation-3, Labelled sketch-2, Identification -1)

4. Identify and comment on the slides **E,F,G,H** 5x4=20
   (Identification-1, Reasons – 2, Labelled sketch-2)

Note to the Examiners

Specimen **A** mounting of pollen grains/ embryo/ pollen germination

Specimen **B, C** – one from stem &one from root, Monocot or dicot

Specimen **D –** Leaf for one type of stomata among any 4 types

Specimen **E, F , G, H –** Permanent slides from Embryology one each from each category

G507 DC2.4P ECOLOGY AND CONSERVATION BIOLOGY

TIME: 3HRS **MAX MARKS: 50**

1. Prepare a temporary stained section of the given specimen **A** and leave it for inspection (Preparation -4, sketch & label-4, identification of the group with ecological features -4) 12x1=12

2. Perform the Experiment **B** from the sample 6
(Performance -3, Calculation &result -3)

3. Identify and comment on the components of the given ecosystem **C** 8
(Description of ecosystem-2, identification &comment on the components -6)

4.. Solve ecological Problem **D** 8
(Derivation- 6, Answer -2)

5. Identify and comment on the spotters/ slides **E, F, G, H** 4x4=16
(Identification-1, comment-3)

Note to the Examiners

Specimen **A** for sectioning from any ecological group

Specimen **B** – BOD/ salinity

Specimen **C –** Pond Ecosystem

Specimen **D –** Simpsons Index / Importance Value Index – Relative Abundance, Relative frequency, Relative density

Specimen **E, F ,G, H –** 2 Permanent slides & 2 spotters from ecological groups one each from each category

Semester V

G507 DC1.5: Plant Taxonomy & Resource Botany

Theory credits:	lecture hours/ week :	Practical Credits :	practical hrs / week
3	**3**	**2**	**4**

Course outcomes:

On Completion of the Course students will be able to

- Understand the concept of plant systematics and classification
- Describe the principles and rules involved in plant systematics and classification
- Identify the plants up to the level of a family
- understand the application of this field in floriculture, agriculture and medicine
- practice sustainable use of plant resources

UNIT 1: SYSTEMATICS & POLYPETALAE **14 hrs**

1.1 Introduction- Importance of systematics

Systems of classification - Artificial, Natural and Phylogenetic

Artificial system: Karl Von Linnaeus - Brief Account

Natural system: Detailed study of Benthem and Hooker's classification upto series with characters, merits and demerits

Phylogenetic system: Brief account of Engler and Prantl's system

Modern Trends in Taxonomy: A brief study of cytotaxonomy, chemotaxonomy and molecular taxonomy

An introduction to APG system of classification -emphasis on APG 4

1.2 Plant nomenclature: Introduction to ICN (International Code of Nomenclature), Binomial nomenclature with principles and guidelines

Herbaria: Introduction, herbarium techniques (plant collection, processing and preservation), Digital herbaria, Regional Herbaria, National Herbaria and International Herbaria

Botanical gardens: Significance with an example of National and International Botanical Gardens

1.3 Study of Selected Families (Bentham and Hooker's System of Classification): Diagnostic characters with morphological peculiarities (Wherever applicable) and economic importance of the following families

Dicotyledonae – Polypetalae - Annonaceae, Brassicaceae, Malvaceae, Rutaceae

1.4 Polypetalae -Anacardiaceae, Papilionaceae, Caesalpiniaceae, Mimosaceae, Cucurbitaceae

UNIT 2: GAMOPETALAE, APETALAE & MONOCOTYLEDONAE 14 hrs

Diagnostic characters with morphological peculiarities (wherever applicable) and economic importance of the following families

2.1 Gamopetalae: Rubiaceae, Asteraceae, Apocyanaceae, Asclepiadaceae ,Convolvulaceae, Solanaceae, Acanthaceae and Lamiaceae

2.2 Apetalae: Amaranthaceae, Euphorbiaceae

2.3 Monocotyledonae: Liliaceae, Orchidaceae,Arecaceae , Poaceae

UNIT 3: BOTANICAL RESOURCES 14 hrs

3.1 Resource Botany: Introduction & Importance

Distribution, Family, Scientific Name, parts used and uses of the following

Cereals and Millets: *Triticum aestivum* , *Oryza sativa*, *Zea mays* , *Eleusine coracana*, Storage of Cereals and millets.

Pulses: *Cicer arietinum* , *Pisum sativum*, *Phaseolus mungo*, *Dolichos biflorus*

Oil yielding plants: *Arachis hypogaea* , *Cocos nucifera*, *Helianthus annuus* , *Brassica nigra*, *Ricinus communis* , *Sesamum indicum* . Extraction of Coconut Oil.

Sugar Yielding Plants: *Saccharum officinarum*, *Beta vulgaris*, *Stevia rebaudiana*. Extraction of sugar from sugarcane.

3.2 Spices and Condiments: *Piper nigrum*, *Syzygium aromaticum*, *Zingiber officinale*, *Curcuma longa*, *Allium sativum*, *Cinnamomum verum*, *Ferula asafoetida*.

Alcohol and Beverages: *Vitis vinifera*, Preparation of Wine.

Coffea arabica, *Camellia sinensis*, *Theobroma cacao*, *Garcinia mangostina.* Extraction of Coffee, Cocoa.

Fiber Yielding Plants*: Gossypium hirsutum , Corchorus capsularis, Cannabis sativa, Musa textilis,* Extraction of fibre from Jute, Coir, Coconut

3.3 Rubber yielding plant: *Hevea brasiliensis.* Extraction of rubber.

Gums and Resins: *Achrus sapota*, *Anacardium occidentale*, *Ailanthus triphysa*

Narcotic/Stimulant Plants: *Cannabis sativa*, *Papaver somniferum*, *Nicotiana tobaccum*

Flavouring and Perfumery Products: *Rosa damascena*, *Vanilla planifolia*, *Santalum album*, *Eucalyptus globulus*

3.4 Medicinal Plants: Distribution, Family, Scientific Name, Parts used and

Therapeutic uses of *Anamirta cocculus, Garcinia indica, Terminalia chebula, Terminalia arjuna, Cyperus rotundus, Strychnos nux-vomica.*

Fruit yielding: *Mangifera indica, Musa paradisiaca, Syzigium cumini, Annona squamosa*

Flower yielding - *Dendrobium*, *Jasminum* sp. *Anthurium, Chrysanthemum*

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B.Sc. BOTANY: Semester V

G507 DC2.5P : Plant Taxonomy & Resource Botany

(Practicals of 4 hrs each, one practical per week)

1. Technical Description - *Hibiscus rosa-sinensis* and *Allamanda cathartica*
2. Study of Dicot Families Polypetalae: Malvaceae, Papilionaceae
3. Study of Caesalpiniae, Mimosae
4. Study of Anacardiaceae, Cucurbitaceae
5. Study of Gamopetalae**-** Rubiaceae, Asteraceae, Apocyanaceae
6. Study of Asclepiadaceae, Convolvulaceae, Solanaceae
7. Study of Acanthaceae, Lamiaceae
8. Study of Apetalae - Amaranthaceae, Euphorbiaceae
9. Study of Monocot Families **:** Orchidaceae, Arecaceae and Poaceae
10. **Botanical Resources:**

    Wine preparation from grapes and estimation of sugar content

    Scientific Name, Common Name, Part used and importance of

    Pulses: Bengal Gram, Pea, Green Gram, Horse Gram

    Cereals and Millets: Wheat, Maize, Rice, Ragi

    Sugar Yielding Plants: Beetroot and Sugarcane

    Oil Yielding Plants: Ground Nut**,** Mustard, Castor, Sesame and Coconut

    Spices and Condiments: Pepper, Clove, Ginger, Turmeric, Garlic, Cinnamon, and Asafoetida

    Beverages: Coffee, Tea and Cocoa

    Fiber Yielding Plants: Cotton, Jute and Banana

    Plantation Crops: Rubber, Arecanut and Cashew

    Medicinal Plants: Kokum, *Cyperus rotundus*
11. Field Visit and writing report
12. Herbaria Preparation - five specimens

B.Sc. BOTANY: Semester V

G507 DC1.6: Genetics and Cell Biology

Theory credits:	lecture hours/ week :	Practical Credits :	practical hrs / week
3	**3**	**2**	**4**

Course outcomes:

On Completion of the Course, students will be able to:

- understand the concept of chromosomal organization, biomolecules (protein and nucleic acid)
- Acquire knowledge of the genes inhabiting the cellular world of life that are engaged in metabolic processes and understand the concepts of cell division and cell cycles .
- gain knowledge on principles of genetics , understand the natural genetic variation in plants and to know how diverse factors contribute to the expression of genotypic and phenotypic variation.
- understand the effect of different types of mutation on genotypic and phenotypic expression , understand the concept of plant sex determination and gene mutation
- widen the knowledge on the role of polyploidy in plant breeding which could be employed in diverse fields of basic and applied research.

UNIT 1: CHROMOSOMES AND BIOMOLECULES: 14hrs

1.1 Chromosomes and Cell division: Introduction, Chromatin Organisation- Nucleosomes, Solenoids and metaphase fibre, Parts of the typical Metaphase Chromosome, Cell division, cell cycle, stages of mitosis and meiosis

1.2 Nucleic Acids: Introduction, chemical composition, structure of DNA- Watson and Crick model, brief note on alternative forms of DNA, organellar- structure and its functions, types of RNA involved in protein synthesis

DNA-replication: semi-conservative method of replication in prokaryotes and eukaryotes

1.3 Protein Synthesis: Process and mechanism of Transcription and Translation (process of initiation, elongation and termination)

Genetic code: Concept of Gene- Cistron, Muton and Recon. Genetic code characteristic features with examples

1.4 Gene Regulation: Gene regulation in prokaryotes, Lac operon concept, gene regulation in eukaryotes, a brief note on m- RNA processing, gene silencing, RNA editing

UNIT 2: GENETICS **14 hrs**

2.1 Mendelism: Mendel and his work, Monohybrid and law of Segregation, Dihybrid cross and Law of Independent assortment. Back Cross and Test cross

2.2 Deviations from Mendelism: Incomplete dominance with plant example, multiple allelism- self sterility alleles in plants with examples

Interaction of genes: Introduction, types, inheritance pattern of complementary, Supplementary, epistatic, duplicate genes with a plant example for each. 9:7 (Complementary - Flower Colour in Sweet Peas), 9:3:4 (Supplementary – Grain colour in Sorghum)

2.3 Interaction of genes: 12:3:1 (Dominant epistasis – Fruit Colour in *Cucurbita pepo*), 15:1 (Duplicate Dominant epistasis - Fruit shape in *Capsella bursa – pastoris*), 9:6:1 (polygenic -Aleurone colour in maize).

2.4 Linkage: Types, Complete and incomplete, linkage in plants (maiz*e*), significance of linkage, Linkage map

Crossing Over and recombination: Types, cytological basis of crossing over in plants, significance

UNIT 3: SEX DETERMINATION & MUTATIONS **14hrs**

3.1 Sex Determination: Note on chromosomal mechanisms of sex determination, XX-XY method in *Melandrium album*. Gene controlled mechanism in plants (Maize, Papaya, *Luffa* and *Asparagus*)

3.2 Chromosomal aberrations (structural variations): Types, Cytology and Significance of Deletions, Duplications, Inversions and Translocations in Plants

3.3. Point / gene mutation: Definition of Dominant & Recessive, Somatic & Germinal, Lethal mutations, A Note on - Spontaneous & Induced mutations, Base pair and frame shift mutations, Brief note on Mutagens- Physical and Chemical.

3.4 Genomic Mutations (Numerical Variations)

Aneuploidy: Trisomy and Nullisomy

Haploidy in plants: Occurrence, Cytology

Polyploidy: Origin of Auto and Allopolyploidy

Significance with examples of Aneuploidy, Haploidy, Polyploidy

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B.Sc. BOTANY: Semester V

G507 DC2.6P : Genetics & Cell Biology

(Practicals of 4 hours each, one practical per week)

1. Isolation of DNA from Coconut Endosperm / Tomato pulp/ Onion Bulb
2. Agarose gel Electrophoresis-Preparation of gel & loading of the sample
3. Separation of eye pigments in *Drosophil*a, and determination of Rf value by Circular paper chromatography method.
4. Measurement of length and Breadth of *Rhoeo* leaf cells by micrometry technique
5. Cell division – Study of stages of mitosis in growing Onion Root Tip by Squash method
6. Cell division – Study of stages of meiosis using members of Liliaceae or any other plant
7. Genetic Problems - Mendelian laws, Incomplete dominance, Interaction of genes - complementary, supplementary
8. Genetic Problems - Interaction of genes - epistatic and duplicate genes, Multiple alleles- self sterility alleles in plants
9. A detailed report on visit to Industries/Research Institutions

B.Sc. BOTANY: Semester V

G507 DSE1.1: Algal & Fungal Biotechnology

Theory credits:	lecture hours/ week :	Practical Credits :	practical hrs / week
3	**3**	**0**	**0**

Course outcomes:

On Completion of the Course students will be able to

- Learn and understand the Biotechnological Applications of Algae and Fungi.
- Understand the impact of Algae & Fungi in Industries.
- To understand the methods for production of industrially important compounds from algal & fungal sources.

UNIT 1: SCOPE AND CULTIVATION OF ALGAE 14 hrs

1.1 Introduction and objectives of Algal Biotechnology

Resource potential of algae with examples; Definition, Algae as a source of food and feed, pigments, Agar Agar, Alginates, Carrageenan, diatomite, mucilage, minerals and elements, medicine, fuel and bio-fertilizers.

1.2 Major algae used in industry: *Spirulina, Dunaliella, Chlorella, Gracilaria, Gelidium, Sargassum, Laminaria,* and *Ulva.*

1.3 Algal culture techniques: Strain selection**,** Algal growth kinetics, Culture media; indoor cultivation methods and scaling up. Measurement of algal growth. Algal culture collection centres in India and abroad and their importance; Centres pursuing algal research in India and their field of interest

1.4 Large-scale cultivation –Raceways, Photo bioreactors. Steps in cultivation, Harvesting of algal Biomass, Drying, problems associated with algal cultures

UNIT 2: IMPORTANCE OF ALGAL TECHNOLOGY 14 hrs

2.1 Industrial importance - Potential of microalgae for SCP, *Spirulina* as single cell protein, production and harvesting of algal biomass, factors affecting biomass production.

Microalgal pigments, Algal Biotechnology companies in India.

2.2 Agricultural importance - Cyanobacterial inoculants (BGA) biofertilizer: Isolation, preparation of starter culture, mass cultivation, field applications and crop

response.

2.3 Algae in waste management: Concept of Phycoremediation, Sewage treatment, treating industrial effluent, heavy metal removal, algae as indicators in assessing water quality and pollution.

2.4 Algal immobilization and its applications, Liquid seaweed fertilizer: Method of preparation and application. A brief note on biodiesel from algae Advantages over other sources of biodiesel.

UNIT 3: FUNGAL BIOTECHNOLOGY 14 hrs

3.1 Introduction, Concept and Scope, Fungal Enzymes and Metabolites –alcohol, steroids, antibiotics, organic acids, amino acids and nucleic acids.

3.2 Techniques of Fungal Biotechnology - Principles of fermenter design and operation with respect to Fungal process, Bioreactors and Fermenters - Components of a typical bioreactor, Types of bioreactors, fermenters used in laboratories. Techniques for strain improvement and strain development.

3.3 Industrial importance: Important fungal strains. Production of fungi-organic acids (Citric acid), enzymes (cellulase xylanase, amylase, protease), *Penicillin* and Alcohol. Applications of Fungi in medical and pharmaceutical products. Production of antibiotics,
drugs, vitamins and therapeutic peptides from fungi.

3.4 Agricultural importance: Fungi as food and fodder, biofertilizers and biopesticides, myconematicides, Mycorrhizae

Fungal nutraceuticals: Mycoproteins, edible fermentation products, alcoholic beverages

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B.Sc. BOTANY: Semester VI

G507 DC1.7: Plant Physiology & Biochemistry

Theory credits:	lecture hours/ week :	Practical Credits :	practical hrs / week
3	**3**	**2**	**4**

Course outcomes:

On Completion of this Course students will be able to

- learn the underlying principles and mechanism involved in various physiological processes like Ascent of sap, transpiration, photosynthesis, translocation and respiration in plants
- know the various plant growth substances and their physiological effects
- understand the role of mineral nutrients in plants
- understand the concepts like vernalization and photoperiodism, and their practical applications in agriculture
- understand the structure & properties of Biochemical compounds

UNIT 1: PLANT WATER RELATIONS 14hrs

1.1 Concept of Imbibition, Diffusion and Osmosis: Osmotic Pressure (O.P), significance of osmosis in plants, plasmolysis and its significance, diffusion pressure deficit (D.P.D), turgor pressure (T.P), plant cell as an osmotic system, relationship between O.P., T.P., D.P.D., Water potential and osmotic relations of plant cells,(relationship between ψ_m, ψs, ψp)

1.2 Absorption of Water: Types of Soil Water, Mechanism of water absorption: 1) active absorption of water (Osmotic and Non osmotic absorption) and Passive absorption of water, External factors affecting water absorption, significance.

Ascent of Sap

Path of ascent of sap, Mechanism of ascent of sap, Physical force theory - Transpiration pull (cohesion tension theory), Merits and Demerits.

1.3 Transpiration and Guttation: Transpiration, kinds of transpiration, Mechansim of transpiration - starch sugar inter conversion theory, proton exchange pump theory, significance of transpiration, advantages of transpiration transpiration as a

necessary evil, factors affecting thr rate of transpiration, plant antitranspirants, Structure of hydathode, differences between transpiration and guttation

1.4 Translocation of Organic Solutes: Direction of translocation, path of translocation of organic solute, Mechanism of translocation through phloem – Munch's (mass flow) hypothesis, phloem loading and unloading

Mineral Nutrition

Essential and non essential elements in plants, general functions of essential elements in plants, specific roles and deficiency symptoms of the following mineral elements in plants Major elements: Nitrogen, Phosphorus and Magnesium
Minor elements: Iron, Manganese and Zinc, Soilless Growth - Hydroponics & Aeroponics

UNIT 2: BIOENERGETICS **14hrs**

2.1 Photosynthesis: History, Ultrastructure of chloroplast, photosynthetic pigments, absorption spectrum and action spectrum, quantum requirement and quantum yield, red drop and Emmerson's enhancement effect, PS I & PS II.

2.2 Mechanism of Photosynthesis : Light reaction/ primary photochemical reaction - Cyclic and Non Cyclic, Chemiosmotic mechanism, Dark reaction/ Carbon fixation cycle / Calvin cycle, Factors affecting Photosynthesis, Blackman's law of limiting factors, Applications of Radioisotope C^{14}

2.3 C4 / dicarboxylic acid pathway/ Hatch-slack pathway, differences between C3 and C4 plants, Photorespiration and gylcolate metabolism (C2 cycle), Crassulacean Acid Metabloism (CAM cycle).

2.4 Respiration: Aerobic and Anaerobic Respiration, Ultrastructure of Mitochondrion, Mechanism of respiration - Glycolysis, Kreb's Cycle, Terminal oxidation (Oxidative phosphorylation)., Fermentation - Alcoholic and Acidic, significance. Respiratory quotient, Factors affecting respiration, Pasteur's effect.

UNIT 3: PLANT GROWTH HORMONES AND BIOCHEMISTRY 14hrs

3.1 Growth: Definition, regions of growth, growth curve, measurement of growth, direct method, horizontal microscope method, Arc auxanometer

Hormones: Natural and Synthetic types

Auxins, Gibberellins: Discovery, Chemical Nature, Physiological effects

3.2 Cytokinins, Ethylene, Abscissic Acid : Discovery, Chemical Nature, Physiological Effects

Photoperiodism: Short day Plants, Long day Plants, Day neutral Plants, Photoperiodic Induction, Phytochromes, Vernalisation & its Practical Applications

3.3 Carbohydrates: Importance, classification. Structure of Monosaccharides- Pentoses (ribose and deoxysibose), hexoses (glucose, fructose),Disaccharides(Sucrose), Polysaccharides (Starch, cellulose)

3.4 Lipids: Importance and classification; Structure and properties of fatty acids, Breif account of storage & membrane lipids.

Proteins: Importance of proteins and classification; Structure of amino acids

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B.Sc. BOTANY: Semester VI

G507 DC2.7P : Plant Physiology & Biochemistry

(Practicals of 4 hrs each, one practical per week)

1. Experiment to measure the osmotic pressure of cell sap by plasmolytic method using *Rhoeo /Tradescantia* leaves
2. Thistle funnel experiment to demonstrate endosmosis
   Experiment to demonstrate the suction due to transpiration
3. Experiment to show the relation between absorption and transpiration.
4. Ganong's potometer experiment to determine the rate of transpiration under different environmental conditions
   Garreau's experiment to demonstrate the unequal rate of transpiration
5. Extraction and separation of photosynthetic pigments by paper chromatographic method and estimation of chlorophylls.
   Ganong's colored light screen experiment to demonstrate the effect of different wavelength of lights on rate of photosynthesis
6. Ganong's respirometer experiment to determine the amount of oxygen absorbed and carbon dioxide liberated during aerobic respiration & determination of Rf value
7. Experiment to show evolution of O_2 under different environmental conditions
8. Qualitative analysis of carbohydrates, proteins, cellulose, oil & lignin in the given plant samples
9. Quantitative estimation of glucose/ proteins.
10. Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides.
11. A detailed report on visit to Industries/Research Institutions

B.Sc. BOTANY: Semester VI

G 507 DC1.8: Plant Biotechnology

Theory credits:	lecture hours/ week :	Practical Credits :	practical hrs / week
3	**3**	**2**	**4**

Course outcomes:

On Completion of this Course students will be able to

- learn the concepts and fundamental aspects pertaining to plant biotechnology,
- know the principle involved in plant tissue culture and to realize the eco-friendly potential application of biotechnological processes in pharmaceuticals , food industry, agriculture and its role in bioremediation.
- understand the concept of genetically modified plants and their relevance to economy
- enhance their analytical skills in research and know the lab safety measures.
- acquire knowledge with regard to commercializing the primary and secondary metabolites as natural medicinal drugs.

UNIT 1: PLANT TISSUE CULTURE 14hrs

1.1 Plant tissue culture: Introduction, scope in biotechnology, history, laboratory design, tools and techniques - instruments (Autoclave, laminar air flow, pH meter, plant growth chamber, lux meter), methods of sterilization, selection of plant material, aseptic conditions, media preparation- Physical factors and nutrient requirements, note on biohazards and biosafety. Concept of totipotency**,** cell differentiation, callus and organogenesis.

1.2 *In vitro* culture techniques: Stages of micropropagation, callus culture, meristem culture, anther culture, embryo culture, protoplast culture. Somaclonal variation, Method of cryopreservation and applications

1.3 Cell suspension cultures and applications: Batch culture and continuous culture significance of secondary metabolites.

UNIT 2 : TRANSGENIC PLANTS 14hrs

2.1. Gene transfer methods to plant cells: Introduction, Direct gene transfer –

microinjection, electroporation, microprojectile techniques , vector mediated gene transfer - Viral vectors, *Agrobacterium* based gene transfer technique

2.2. Genetic manipulation (GM) of plants : Gene Cloning, Transgenic crops for improved quality (GMOs- golden rice, BT brinjal, Bt –cotton, Flavr-savr tomato), Advantages and disadvantages of GMOs, safety, and public acceptance of cultivating transgenic plants.

2.3. Molecular Techniques: PCR, Gel electrophoresis – agarose, poly acrylamide, blotting techniques – nucleic acid and protein blotting, autoradiography

UNIT 3: TECHNIQUES AND APPLICATIONS OF PLANT BIOTECHNOLOGY

14hrs

3.1. Application of Transgenic plants: Development of transgenic plants for resistance to virus, bacteria, fungi, insect , herbicide stress and tolerant, delayed fruit ripening

3.2. Applications of Plant Biotechnology:

Industrial applications: Edible vaccines- Plantibodies. Synthetic seed production, Nutraceuticals Agricultural applications: Plant health and diseases, biofertilizers

3.3. Bioremediation (plant and microbial) - Microbes in mining. Waste management and utilization. Heavy metals, xenobiotics

REFERENCES

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G507 DC2.8P : Plant Biotechnology

(Practicals of 4 hrs each, one practical per week)

1. Laboratory design, Instrumentation: autoclave, laminar air flow cabinet, hot air oven, incubator, culture rack
2. Nutrient media used in plant tissue culture - MS medium
3. Different types of sterilization techniques
4. Preparation of explant for sterilization- root, stem, leaf
5. Callus culture
6. Embryo culture and preparation of Synthetic seeds by alginate encapsulation
7. Quantification of phenols / flavonoids
8. Estimation of DNA
9. Extraction of industrially important enzymes
10. Isolation of polysaccharide (starch) from plant source.
11. Isolation of pectin from fruit peel
12. A detailed report on visit to Industries /Research Institutions

B.Sc. BOTANY: Semester VI

G507 DSE1.2: Herbal Technology

Theory credits:	lecture hours/ week :	Practical Credits :	practical hrs / week
3	**3**	**0**	**0**

Course outcomes:

On Completion of this Course students will be able to

- Understand about the various technologies used in herbal preparations.
- Learn the fundamentals of various systems of herbal medicines, screening and its standardization.
- Understand raw material as source of herbal drugs from cultivation to herbal drug product
- Know the WHO and ICH guidelines for evaluation of herbal drugs
- Know the herbal cosmetics, natural sweeteners, nutraceuticals

UNIT1: INDIAN SYSTEMS OF MEDICINE & CULTIVATION 14hrs

1.1 Introduction : Herbal lore of Ayurveda, Unani, Siddha and Homeopathy systems of medicine. Ancient Indian classification of herbs based on their medicinal uses.

1.2 Cultivation: Good Agricultural Practices , environmental conditions for ideal cultivation of plants, Structure of A typical Medicinal Garden, Methods of cultivation of medicinal plants. NTFP & Its Importance, Production of QPM (Quality planting Material), good nursery practices and importance of QPM in Cultivation

1.3 Identification and Authentication of Herbs – Botanical identity- scientific name (genus, species, subspecies/variety, author, and family), the local and English name or common name, cultivar name of ten different plants of the locality.

1.4 Collection of Medicinal Plants – Good collection practices for plant parts like Rhizome,

Roots, Stem, Bark, leaves, fruits, flowers etc. Time of collection, method of Collection.

Rhizomes: *Alpinia calcarata* Rosc. Roots: *Hemidesmus indicus* (L.)R.Br. Stem: *Tinospora cordifolia* (Thunb.) Miers Bark: *Cinnamomum verum* J.Presl Leaves: *Justicia adhatoda* Linn. Fruits: *Garcinia indica* Choisy Flowers: *Syzygium aromaticum* (L.) Merr & L.M. Perry

1.5 Harvesting practices: Time of Harvesting - optimum time for harvesting,

importance of

harvesting on plant metabolites, Post Harvesting Factors - storage and transportation of herbs

UNIT 2: PHYTOCHEMICALS AND EXTRACTION 14hrs

2.1 Drug evaluation protocol: Crude drug evaluation of following aspects with suitable examples-morphological, anatomical, organoleptic aspects and active components \(phytochemicals) of root, stem, leaf, seed and flower drugs

2.2 Secondary Metabolites: Definition, source, phytochemical compositions and therapeutic properties of the following types of secondary metabolites

Alkaloids - *Rauwolfia serpentina, Vinca rosea*

Tannins - *Terminalia* sp., *Phyllanthus emblica*

Glycosides - *Cassia angustifolia*, *Digitalis purpurea*

Terpenoides - *Myristica fragrans, Eugenia caryophyllata*

2.3 Secondary Metabolites: Definition, source, phytochemical compositions and therapeutic

properties of the following types of secondary metabolites

Phenolics - *Coffea* sp., *Solanum* sp.

Flavanoides - *Citrus* sp., *Camellia sinensis*

Steroids - *Spinacia oleracea*, *Trigonella foenum- graecum*

Resins - *Ferula asafoetida*, *Commiphora wightii*

2.4 Extraction of Herbal Drugs: Infusion, Decoction, Digestion, Maceration, Percolation, Successive solvent extraction, Supercritical fluid extraction, Steam distillation, Methods of Extraction Factors Affecting the Choice of Extraction Process - nature of the crude drug, stability profile of the crude drug, cost, nature of the solvent, method used for concentration of the extract

UNIT 3: ISOLATION, ANALYSIS OF PHYTO-PHARMACEUTICALS & APPLICATIONS 14hrs

3.1 Isolation & Quantification Methods: Principle, Procedure and application of Soxhlet, Clevenger, Column Chromatography, LCMS, GC-MS.

Drug adulteration: adulterants and substitutes, methods of detection in *Saraca indica* and *Rauwolfia serpentina* -Taxonomy**,** microscopy and organoleptic

3.2 Herbal Cosmetics, natural sweeteners, nutraceuticals Sources and description of

raw materials of herbal origin used in, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products

3.3 Conservation: Conversation strategies of medicinal plants, Bioprospecting and Biopiracy. Patenting aspects of Traditional Knowledge and Natural Products Case study of Curcuma & Neem.

3.4 Herbal drugs industry: Present scope and future prospects for herbal drug industry in AYUSH sector. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.

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B.Sc. BOTANY: Semester V
Plant Taxonomy & Resource Botany

Number of Theory credits:	Number of lecture hours/ week :	Number of Practical Credits :	Number of Practical hrs / week :
4	**4**	**2**	**4**

Course outcomes:

On Completion of the Course students will be able to

- Understand the concept of plant systematics and classification
- Describe the principles and rules involved in plant systematics and classification
- Identify the plants up to the level of a family
- understand the application of this field in floriculture, agriculture and medicine
- practice sustainable use of plant resources

UNIT 1: SYSTEMATICS **15 hrs**

1.5 Introduction- Importance of systematics

Systems of classification - Artificial, Natural and Phylogenetic

Artificial system: Karl Von Linnaeus - Brief Account

Natural system: Detailed study of Benthem and Hooker's classification upto series with characters, merits and demerits

1.2 Phylogenetic system: Brief account of Engler and Prantl's system

Modern Trends in Taxonomy: A brief study of cytotaxonomy, chemotaxonomy and molecular taxonomy

An introduction to APG system of classification -emphasis on APG 4

1.3 Taxonomic Hierarchy: Concept of taxa (family, genus, species)

Plant nomenclature: Introduction to ICN (International Code of Nomenclature), Principles and rules (ICN); Latest code –brief account, Author citation

1.4 Herbaria: Introduction, herbarium techniques (plant collection, processing and preservation), Regional Herbaria, National Herbaria and International Herbaria, Digital herbaria

Botanical gardens: Significance with an example of National and International Botanical Gardens

UNIT 2 POLYPETALAE & GAMOPETALAE **15 hrs**

2.1 Study of Selected Families (Bentham and Hooker's System of Classification): Diagnostic characters with morphological peculiarities (Wherever applicable) and economic importance of the following families

Dicotyledonae – Polypetalae - Annonaceae, Brassicaceae, Malvaceae

2.2 Polypetalae - Rutaceae, Anacardiaceae, Papilionaceae, Caesalpiniaceae, Mimosaceae,

2.3 Polypetalae -Cucurbitaceae, Myrtaceae and Apiaceae

2.4 Gamopetalae: Rubiaceae, Asteraceae, Apocyanaceae, Asclepiadaceae

UNIT 3: GAMOPETALAE (Continued), APETALAE & MONOCOTYLEDONAE **15 hrs**

Diagnostic characters with morphological peculiarities (wherever applicable) and economic importance of the following families

3.1 Gamopetalae: Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae and Lamiaceae

3.2 Apetalae: Amaranthaceae, Euphorbiaceae and Moraceae

3.3 Monocotyledonae: Liliaceae, Zingiberaceae, Musaceae

3.4 Monocotyledonae: Arecaceae, Orchidaceae and Poaceae

UNIT 4 : BOTANICAL RESOURCES **15 hrs**

4.1 Resource Botany: Introduction & Importance

Distribution, Family, Scientific Name, parts used and uses of the following

Cereals and Millets: *Triticum aestivum* , *Oryza sativa*, *Zea mays* , *Eleusine coracana*, Storage of Cereals and millets.

Pulses: *Cicer arietinum* , *Pisum sativum*, *Phaseolus mungo*, *Dolichos biflorus*

Oil yielding plants: *Arachis hypogea* , *Cocos nucifera*, *Helianthus annuus* , *Brassica nigra*, *Ricinus communis* , *Sesamum indicum* . Extraction of Coconut Oil.

Sugar Yielding Plants: *Saccharum officinarum*, *Beta vulgaris*, *Stevia rebaudiana*. Extraction of sugar from sugarcane.

4.2 Spices and Condiments: *Piper nigrum*, *Syzygium aromaticum*, *Zingiber officinale*, *Curcuma longa*, *Allium sativum*, *Cinnamomum verum*, *Ferula asafoetida*.

Alcohol and Beverages: *Vitis vinifera*, Preparation of Wine.

Coffea arabica, *Camellia sinensis*, *Theobroma cacao*, *Garcinia mangostina.* Extraction of Coffee, Cocoa.

Fiber Yielding Plants*: Gossypium hirsutum , Corchorus capsularis, Cannabis sativa, Musa textilis,* Extraction of fibre from Jute, Coir, Coconut

Rubber yielding plant: *Hevea brasiliensis.* Extraction of rubber.

Gums and Resins: *Achrus sapota*, *Anacardium occidentale*, *Ailanthus triphysa*

Narcotic/Stimulant Plants: *Cannabis sativa*, *Papaver somniferum*, *Nicotiana tobaccum*

Flavouring and Perfumery Products: *Rosa damascena*, *Vanilla planifolia*, *Santalum album*, *Eucalyptus globulus*

4.3 Medicinal Plants: Distribution, Family, Scientific Name, Parts used and Therapeutic uses of *Anamirta cocculus, Garcinia indica, Terminalia chebula, Terminalia arjuna,Cyperus rotundus, Strychnos nux-vomica.*

Fruit yielding: *Mangifera indica, Musa paradisiaca, Syzigium cumini, Annona squamosal*

Flower yielding - *Dendrobium*, *Jasminum* sp. *Anthurium, Chrysanthemum*

4.4 Bioprospecting: Introduction, a brief note on Indigenous Knowledge Systems, Indigenous people and protected areas, Biopiracy, IPRs and Ownership of Traditional Knowledge, Community Biodiversity Registers.

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B.Sc. BOTANY: Semester V

Plant Taxonomy & Resource Botany

(Practicals of 4 hrs each, one practical per week)

13. Study of inflorescence types, Study of flower and its parts ,Study of types of fruits.
14. Technical Description , Floral diagram and floral formula - *Hibiscus rosa-sinensis* and *Allamanda cathartica*
15. Study of Dicot Families Polypetalae: Malvaceae, Papilionaceae
16. Study of Caesalpiniae, Mimosae
17. Study of Anacardiaceae, Cucurbitaceae/ Myrtaceae
18. Study of Gamopetalae**-** Rubiaceae, Asteraceae, Apocyanaceae
19. Study of Asclepiadaceae, Convolvulaceae, Solanaceae
20. Study of Acanthaceae, Lamiaceae
21. Study of Apetalae - Amaranthaceae, Euphorbiaceae
22. Study of Monocot Families **:** Orchidaceae, Arecaceae and Poaceae
23. **Botanical Resources:**

    Wine preparation from grapes and estimation of sugar content

    Scientific Name, Common Name, Part used and importance of

    Pulses: Bengal Gram, Pea, Green Gram, Horse Gram

    Cereals and Millets: Wheat, Maize, Rice, Ragi

    Sugar Yielding Plants: Beetroot and Sugarcane

    Oil Yielding Plants: Ground Nut**,** Mustard, Castor, Sesame and Coconut

    Spices and Condiments: Pepper, Clove, Ginger, Turmeric, Garlic, Cinnamon, and Asafoetida

    Beverages: Coffee, Tea and Cocoa

    Fiber Yielding Plants: Cotton, Jute and Banana

    Plantation Crops: Rubber, Arecanut and Cashew
24. Field Visit and writing report -Local or outside area/ Botanical garden
25. Herbaria Preparation - (Preparation of 5 properly identified herbarium specimens; mounting of properly dried and pressed specimen of any common plants from the locality with herbarium label).

B.Sc. BOTANY: Semester V
Genetics and Plant Breeding

Number of Theory credits	Number of lecture hours/ week	Number of Practical Credits	Number of practical hrs / week
4	**4**	**2**	**4**

Course outcomes:

On Completion of the Course, students will be able to:

- Gain knowledge on principles of genetics, understand the natural genetic variation in plants and to know how diverse factors contribute to the expression of genotypic and phenotypic variation.
- understand the effect of different types of mutation on genotypic and phenotypic expression, understand the concept of plant sex determination and gene mutation
- Understanding the basics of plant breeding, widen the knowledge on the role of polyploidy in plant breeding which could be employed in diverse fields of basic and applied research.

UNIT 1: GENETICS **15 hrs**

1.1 **Mendelism:** Mendel and his work, Monohybrid and law of Segregation, Dihybrid cross and Law of Independent assortment. Back Cross and Test cross

1.2 **Deviations from Mendelism:** Incomplete dominance with plant example, multiple allelism- self sterility alleles in plants with examples

Interaction of genes: Introduction, types, inheritance pattern of complementary, supplementary, epistatic, duplicate genes with a plant example for each. 9:7 (Complementary - Flower Colour in Sweet Peas), 9:3:4 (Supplementary – Grain colour in Sorghum)

1.3 **Interaction of genes:** 12:3:1 (Dominant epistasis – Fruit Colour in *Cucurbita pepo*), 15:1 (Duplicate Dominant epistasis - Fruit shape in *Capsella bursa – pastoris*), 9:6:1 (polygenic -Aleurone colour in maize).

1.4 **Linkage:** Types, Complete and incomplete, linkage in plants (maiz*e*), significance of linkage, Linkage map

Crossing Over and recombination: Types, cytological basis of crossing over in plants, Significance

UNIT 2: SEX DETERMINATION & MUTATIONS **15 hrs**

2.1 Sex Determination: Note on chromosomal mechanisms of sex determination, XX-XY method in *Melandrium album*. Gene controlled mechanism in plants (Maize, Papaya, Luffa and *Asparagus*)

2.2 Chromosomal aberrations (structural variations): Types, Cytology and Significance of Deletions, Duplications, Inversions and Translocations in Plants

2.3. Point / gene mutation: Definition of Dominant & Recessive, Somatic & Germinal, Lethal mutations, A Note on - Spontaneous & Induced mutations, Base pair and frame shift mutations, Brief note on Mutagens- Physical and Chemical.

2.4 Genomic Mutations (Numerical Variations)

Aneuploidy: Trisomy and Nullisomy

Haploidy in plants: Occurrence, Cytology

Polyploidy: Origin of Auto and Allopolyploidy

Significance with examples of Aneuploidy, Haploidy, Polyploidy

UNIT 3: **15 hrs**

3.1. Plant Breeding: Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.

3.2. Methods of crop improvement: Introduction - Centers of origin and domestication of crop plants, plant genetic resources, Acclimatization

3.3. Selection methods: For self-pollination, cross pollination and vegetative propagation in plants

3.4. Hybridization: For self, cross and vegetative propagation in plants – Procedure, advantages and limitations.

UNIT 4: **15 hrs**

4.1. Quantitative inheritance: Concept, mechanism, examples of inheritance of Kernel color in wheat, Monogenic vs polygenic Inheritance.

4.2. Inbreeding depression and heterosis: History, genetic basis of inbreeding depression and heterosis; Applications.

4.3 Crop improvement and breeding: Role of mutations, Mutation breeding, Polyploidy

4.4. Distant hybridization and role of biotechnology in crop improvement.

Significance with examples of Aneuploidy, Haploidy, Polyploidy

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B.Sc. BOTANY: Semester V
Genetics & Plant Breeding

(Practicals of 4 hours each, one practical per week)

10. Separation of eye pigments in *Drosophil*a, and determination of Rf value by Circular paper chromatography method.
11. Cell division – Study of stages of mitosis in growing Onion Root Tip by Squash method
12. Genetic Problems - Mendelian laws, Incomplete dominance, Interaction of genes - complementary, supplementary
13. Genetic Problems - Interaction of genes - epistatic and duplicate genes, Multiple alleles- self sterility alleles in plants
14. Reproductive biology of self and cross pollinated plants; Vegetative reproduction
15. Hybridization: Emasculation, bagging, pollination and production of hybrids
16. Pollen viability test
17. Origin, distribution and centres of diversity of crop plants: Wheat, Sorghum, Rice, Chilly Sugarcane, Cotton, Potato, coffee, Sunflower and groundnut
18. Demonstration of Grafting, budding and layering.
19. Photographs/Permanent Slides – Reciprocal Translocation, Trisomy in Datura , Linkage map.
20. A detailed report on visit to Industries/Research Institutions

B.Sc. BOTANY: Semester V
Algal & Fungal Biotechnology

Number of Theory credits: **3**	Number of lecture hours/ week : **3**	Number of Practical Credits : **0**	Number of practical hrs / week : **0**

Course outcomes:

On Completion of the Course students will be able to

- Learn and understand the Biotechnological Applications of Algae and Fungi.
- Understand the impact of Algae & Fungi in Industries.
- To understand the methods for production of industrially important compounds from algal & fungal sources.

UNIT 1: SCOPE AND CULTIVATION OF ALGAE 14 hrs

1.1 Introduction and objectives of Algal Biotechnology

Resource potential of algae with examples; Definition, Algae as a source of food and feed, pigments, Agar Agar, Alginates, Carrageenan, diatomite, mucilage, minerals and elements, medicine, fuel and bio-fertilizers.

1.2 Major algae used in industry: *Spirulina, Dunaliella, Chlorella, Gracilaria, Gelidium, Sargassum, Laminaria,* and *Ulva.*

1.3 Algal culture techniques: Strain selection**,** Algal growth kinetics, Culture media; indoor cultivation methods and scaling up. Measurement of algal growth. Algal culture collection centres in India and abroad and their importance; Centres pursuing algal research in India and their field of interest

1.4 Large-scale cultivation –Raceways, Photo bioreactors. Steps in cultivation, Harvesting of algal Biomass, Drying, problems associated with algal cultures

UNIT 2: IMPORTANCE OF ALGAL TECHNOLOGY 14 hrs

2.1 Industrial importance - Potential of microalgae for SCP, *Spirulina* as single cell protein, production and harvesting of algal biomass, factors affecting biomass production. Microalgal pigments, Algal Biotechnology companies in India.

2.2 Agricultural importance - Cyanobacterial inoculants (BGA) biofertilizer: Isolation, preparation of starter culture, mass cultivation, field applications and crop response.

2.3 Algae in waste management: Concept of Phycoremediation, Sewage treatment, treating industrial effluent, heavy metal removal, algae as indicators in assessing water quality and pollution.

2.4 Algal immobilization and its applications, Liquid seaweed fertilizer: Method of preparation and application. A brief note on biodiesel from algae Advantages over other sources of biodiesel.

UNIT 3: FUNGAL BIOTECHNOLOGY **14 hrs**

3.1 Introduction, Concept and Scope, Fungal Enzymes and Metabolites –alcohol, steroids, antibiotics, organic acids, amino acids and nucleic acids.

3.2 Techniques of Fungal Biotechnology - Principles of fermenter design and operation with respect to Fungal process, Bioreactors and Fermenters - Components of a typical bioreactor, Types of bioreactors, fermenters used in laboratories. Techniques for strain improvement and strain development.

3.3 Industrial importance: Important fungal strains. Production of fungi-organic acids (Citric acid), enzymes (cellulase xylanase, amylase, protease), *Penicillin* and Alcohol. Applications of Fungi in medical and pharmaceutical products. Production of antibiotics, drugs, vitamins and therapeutic peptides from fungi.

3.4 Agricultural importance: Fungi as food and fodder, biofertilizers and biopesticides, myconematicides, Mycorrhizae

Fungal nutraceuticals: Mycoproteins, edible fermentation products, alcoholic beverages

REFERENCES:

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B.Sc. BOTANY: Semester VI
Plant Physiology & Biochemistry

Number of Theory credits**: 4**	Number of lecture hours/ week **: 4**	Number of Practical Credits **: 2**	Number of practical hrs / week **: 4**

Course outcomes:

On Completion of this Course students will be able to

- learn the underlying principles and mechanism involved in various physiological processes like Ascent of sap, transpiration, photosynthesis, translocation and respiration in plants
- know the various plant growth substances and their physiological effects
- understand the role of mineral nutrients in plants
- understand the concepts like vernalization and photoperiodism, and their practical applications in agriculture
- understand the structure & properties of Biochemical compounds

UNIT 1: PLANT WATER RELATIONS **15 hrs**

1.5 Concept of Imbibition, Diffusion and Osmosis: Osmotic Pressure (O.P), significance of osmosis in plants, plasmolysis and its significance, diffusion pressure deficit (D.P.D), turgor pressure (T.P), plant cell as an osmotic system, relationship between O.P., T.P., D.P.D., Water potential and osmotic relations of plant cells,(relationship between ψ_m, ψs, ψp)

1.6 Absorption of Water: Types of Soil Water, Mechanism of water absorption: 1) active absorption of water (Osmotic and Non osmotic absorption) and Passive absorption of water, External factors affecting water absorption, significance.

Ascent of Sap

Path of ascent of sap, Mechanism of ascent of sap, Physical force theory - Transpiration pull (cohesion tension theory), Merits and Demerits.

1.7 Transpiration and Guttation: Transpiration, kinds of transpiration, Mechansim of transpiration - starch sugar inter conversion theory, proton exchange pump theory, significance of transpiration, advantages of transpiration transpiration as a necessary evil, factors affecting thr rate of transpiration, plant antitranspirants, Structure of hydathode, differences between transpiration and guttation

1.8 Translocation of Organic Solutes: Direction of translocation, path of translocation of organic solute, Mechanism of translocation through phloem – Munch's (mass flow) hypothesis, phloem loading and unloading

Mineral Nutrition

Essential and non essential elements in plants, general functions of essential

elements in plants, specific roles and deficiency symptoms of the following mineral elements in plants Major elements: Nitrogen, Phosphorus and Magnesium

Minor elements: Iron, Manganese and Zinc, Soilless Growth - Hydroponics & Aeroponics

UNIT 2: BIOENERGETICS **15 hrs**

2.5 Photosynthesis: History, Ultrastructure of chloroplast, photosynthetic pigments, absorption spectrum and action spectrum, quantum requirement and quantum yield, red drop and Emmerson's enhancement effect, PS I & PS II.

2.6 Mechanism of Photosynthesis : Light reaction/ primary photochemical reaction - Cyclic and Non Cyclic, Chemiosmotic mechanism, Dark reaction/ Carbon fixation cycle / Calvin cycle, Factors affecting Photosynthesis, Blackman's law of limiting factors, Applications of Radioisotope C^{14}

2.7 C4 / dicarboxylic acid pathway/ Hatch-slack pathway, differences between C3 and C4 plants, Photorespiration and gylcolate metabolism (C2 cycle), Crassulacean Acid Metabloism (CAM cycle).

2.8 Respiration: Aerobic and Anaerobic Respiration, Ultrastructure of Mitochondrion, Mechanism of respiration - Glycolysis, Kreb's Cycle, Terminal oxidation (Oxidative phosphorylation)., Fermentation - Alcoholic and Acidic, significance. Respiratory quotient, Factors affecting respiration, Pasteur's effect.

UNIT 3: PLANT GROWTH AND HORMONES **15 hrs**

3.1 Growth: Definition, regions of growth, growth curve, measurement of growth, direct method, horizontal microscope method, Arc auxanometer, Pfefer's auxanometer

Hormones: Natural and Synthetic types

Auxins: Discovery, Chemical Nature, Natural Auxins, Synthetic Auxins, Physiological effects of Auxins

3.2 Gibberellins: Discovery, Chemical Nature, Physiological Effects of Gibberellins

Kinetin and Cytokinins: Discovery, Chemical Nature, Zeatin, Physiological effects of Kinetin/Cytokinin

Ethylene: Discovery, Physiological Effects of Ethylene

A brief note on Plant signalling- Pathway of Ethylene formation, brief note on antisense RNA technology

3.3 Abscissic Acid: Discovery, Chemical Nautre, Physiological effects of Abscissic Acid

Photoperiodism: Short day Plants, Long day Plants, Day neutral Plants, Photoperiodic

Induction, Phytochromes,Vernalisation & its Practical Applications

3.4 Germination and dormancy of seeds and buds: Physiological and Biochemical changes accompanying seed germination. Dormancy of seeds, factors causing dormancy of seeds, artificial methods of breaking seed dormancy, Quiscent seeds, longevity of seeds, orthodox and recalcitrant seeds

Plant movements: Broad classification of plant movements, Tropic, Nastic, and Tactic Movements in detail.

Tropic movements -- Geotropic, phototropic, thigmotropic ,hydrotropic, chemotropic, thermotropic, and aerotropic movements.

Nastic movements –Nyctinastic, seismonastic, and thigmonastic movements.

Tactic movements – Phototactic, chemotactic, and thermotactic movements.

UNIT 4: PLANT BIOCHEMISTRY 15 hrs

4.1 Carbohydrates: Importance, classification. Structure of Monosaccharides- Pentoses (ribose and deoxysibose), hexoses (glucose, fructose),Disaccharides(Sucrose), Polysaccharides (Starch, cellulose)

4.2 Lipids: Importance and classification; Structure and properties of fatty acids, Breif account of storage & membrane lipids.

4.3 Proteins: Importance of proteins and classification; structure - primary, secondary, tertiary and quaternary ,Structure of amino acids

4.4 Enzymes- classification, kinetics and mechanism of action.

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B.Sc. BOTANY: Semester VI

Plant Physiology & Biochemistry
(Practicals of 4 hrs each, one practical per week)

12. Experiment to measure the osmotic pressure of cell sap by plasmolytic method using *Rhoeo /Tradescantia* leaves
13. Thistle funnel experiment to demonstrate endosmosis
    Experiment to demonstrate the suction due to transpiration
14. Experiment to show the relation between absorption and transpiration.
15. Ganong's potometer experiment to determine the rate of transpiration under different environmental conditions
    Garreau's experiment to demonstrate the unequal rate of transpiration
16. Extraction and separation of photosynthetic pigments by paper chromatographic method and measure their Rf values.
    Ganong's colored light screen experiment to demonstrate the effect of different wavelength of lights on rate of photosynthesis
17. Ganong's respirometer experiment to determine the amount of oxygen absorbed and carbon dioxide liberated during aerobic respiration & determination of Rf value
18. Experiment to show evolution of O_2 under different environmental conditions
19. Qualitative analysis of carbohydrates, proteins, cellulose, oil & lignin in the given plant samples
20. Quantitative estimation of glucose/ proteins.
21. Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides.
22. A detailed report on visit to Industries/Research Institutions

B.Sc. BOTANY: Semester VI
Plant Biotechnology

Number of Theory credits: **4**	Number of lecture hours/ week : **4**	Number of Practical Credits : **2**	Number of practical hrs / week : **4**

Course outcomes:

On Completion of this Course students will be able to

- learn the concepts and fundamental aspects pertaining to plant biotechnology,
- know the principle involved in plant tissue culture and to realize the eco-friendly potential application of biotechnological processes in pharmaceuticals, food industry, agriculture and its role in bioremediation.
- understand the concept of genetically modified plants and their relevance to economy
- enhance their analytical skills in research and know the lab safety measures.
- acquire knowledge with regard to commercializing the primary and secondary metabolites as natural medicinal drugs.

UNIT 1: PLANT TISSUE CULTURE 15hrs

1.1 Plant tissue culture: Introduction, scope in biotechnology, history

1.2 Laboratory design, tools and techniques: instruments (Autoclave, laminar air flow, pH meter, plant growth chamber, lux meter), methods of sterilization, selection of plant material, aseptic conditions,

1.3 Media preparation: Physical factors, Composition of media; Nutrient and hormone requirements (role of vitamins and hormones);, note on biohazards and biosafety. Concept of totipotency**,** cell differentiation, callus and organogenesis, Embryogenesis (somatic and zygotic)

UNIT 2: *IN VITRO* CULTURE TECHNIQUES IN PLANT TISSUE CULTURE 15hrs

2.1 In vitro culture techniques: Stages of micropropagation, callus culture, meristem culture, anther culture, embryo culture, Protoplast isolation, culture and fusion, haploids, triploids and cybrids

2.2 Somaclonal variation, Method of cryopreservation and applications

2.3 Cell suspension cultures and applications: Batch culture and continuous culture, significance of secondary metabolites.

UNIT 3: TRANSGENIC PLANTS 15 hrs

3.1. Gene transfer methods to plant cells: Introduction, Direct gene transfer – microinjection, electroporation, microprojectile techniques, vector mediated gene transfer - Viral vectors, *Agrobacterium* based gene transfer technique

3.2. Genetic manipulation (GM) of plants: Gene Cloning, Transgenic crops for improved quality (GMOs- golden rice, BT brinjal, Bt –cotton, Flavr-savr tomato), Advantages and disadvantages of GMOs, safety, and public acceptance of cultivating transgenic plants.

3.3. Molecular Techniques: PCR, Gel electrophoresis – agarose, poly acrylamide, blotting techniques – nucleic acid and protein blotting, autoradiography

UNIT 4: TECHNIQUES AND APPLICATIONS OF PLANT BIOTECHNOLOGY 15 hrs

4.1. Application of Transgenic plants: Development of transgenic plants for resistance to virus, bacteria, fungi, insect, herbicide stress and tolerant, delayed fruit ripening

4.2. Applications of Plant Biotechnology:

Industrial applications: Edible vaccines- Plantibodies. Synthetic seed production, Nutraceuticals Agricultural applications: Plant health and diseases, biofertilizers

4.3. Bioremediation (plant and microbial) - Microbes in mining. Waste management and utilization. Heavy metals, xenobiotics

REFERENCES

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B.Sc. BOTANY: Semester VI

G507 DC2.8P: Plant Biotechnology

(Practicals of 4 hrs each, one practical per week)

13. Laboratory design, Instrumentation: autoclave, laminar air flow cabinet, hot air oven, incubator, culture rack
14. Nutrient media used in plant tissue culture - MS medium
15. Different types of sterilization techniques
16. Preparation of explant for sterilization- root, stem, leaf
17. Callus culture, Anther culture, Meristem culture
18. Embryo culture and preparation of Synthetic seeds by alginate encapsulation
19. Quantification of phenols / flavonoids
20. Isolation of DNA
21. Agarose gel Electrophoresis- Preparation of gel & loading of the sample
22. Extraction of industrially important enzymes
23. Isolation of polysaccharide (starch) from plant source.
24. Isolation of pectin from fruit peel
25. A detailed report on visit to Industries / Research Institutions

B.Sc. BOTANY: Semester VI
G507 VOC1.2: Herbal Technology

Number of Theory credits:	Number of lecture hours/ week	Number of Practical Credits :	Number of practical hrs / week :
3	**3**	**0**	**0**

Course outcomes:

On Completion of this Course students will be able to

- Understand about the various technologies used in herbal preparations.
- Learn the fundamentals of various systems of herbal medicines, screening and its standardization.
- Understand raw material as source of herbal drugs from cultivation to herbal drug product
- Know the WHO and ICH guidelines for evaluation of herbal drugs
- Know the herbal cosmetics, natural sweeteners, nutraceuticals

UNIT 1: INDIAN SYSTEMS OF MEDICINE & CULTIVATION 14hrs

1.5 Introduction: Herbal lore of Ayurveda, Unani, Siddha and Homeopathy systems of medicine. Ancient Indian classification of herbs based on their medicinal uses.

1.6 Cultivation: Good Agricultural Practices, environmental conditions for ideal cultivation of plants, Structure of A typical Medicinal Garden, Methods of cultivation of medicinal plants. NTFP & Its Importance, Production of QPM (Quality planting Material), good nursery practices and importance of QPM in Cultivation

1.7 Identification and Authentication of Herbs – Botanical identity- scientific name (genus, species, subspecies/variety, author, and family), the local and English name or common name, cultivar name of ten different plants of the locality.

1.8 Collection of Medicinal Plants – Good collection practices for plant parts like Rhizome, Roots, Stem, Bark, leaves, fruits, flowers etc. Time of collection, method of Collection. Rhizomes: *Alpinia calcarata* Rosc. Roots: *Hemidesmus indicus* (L.)R.Br. Stem: *Tinospora cordifolia* (Thunb.) Miers Bark: *Cinnamomum verum* J.Presl Leaves: *Justicia adhatoda* Linn. Fruits: *Garcinia indica* Choisy Flowers: *Syzygium aromaticum* (L.) Merr & L.M. Perry

1.5 Harvesting practices: Time of Harvesting - optimum time for harvesting, importance of harvesting on plant metabolites, Post Harvesting Factors - storage and transportation of herbs

UNIT 2: PHYTOCHEMICALS AND EXTRACTION 14hrs

2.1 Drug evaluation protocol: Crude drug evaluation of following aspects with suitable examples-morphological, anatomical, organoleptic aspects and active components (phytochemicals) of root, stem, leaf, seed and flower drugs

2.2 Secondary Metabolites: Definition, source, phytochemical compositions and therapeutic properties of the following types of secondary metabolites

Alkaloids - *Rauwolfia serpentina, Vinca rosea*

Tannins - *Terminalia* sp., *Phyllanthus emblica*

Glycosides - *Cassia angustifolia*, *Digitalis purpurea*

Terpenoides - *Myristica fragrans, Eugenia caryophyllata*

2.3 Secondary Metabolites: Definition, source, phytochemical compositions and the rapeutic properties of the following types of secondary metabolites

Phenolics - *Coffea* sp., *Solanum* sp.

Flavanoides - *Citrus* sp., *Camellia sinensis*

Steroids - *Spinacia oleracea*, *Trigonella foenum- graecum*

Resins - *Ferula asafoetida*, *Commiphora wightii*

2.9 Extraction of Herbal Drugs: Infusion, Decoction, Digestion, Maceration, Percolation, Successive solvent extraction, Supercritical fluid extraction, Steam distillation, Methods of Extraction Factors Affecting the Choice of Extraction Process - nature of the crude drug, stability profile of the crude drug, cost, nature of the solvent, method used for concentration of the extract

UNIT 3: ISOLATION, ANALYSIS OF PHYTO-PHARMACEUTICALS & APPLICATIONS 14 hrs

3.1 Isolation & Quantification Methods: Principle, Procedure and application of Soxhlet, Clevenger, Column Chromatography, LCMS, GC-MS.

Drug adulteration: adulterants and substitutes, methods of detection in *Saraca indica* and *Rauwolfia serpentina* -Taxonomy**,** microscopy and organoleptic

3.2 Herbal Cosmetics, natural sweeteners, nutraceuticals

Sources and description of raw materials of herbal origin used in, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products

3.3 Conservation:

Conversation strategies of medicinal plants, Bioprospecting and Biopiracy.

Patenting aspects of Traditional Knowledge and Natural Products Case study of Curcuma & Neem.

3.4 Herbal drugs industry:

Present scope and future prospects for herbal drug industry in AYUSH sector. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.

REFERENCES

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