

Four Years Graduate Programme in BOTANY (NEP – 2020)

DISCIPLINE CORE PAPERS (DSC)

Sl. No.	Semester Details	Subject	Paper No
1	Semester I	Microbial Diversity and Technology	A-1
2	Semester II	Diversity and Conservation of Non Flowering Plants	A-2
3	Semester III	Plant Anatomy and Development Biology	A-3
4	Semester IV	Ecology and Conservation Biology	A-4
5	Semester V	Plant taxonomy and Resource Botany	A-5
		Genetics and Cell Biology	A-6
6	Semester VI	Plant Physiology and Biochemistry	A-7
		Plant Biotechnology	A-8
7	Semester VII	Molecular Biology	A-9
		Seed Biology and Seed Technology	A-10
		Plant Health Technology	A-11
8	Semester VIII	Medicinal Plants and Phytochemistry	A-12
		Bioinformatics and Computational Biology	A-13
		Research Methodology	A-14

CORE SPECIFIC ELECTIVE PAPERS (DSE)

Sl No.	Semester Details	Subject: Botany	Credits	Paper No
1	Semester V	DSE 1: Algal and Fungal Biotechnology	03	E-1
2	Semester VI	DSE 2: Herbal Technology	03	E-2
3	Semester VII	DSE 3: Plant Propagation and Tissue Culture	03	E-3
4	Semester VIII	DSE 4: Landscaping, Gardening and Green House Technology	03	E-4

B.Sc. BOTANY: Semester - 1

Title of the Course: Microbial Diversity and Technology

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
4	56	2	56
Content of Theory Course 1			56 Hrs
Unit –1			15
Chapter No. 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. Distribution of microbes in soil, air, food and water. Significance of microbial diversity in nature.			5
Chapter No. 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. Contributions of any two Indian microbiologists.			5
Chapter No. 3 Microscopy -Working principle and applications of light, dark field, phase contrast and electron microscopes (SEM and TEM). Microbiological stains (acidic, basic and special) and Principles of staining. Simple, Gram's and differential staining.			5

Unit – 2	15
Chapter No. 4. Culture media for Microbes- Natural and synthetic media, Routine media -basal media, enriched media, selective media, indicator media, transport media, and storage media.	5
Chapter No. 5. Sterilization methods -Methods of disinfection: antiseptic, tyndallisation and Pasteurization. Sterilization -Physical methods: dry heat, moist heat, UV light, ionization radiation, filtration. Chemical methods - phenolic compounds, anionic and cationic detergents.	5
Chapter No. 6. Microbial Growth -Microbial growth and measurement. Nutritional types of Microbes- autotrophs and heterotrophs, phototrophs and chemotrophs; lithotrophs and organotrophs.	5
Unit – 3	11
Chapter No. 7 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.	5
Chapter No. 8. 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.	4
Chapter No. 9. Viroids- general characteristics and structure of Potato Spindle	2

Tuber Viroid (PSTVd); Prions - general characters and Prion diseases. Economic importance of viruses.	
Unit – 4	15
Chapter No. 10. Bacteria- General characteristics and classification.(Bergey's classification) Archaeobacteria and Eubacteria. Ultrastructure of Bacteria; Bacterial growth and nutrition. Reproduction in bacteria- asexual and sexual methods. Study of <i>Rhizobium</i> and its applications. A brief account of Actinomycetes. Mycoplasmas and Phytoplasmas- General characteristics and diseases.	5
Chapter No. 11. 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 <i>Phytophthora</i> , <i>Rhizopus</i> , <i>Neurospora</i> , <i>Puccinia</i> , <i>Penicillium</i> and <i>Trichoderma</i> . Morphology and reproduction of <i>Phytophthora</i> and <i>Puccinia</i> . VAM Fungi and their significance. Microbial plant diseases -Late Blight of Potato, Black stem rust of wheat; Downy Mildew of Bajra, Grain smut of Sorghum, Sandal Spike, Citrus Canker, Root Knot Disease of Mulberry. Economic importance of Fungi.	7
Chapter No. 12. Lichens – Structure and reproduction.	3

References

1. Ananthnarayan R and Panikar JCK. 1986. Text book of Microbiology. Orient Longman Ltd. New Delhi.
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, New Delhi.
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.
 7. Sharma PD. 1999. Microbiology and Plant Pathology. Rastogi publications. Meerut, India.
 8. Vasanthkumari R. 2007. A textbook of Microbiology, BI Publications Pvt. Ltd., New Delhi.
 9. Alexepoulos CJ and Mims CW. 1989. Introductory Mycology, Wiley Eastern Ltd., New Delhi.
 10. Allas RM. 1988. Microbiology: Fundamentals and Applications, Macmillan publishing co. New York.
 11. Brook TD, Smith DW and Madigan MT. 1984. Biology of Microorganisms, 4thed. 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.
 14. Ketchum PA. 1988. Microbiology, concepts and applications. John Wiley and Sons. New York.
 15. Michel J, Pelczar Jr. EC and Krieg CR. 2005. Microbiology, Mc.Graw-Hill, New Delhi.
 16. Powar CB and Dagainawala. 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.

Content of Practical Course 1: 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, Haemocytometer, 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*/*Mucor*, *Saccharomyces*, *Neurospora*/*Sordaria*, *Puccinia*, *Agaricus*, *Lycoperdon*, *Aspergillus*/*Penicillium*, *Trichoderma*.(Depending on local availability)

Practical 10: Study of late blight of Potato, Downy mildew of Bajra, Citrus canker, Tobacco mosaic disease, Sandal spike disease.

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.

Scheme of Formative Assessment : Semester - 1

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
I TEST	10
II TEST	10
ASSIGNMENT	10
SEMINAR	10
Total	40

B.Sc. BOTANY: Open Elective Course (OE-1)

I Semester

Title of the Course: Plants and Human Welfare

Course Outcome:

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

1. To make the students familiar with economic importance of diverse plants that offer resources to human life.
2. To make the students known about the plants used as-food, medicinal value and also plant source of different economic value .
3. To generate interest amongst the students on plants importance in day today life, conservation, ecosystem and sustainability.
- 4.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	30	0	00
Content of Theory Course 1			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.			2
Unit II			
Cereals: Wheat and Rice (origin, evolution, morphology, post-harvest processing & uses).Green revolution. Brief account of millets and their nutritional importance.			3

Unit III	
Legumes: General account (including chief pulses grown in Karnataka- red gram, green gram, chick pea, soybean). Importance to man and ecosystem.	2
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 mustered (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, rose 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.

Scheme of Formative Assessment : (OE-1)

Semester - 1

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
I TEST	10
II TEST	10
ASSIGNMENT	10
SEMINAR	10
Total	40

B.Sc. BOTANY: Semester – 2

Title of the Course: Diversity of Non- Flowering Plants

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
4	56	2	56
Content of Theory Course 2			56Hrs
Unit –1			15
Chapter No. 1 Algae –Introduction and historical development in algology. Distribution of Algae. General characteristics, classification of algae by Fritsch. Diversity- habitat, thallus organization, pigments, reserve food, flagella types, life-cycle and alternation of generation in Algae.			5
Chapter No. 2 Morphology and reproduction and life-cycles of Nostoc, Scytonema, <i>Oedogonium</i> , <i>Chara</i> , <i>Sargassum</i> and <i>Polysiphonia</i> . Diatoms and their importance.			5
Chapter No. 3 Algal cultivation- a general account. Cultivation of microalgae- <i>Spirulina</i> and <i>Dunaliella</i> ; Algal products- Food and Nutraceuticals, Feed stocks, food colorants; fertilizers, aquaculture feed; therapeutics and cosmetics; medicines; dietary fibres from algae. Algal blooms and toxins.			5
Unit – 2			15

Chapter No. 4. Bryophytes – General characteristics and classification (Rothmaler) of Bryophytes.	3
Chapter No. 5 Distribution, morphology, anatomy, reproduction and life-cycles of <i>Riccia</i> , <i>Anthoceros</i> , and <i>Funaria</i> . Ecological and economic importance of Bryophytes.	7
Chapter No. 6. . Pteridophytes- General characteristics and classification (Smith); Distribution, morphology, anatomy, reproduction and life-cycle in <i>Selaginella</i> , <i>Equisetum</i> , <i>Pteris</i> and <i>Marselia</i> .	5
Unit – 3	15
Chapter No. 7 A brief account of heterospory and seed habit. Stelar evolution in Pterodophytes. Affinities and evolutionary significance of Pteridophytes. Ecological and economic importance.	5
Chapter No. 8. Gymnosperms- General characteristics. Distribution and classification of Gymnosperms (Sporne). Study of the habitat, habit, anatomy, reproduction and life-cycle in <i>Cycas</i> , <i>Pinus</i> and <i>Gnetum</i> .	5
Chapter No. 9. Affinities and evolutionary significance of Gymnosperms. Economic importance of Gymnosperms - food, timber, industrial uses and medicines.	5
Unit – 4	11

Chapter No. 10. Origin and evolution of Plants: Origin and evolution of plants through Geological Time scale.	2
Chapter No. 11. Paleobotany- Paleobotanical records, plant fossils, Types of plant fossils - impressions, compressions, incrustation, actual remains petrification. Radiocarbon dating. A general account of fossil Bryophytes.	5
Chapter No. 12. Fossil taxa- <i>Rhynia</i> , <i>Lepidodendron</i> , <i>Cycadeoidea</i> . Contributions of Birbal Sahni. Birbal Sahni Institute of Paleosciences.	4

References:

- 1) Chopra, G.L. 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.
- 3) Sharma, O.P. 1990. Text Book of Pteridophyta. McMillan India Ltd. New Delhi.
- 4) Sharma, O.P. 1992. Text Book of Thallophytes. McGraw Hill Publishing Co. New Delhi.
- 5) Sharma, O.P., 2017, Algae Singh-Pande-Jain 2004-05. A Text Book of Botany. Rastogi Publication, Meerut.
- 6) Sambamurty, A.V.S.S.. A Text Book of Algae. I.K. International Private Ltd., New Delhi.
- 7) Agashe, S.N. 1995. Paleobotany. Plants of the past, their evolution, paleoenvironment and Allied plants. Hutchinson & Co., Ltd., London.
- 8) Anderson R.A. 2005, Algal cultural Techniques, Elsevier, London.
- 9) Publication, Application in exploration of fossil fuels. Oxford & IBH., New Delhi.
- 10) Eams, A.J., (1974) Morphology of vascular plants - Lower groups. Tata Mc Grew-Hill Publishing Co. New Delhi, Freeman & Co., New York.
- 11) Fritze, R.E. 1977. Structure and reproduction of Algae. Cambridge University Press.

- 12) Goffinet B and Shaw A.J. 2009, Bryophyte Biology, 2nd ed. Cambridge University Press, Cambridge. Gymnosperms.
- 13) Srivastava, H N, 2003. Algae Pradeep Publication, Jalandhar, India.
- 14) Kakkar, R.K. and B.R. Kakkar (1995) The Gymnosperms (Fossils and Living) Central Publishing House, Allahabad.
- 15) Kumar H. D., 1999, Introductory Phycology, Affiliated East-West Press, Delhi.
- 16) Lee, R.E., 2008, Phycology, Cambridge University Press, Cambridge. 4th edition. McGraw Hill Publishing Co., New Delhi.
- 17) Parihar, N.S. 1970. An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book, Allahabad.
- 18) Parihar, N.S. (1976) An Introduction to Pteridophytes, Central Book Depot, Allahabad.
- 19) Parihar, N.S. 1977. The Morphology of Pteridophytes. Central Book Depot, Allahabad. Press, Cambridge.
- 20) Rashid, A. 1998. An Introduction to Pteridophyta. II ed., Vikas Publishing House, New Delhi.
- 21) Smith, G.M. 1971. Cryptogamic Botany. Vol. II. Bryophytes & Pteridophytes. Tata McGraw Hill Publishing, New Delhi.
- 22) Smith, G.M. 1971. Cryptogamic Botny. Vol. I Algae & Fungi. Tata McGraw Hill Publishing. New Delhi.
- 23) Sporne, K.R. 1965. The Morphology of Gymnosperms. Hutchinson & Co., Ltd., London.
- 24) Stewart, W.M. 1983. Paleobotany and the Evolution of Plants, Cambridge University Cambridge.
- 25) Sundarajan, S. 1997. College Botany Vol. I. S Chand & Co. Ltd., New Delhi.
- 26) Vanderpoorten, A. and Goffinet, B. 2009, Introduction to Bryophytes, Cambridge University Press, Cambridge.
- 27) Vashista, B.R. 1978. Bryophytes. S Chand & Co. Ltd., New Delhi.

Content of Practical Course 2: List of Experiments to be conducted

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

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

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* and *Equisetum*.

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.

Scheme of Formative Assessment : Semester - 2

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
I TEST	10
II TEST	10
ASSIGNMENT	10
SEMINAR	10
Total	40

B.Sc. BOTANY: Open Elective Course (OE-2)

II Semester

Title of the Course: Plant Propagation, Nursery management and Gardening

Paper Outcome:

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

1. To gain knowledge of gardening, cultivation, multiplication, raising of seedlings of garden plants.
2. To get knowledge of new and modern techniques of plant propagation.
3. To develop interest in nature and plant life.

5.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	30	0	00
Content of Theory Course 1			36 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, ferns, 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 Formative Assessment : (OE-2)

Semester - 2

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
I TEST	10
II TEST	10
ASSIGNMENT	10
SEMINAR	10
Total	40