NATIONAL EDUCATION POLICY-2020

(NEP-2020)

Report on
Proposed Model Syllabus for Four Years Graduate Programmes in Universities of Karnataka State under NEP-2020 in

BOTANY

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Submitted to

Davangere University

Davangere-577 007

Registrar
Davangere University
Shivagangotri, Davangere.

Semester I and II

Course Title: **B.Sc. BOTANY**	
Total Contact Hours: 62	Course Credits:06
Formative Assessment Marks: 40	Duration of ESA/Exam: 3hrs
Model Syllabus Authors: Dr. G.R.NAIK AND TEAM	Summative Assessment Marks: 60

Course Pre-requisite(s): Mention only course titles from the curriculum that are needed to be taken by the students before registering for this course.

DISCIPLINE CORE PAPERS (DSC)

Sl. No.	Semester Details	Subject	Paper No
1	Semester I	Microbial Diversity	**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**

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CORESPECIFIC 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

Open Electives for Semester I
OE 1.1: **Plants and human welfare** I OE 1.2: **Botany for the Beginners / Climate change** I OE 1.3: **Mushroom Cultivation**
Open Electives for Semester II
OE 2.1: **Plant propagation, nursery management and gardening.** OE 2.2: **Bio-fuels** OE 2.3: **Bio-fertilizers**

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BOTANY COURSE OUTCOMES (COs):

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

(Write 3-7 course outcomes. Course outcomes are statements of observable student actions that serve as evidence of knowledge, skills and values acquired in this course)

Semester I (A-1): Microbial Diversity

1. Understand the fascinating diversity, evolution, and significance of microorganisms.
2. Comprehend the systematic position, structure, physiology and life cycles of microbes and their impact on humans and environment.
3. Gain laboratory skills such as microscopy, microbial cultures, staining, identification, preservation of microbes for their applications in research and industry.

Semester II (A-2): Diversity of Non- Flowering Plants

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

Semester III (A-3): Plant Anatomy and Developmental Biology

1. Observation of variations that exist in internal structure of various parts of a plant and as well as among different plant groups in support for the evolutionary concept.
2. Skill development for the proper description of internal structure using botanical terms, their identification and further classification.
3. Understanding the basic concepts in plant morphogenesis, embryology and organ development.

Semester IV (A-4): Ecology & Conservation Biology

1. Understanding the fundamental concepts in ecology, environmental science and phytogeography.
2. Concept development in conservation, global ecological crisis, Sustainable development and pros and cons of human intervention.
3. Enable the student to appreciate bio diversity and the importance of various conservation strategies, laws and regulatory authorities and global issues related to climate change and sustainable development.

Semester V (A-5): Plant Taxonomy &Resource Botany

1. Ability to identify, classify and describe the plants in scientific terms. Identification of plants using dichotomous keys.

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2. Recognition, processing and utilization of economically important plants.
3. Skill development in processing of biomass and plant products as source of food, healthcare, energy and natural products.

Semester V (A-6): Cell Biology & Genetics

1. Identify the basic principles and current trends in classical genetics and Cell biology.
2. Recognize the historical process of the evolution of molecular genetics from classical genetics.
3. Develop theoretical background on molecular genetics to provide a strong support for the student for future research and employability.

Semester VI (A-7): Plant Physiology & Biochemistry

1. Preliminary understanding of the basic functions and intermediary metabolism in a plant body.
2. Awareness on the interdisciplinary nature of botany, chemistry and physics by studying the principles of plant life, growth and reproduction.
3. Recognizing the wonderful mechanism of transport and the Interrelationships existing between metabolic pathways thereby gaining and idea about the importance of plants in the dynamicity of nature.

Semester VI (A-8): Plant Biotechnology

1. Learning of knowledge & skill in plant tissue culture, plant molecular biology and transgenic.
2. Application of plant biotechnology in plant genomics, phylogenetic studies and metabolic engineering.
3. Understanding of new molecular techniques in cell and metabolic manipulations.

Semester VII (A-9): Molecular Biology

1. Understanding the mechanism and concepts of life process at molecular level through central dogma concept.
2. Skill acquiring in the basic molecular biology techniques & characterization of micro-molecules.
3. Acquiring the emerging technology skills in plant genetic engineering & proteomics.

Semester VII (A-10): Seed Biology & Seed Technology

1. Understanding the seed structure and related functions, seed health and productivity.
2. Technology for assessing the seed pathology, purity, and preservation.
3. Learning the field and laboratory protocols ofseed production, certification and quality.

Semester VII (A-11): Plant Health Technology

1. Understanding & learning common diseases & control measures of plant diseases.

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2. Acquiring skills in plant disease diagnosis, control & management through IPM.
3. Learning of new skills in health clinic through biological methods.

Semester VIII (A-13): Medicinal Plants & Phytochemistry

1. Knowledge of Indian system of medicine with regard to medicinal plants.
2. Acquiring skills in identification, cultivation and preservation of medicinal plants.
3. Isolation, identification, characteristics of active principles in medicinal plants & drug formulations.

Semester VIII (A-14): Bioinformatics & Computational Biology

1. Learning of basic principles of application, ICT Technology in biological studies & research.
2. Acquiring skill to utilize the computational apps, active data basis and tools in analysis in genetics & proteomics.
3. Learning skills and software used for biological research & process understanding.

Semester VIII (A-15): Research Methodology

1. Understanding the working of science for further application in free, independent, individual needs and in designing scientific experimentation.
2. Acquire knowledge on the principles, components and applications of various scientific equipment in biology.
3. Foundation knowledge in the basic concepts, components and functions of informatics and the importance of statistical principles in biological research.

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Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

SEMENAR	Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12
1	A-1	X	X	X			X			X			X
2	A-2	X	X	X			X		X	X			X
3	A-3		X	X	X	X		X		X			X
4	A-4			X		X	X	X	X	X	X	X	X
5	A-5, A-6	X	X	X	X	X		X	X	X	X	X	X
6	A-7, A-8					X		X		X		X	X
7	A-9, A-10, A-11					X	X	X		X	X	X	X
8	A-12A-13, A-14,					X	X	X	X	X	X	X	X

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

B.Sc. BOTANY: Semester - 1

Title of the Course: Microbial Diversity

Number of theory credits	Number of lecture hours/ semester	Number of practical credits	Number of practical hours /semester
4	60	2	56

Content of Theory Course 1	60 Hrs
UNIT-1	**15**
Chapter 1: Microbial diversity-Introduction to microbial diversity; Methods of estimation; 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 ofmicrobial diversity in nature.	5
Chapter 2: History and developments of microbiology-Microbiologists and their contributions (Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Dmitri Iwanowski, Sergius Winogradsky and M W Beijerinck and Paul Ehrlich).	5
Chapter 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 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 5: Sterilization methods -Principle of disinfection, antiseptic, tyndallisation and Pasteurization, **Sterilization**-Sterilization by dry heat, moist heat, UV light, ionization radiation, filtration. Chemical methods of sterilization-phenolic compounds, anionic and cationic detergents.	5
Chapter 6: Microbial Growth-Microbial growth and measurement. Nutritional types of Microbes- autotrophs, heterotrophs, phototrophs, chemotrophs, lithotrophs and organotrophs.	5
UNIT-3	**15**
Chapter 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 8: Viruses- General structure and classification of Viruses; ICTV system of classification. Structure and multiplication of TMV, SARS-COV-2, Rabies and Bacteriophage (T2). Vaccines and types.	5
Chapter 9: Viroids- general characteristics and structure of Potato Spindle Tuber Viroid (PSTVd); Prions - general characters and Prion diseases. Economic importance of viruses.	5
UNIT-4	**15**
Chapter 10: 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 and Cyanobacteria. Mycoplasmas and Phytoplasmas- General characteristics and diseases. Economic	5

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importance of Bacteria.	
Chapter 11: Fungi-General characteristics and classification. Thallus organization and nutrition in fungi. Reproduction in fungi (asexual and sexual). Heterothallism and parasexuality. Type study of *Neurospora, Trichoderma, Phytophthora, Rhizopus, Penicillium* and *Puccinia*. Economic importance of Fungi. **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.	7
Chapter 12: Lichens – Structure and reproduction. **VAM Fungi** and their significance.	2

Text Books

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.

References

1. Alexepoulos CJ and Mims CW. 1989. Introductory Mycology, Wiley Eastern Ltd., New Delhi.
2. Allas RM. 1988. Microbiology: Fundamentals and Applications, Macmillan publishing co. New York.
3. Brook TD, Smith DW and Madigan MT. 1984. Biology of Microorganisms, 4thed. Eaglewood Cliffts. N.J.Prentice- Hall. New Delhi.
4. Burnell JH and Trinci APJ. 1979. Fungal walls and hyphal growth, Cambridge University Press. Cambridge.
5. Jayaraman J. 1985. Laboratory Manual of Biochemistry, Wiley Eastern Limited. New Delhi.
6. Ketchum PA. 1988. Microbiology, concepts and applications. John Wiley and Sons. New York.
7. Michel J, Pelczar Jr.EC and Krieg CR. 2005. Microbiology, Mc.Graw-Hill, New Delhi.
8. Powar CB and Daginawala. 1991. General Microbiology, Vol – I and Vol – II Himalaya publishing house, Bombay.
9. Reddy S and Ram. 2007. Microbial Physiology. Scientific Publishers, Jodhpur, 385pp.
10. Sullia SB and Shantharam S. 1998. General Microbiology. Oxford and IBH publishing Co.Pvt.Ltd. New Delhi.
11. Schlegel HG. 1986. General Microbiology. Cambridge. University Press. London, 587pp.
12. Roger S, Ingrahan Y, Wheelis JL, Mark L and Page PR. 1990. Microbial World5th

edition. Prentice-Hall India, Pvt. Ltd. New Delhi.
13. Sullia SB. and Shantharam S. 2005. General Microbiology, Oxford and IBH, New Delhi.

Pedagogy:
Lectures, Practical, 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
Seminar	10
Assignment	05
Attendance	05
Total	40

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, Haemocytomer, Micrometer etc.).
Practical 2	:	Enumeration of soil/food /seed microorganisms by serial dilution technique.
Practical 3	:	Preparation of culture media (NA/PDA) sterilization, inoculation, incubation of *E coli / B. subtilis/* Fungi and study of cultural characteristics.
Practical 4	:	Determination of cell count by using Haemocytometer and determination of microbial cell dimension by using Micrometer.
Practical 5	:	Simple staining of bacteria (Crystal violet /Nigrosine blue) / Gram's staining of bacteria.
Practical 6	:	Isolation and study of morphology of *Rhizobium* from root nodules of legumes
Practical 7	:	Preparation of spawn and cultivation of paddy straw (Oyster) mushroom.
Practical 8	:	Study of vegetative structures and reproductive structures - *Rhizopus/Mucor, Aspergillus/Penicillium, Phytophthora/Pythium, Albugo, Saccharomyces, Neurospora/Sordaria, Trichoderma, Lycoperdon, Puccinia, Agaricus,* (Depending on local availability).
Practical 9	:	Study of late blight of Potato, Downy mildew of Bajra, Citrus canker, Tobaccomosaic disease, Sandal spike disease.
Practical 10	:	Study of well-known microbiologists and their contributions through charts andphotographs.
Practical 11	:	Preparation of agar slants, inoculation, incubation, pure culturing and preservation of microbes by oil overlaying.
Practical 12	:	Visit to water purification units/ composting/ microbiology labs/dairy and farms to understand role of microbes in day today life.

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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	60	2	56

Content of Theory Course 1	60 Hrs
UNIT-1	**15**
Chapter 1: Algae –Introduction and historical development in algology. General characteristics and classification of algae, **Diversity**- habitat, thallus organization, pigments, reserve food, flagella types, life-cycle and alternation of generation in Algae. Distribution of Algae.	5
Chapter 2: Morphology, reproduction and life-cycles of *Nostoc*, *Oedogonium, Chara, Sargassum* and *Batrachospermum*. Diatoms and their importance. Blue-green algae and their importance. Algal blooms and toxins.	5
Chapter 3: Algal cultivation- cultivation of microalgae-*Spirulina* and *Dunaliella;* Algal cultivation methods in India. **Algal products**- Food and Nutraceuticals, Feed stocks, food colorants; fertilizers, aquaculture feed; therapeutics and cosmetics; medicines; dietary fibres from algae and uses.	5
UNIT-2	**15**
Chapter 4: Bryophytes – General characteristics and classification of Bryophytes, Diversity-habitat, thallus structure, Gametophytes and sporophytes.	5
Chapter 5: Distribution, morphology, anatomy, reproduction and life-cycles of *Riccia, Marchantia, Anthoceros* and *Funaria.* Ecological and economic importance of Bryophytes.Fossil Bryophytes.	5
Chapter 6: Pteridophytes- General characteristics and classification; Structure of sporophytes and life-cycles. Distribution, morphology, anatomy, reproduction and life-cycles in *Selaginella*, *Lycopodium*, *Equisetum*, *Pteris* and *Salvinia*.	5
UNIT-3	**15**
Chapter 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 8: Gymnosperms- General characteristics. Distribution and classification of Gymnosperms. Study of the habitat, distribution, habit, anatomy, reproduction and life-cycles in *Cycas*, *Pinus* and *Gnetum*.	5
Chapter 9: Affinities and evolutionary significance of Gymnosperms. Economic importance of Gymnosperms - food, timber, industrial uses and medicines.	5
UNIT-4	**15**
Chapter 10: Origin and evolution of plants: Origin and evolution of plants through Geological Time scale.	5
Chapter 11: Paleobotany- Paleobotanical records, plant fossils, Preservation of plant fossils - impressions, compressions, petrification's, moulds and casts, pith casts. Radiocarbon dating.	5
Chapter 12: Fossil taxa- *Rhynia, Lepidodendron, Lepidocarpon,Lyginopteris* and *Cycadeoidea*. Exploration of fossil fuels. Birbal Sahni Institute of Paleosciences.	5

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Text Books

1. Chopra GL. 1998. A text book of Algae. Rastogi & Co., Meerut, Co., New Delhi, Depot. Allahabad.
2. Johri L and Tyagi. 2012, A Text Book of, Vedam e Books, New Delhi.
3. Sharma OP.1990. Text Book of Pteridophyta. McMillan India Ltd. New Delhi.
4. Sharma OP.1992. Text Book of Thallophytes. McGraw Hill Publishing Co. NewDelhi.
5. Sharma O.P.2017. Algae Singh-Pande-Jain 2004-05. A Text Book of Botany. Rastogi Publication, Meerut.

References

1. Sambamurty AVSS. 2005. A Text Book of Algae. I.K. International Private Ltd., New Delhi.
2. Agashe SN.1995. Paleobotany. Plants of the past, their evolution. Paleoenvironment and Allied plants. Hutchinson & Co., Ltd., London.
3. Anderson RA. 2005, Algal cultural techniques, Elsevier, London publication, Application in exploration of fossil fuels. Oxford & IBH., New Delhi.
4. Eams AJ.1974. Morphology of vascular plants - Lower groups. Tata Mc Grew-Hill Publishing Co. New Delhi, Freeman & Co., New York.
5. Fritze RE. 1977. Structure and reproduction of Algae. Cambridge UniversityPress.
6. Goffinet B and Shaw AJ. 2009. Bryophyte Biology, 2nd ed. Cambridge University Press, Cambridge.Gymnosperms.
7. Srivastava HN. 2003. Algae Pradeep Publication, Jalandhar, India.
8. Kakkar RK and Kakkar BR.1995. The Gymnosperms (Fossils and Living) Central Publishing House, Allahabad.
9. Kumar HD. 1999. Introductory Phycology, Affiliated East-West Press, Delhi.
10. Lee RE. 2008. Phycology, Cambridge University Press, Cambridge. 4th edition. McGraw Hill Publishing Co., New Delhi.
11. Parihar NS. 1970. An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book, Allhabad.
12. Parihar NS. 1976. An Introduction to Pteridophytes, Central Book Depot,Allhabad.
13. Parihar NS. 1977. The Morphology of Pteridophytes. Central Book Depot., Allahabad. Press, Cambridge.
14. Rashid A.1998.An Introduction to Pteridophyta.II ed., Vikas Publishing House, New Delhi.
15. Smith GM. 1971. Cryptogamic Botany. Vol. II. Bryophytes & Pteridophytes. Tata McGraw Hill Publishing, New Delhi.
16. Smith GM. 1971. Cryptogamic Botany. Vol. I Algae & Fungi. Tata McGraw Hill Publishing. New Delhi.
17. Sporne KR. 1965. The Morphology of Gymnosperms. Hutchinson & Co., Ltd.,London.
18. Stewart WM.1983.Paleobotany and the Evolution of Plants, Cambridge University Cambridge.
19. Sundarajan S.1997. College Botany Vol. I. S Chand & Co. Ltd., New Delhi.
20. Vanderpoorten A and Goffinet B. 2009, Introduction to Bryophytes, Cambridge Unversity Press, Cambridge.
21. Vashista BR. 1978. Bryophytes. S Chand & Co. Ltd., New Delhi.

Pedagogy: Lectures, Practical, Field and laboratory visits, participatory learning, seminars, assignments, MOOCs and specimen preparation and submission.

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
I Test	10
II Test	10
Seminar	10
Assignment	05
Attendance	05
Total	40

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

Practical 1	:	Study of morphology, classification, reproduction and life cycle of *Nostoc/ Oscillatoria.*
Practical 2	:	Study of morphology, classification, reproduction and life-cycle of *Oedogonium, Chara, Sargassum, Batrachospermum/ Polysiphonia.*
Practical 3	:	Study of morphology, classification, reproduction and life-cycle of *Riccia* and *Anthoceros.*
Practical 4	:	Study of morphology, classification, anatomy, reproduction and life-cycle of *Selaginella* and *Equisetum.*
Practical 5	:	Study of morphology, classification, anatomy, reproduction and life-cycle of *Pteris* and *Azolla.*
Practical 6	:	Study of morphology, classification, anatomy and reproduction in *Cycas*.
Practical 7	:	Study of morphology, classification & anatomy, reproduction in *Pinus*.
Practical 8	:	Study of morphology, classification & anatomy, reproduction in *Gnetum*.
Practical 9	:	Study of important blue green algae causing water blooms in the lakes.
Practical 10	:	Study of different methods of cultivation of ferns in a nursery.
Practical 11	:	Preparation of natural media and cultivation of *Azolla* in artificial ponds.
Practical 12	:	Media preparation and cultivation of *Spirulina*.
Practical 13	:	Study 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.

(Note: Botanical study tour to a floristic rich area for 1-2 days and submission of study report is compulsory).

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B.Sc. BOTANY: Open Elective Course (OE-1.1)
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.

Number of Theory Credits	Number of Lecture hours/ Semester	Number of Practical Credits	Number of Practical Hours/ Semester
3	30	0	00

Contents of Theory Course 1	30 Hrs
UNIT-I	10
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. **Cereals**: Wheat and Rice (origin, evolution, morphology, post-harvest processing & uses).Green revolution. Brief account of millets and their nutritional importance. **Legumes:** General account (including chief pulses grown in Karnataka- red gram, green gram, chick pea, soybean). Importance to man and ecosystem.	
UNIT-II	10
Cash crops: Morphology, new varieties and processing of sugarcane, products and by-products of sugarcane industry. Natural Rubber –cultivation, tapping and processing. **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. **Fruits:** Mango, grapes and Citrus (Origin, morphology, cultivation, processing and uses) **Beverages:** Tea, Coffee (morphology, processing & uses)	
UNIT-III	10
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. **Essential Oils:** General account. Extraction methods of sandal wood oil, rosa oil and eucalyptus oil. Economic importance as medicine, perfumes and insect repellents. **Drug-yielding plants:** Therapeutic and habit-forming drugs with special	

reference to Cinchona, Digitalis, Aloe vera and Cannabis. **Fibers:** Classification based on the origin of fibers; Cotton and jute (origin morphology, processing and uses).	

Text Books and References

1. Kochhar SL. 2012. Economic Botany in Tropics. New Delhi, India: MacMillan & Co.
2. Wickens GE. 2001. Economic Botany: Principles & Practices. The Netherlands: Kluwer Academic Publishers.
3. Chrispeels MJ and Sadava DE. 1994. Plants, Genes and Agriculture. Jones& Bartlett - Publishers.

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
Total	30

B.Sc. BOTANY: Open Elective Course (OE-1.2)
I Semester

Title of the Course: Botany for the Beginners

Course Outcome:

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

1. To Make the students familiar with importance of botany, plants as natural resources.
2. To make the students known about the plants used as-food, medicinal value and economic value for sustainable development.
3. To generate interest amongst the students to know the importance of plants in day today life, ecosystem restoration.

Number of Theory Credits	Number of Lecture hours/ Semester	Number of Practical Credits	Number of Practical Hours/ Semester
3	30	0	00

Contents of Theory Course 1	30 Hrs
UNIT-I : Living World	10
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. **Concept of Living and Non Living**: Viruses, Bacteria, Fungi, Plants and Animals; Five kingdom Classification- Classification of plants- Eichler's system – general characters of groups- An introduction to the Life cycle of plants. Cell Structure-Prokaryote and eukaryote	
UNIT II: Morphology of Angiosperms, Origin and Evolution of Life	10
Typical angiosperm plant: Functions of each organ viz. Root, Stem, leaves, inflorescence, flowers, fruit and seed. Flower: Basic structure - essential and non-essential whorls. Definition, Ancient Concepts and Modern Concepts. Origin of Life – Geological Time scale – Variation in Hydrosphere, Lithosphere, Atmosphere and Biosphere from Pre Cambrian to Coenozoic era. Darwin's Natural Selection theory and Modern evidences at molecular and organismic level in support of Darwin's theory	
UNIT-III: Interaction between plants and animals	10
General concept on Interaction between plants, microbes and animals. Ecological Significance of Plants – Solar energy fixing Producers, Nitrogen fixation, biofertilisers, biopesticides, Symbiotic relationships-Mutualism, Commensalism, Protoco-operation, Parasitism. Plants and Animals for pollination and seed/fruit dispersal-	

Pollination- Entomophily, Chiropterophily, Myrmecophily Seed Dispersal: Zoochory, Specific case studies on examples for co evolution- Dodo and Calvaria, Butterflies and plants; Wasps and Ficus, mimicking for pollinators. Medicinal uses of plants – traditional knowledge and scientific knowledge – a brief account	

Text Books and References

1. Agarwal SK. 2009. Foundation Course in Biology, Ane Books Pvt. Ltd., New Delhi.
2. Datta AC. 2000. Class Book of Botany
3. Rao M. 2009. Microbes and Non flowering plants-impacts and applications, Ane Books, Pvt Ltd, New Delhi.
4. Pandey BP.2001. College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd, New Delhi.
5. Singh P. 2007. An introduction to Biodiversity- Ane Books India, New Delhi
6. Raven PH, Johnson GB, Losos JB, Singer SR. 2005. Biology, seventh edition, Tata McGraw-Hill, New Delhi
7. Wallace RA. 1992. Biology, The world of life. Harper Collins Publishers

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
Total	30

B.Sc. BOTANY: Open Elective Course (OE-1.3)
I Semester

Title of the Course : Mushroom Cultivation

Course Outcome:

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

1. To make the students familiar with mushromm cultivation for commercial exploitation.
2. To make the students known about the *Agaricus* (mushroom) used as food, medicine and economic value for sustainable development.
3. To generate interest amongst the students to know the importance of mushroom in day today life.

Number of Theory Credits	Number of Lecture hours/ Semester	Number of Practical Credits	Number of Practical Hours/ Semester
3	30	0	00

Contents of Theory Course 1	30 Hrs
UNIT-I : Mycology and Mushroom Biology	10
Five kingdom classification of organisms. Kingdom fungi. General characters of form, function, reproduction and relationship with other organisms. Importance of fungi in human welfare. Morphology (range of form, macro-morphology, micro-morphology), life cycle of a typical mushroom and biological function. Edible, non-edible and poisonous species. Domestication of mushroom. Importance of mushroom in human nutrition, sustainable livelihood, ecosystem function and quality of the environment.	
UNIT II: Applied Mushroom Biology	10
Mushroom cultivation and production. Lab scale, pilot plant and large scale cultivation of commercial species. Crop cycle- spawn, substrate, substrate processing, spawning, spawn run, cropping, harvesting, environment requirement, post-harvest practices, shelf life, preservation, storage, transport and marketing. Value-added products of mushroom. Constraints and environment management. Economics of mushroom cultivation. Designs of mushroom facility. Economics of mushroom cultivation and marketing.	
UNIT-III: Mushroom Biotechnology	10
Concept. Preparation of flavours, appetizers, neutraceuticals, dietary supplements and cosmetics. Mushroom bioremediation. Cleaning of polluted sites .Utilization of mushroom mycelium or enzymes in recycling biological materials. Mycofiltration and applications of the process. Mycorrhiza applications. Biopulping, biobleaching and biotransformations. Biodetergents.	

References

1. Singh H. 1991. Mushrooms: the art of Cultivation. Sterling Publishers.
2. Kaul TN. 2001. Biology and conservation of Mushrooms. Oxford and IBH Publishing Company.
3. Tripathi M. 2019. Mushroom Cultivation. Oxford and IBH Publishing Company.
4. Suman BC and Sharma VP. 2007. Mushroom Cultivation in India. Eastern Book Corporation.
5. Singh R and Singh UC. 2005. Modern Mushroom Cultivation. Agrobios.

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
Total	30

B.Sc. BOTANY: Open Elective Course (OE-2.1)

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.

Number of Theory Credits	**Number of Lecture hours/ Semester**	**Number of Practical Credits**	**Number of Practical Hours/ Semester**
3	30	0	00

Contents of Theory Course 1	30 Hrs
UNIT-I: Nursery	
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.	4
UNIT-II: Seed	
Structure and types - Seed dormancy; causes and methods of breaking	6

dormancy. Seed storage: Seed banks, factors affecting seed viability, genetic erosion Seed production technology. Seed testing and certification.	
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.	6
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.	8
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.	6

Text Books and References

1. Agrawal PK. 1993. Hand Book of Seed Technology. New Delhi, Delhi: Dept. of Agriculture and Cooperation, National Seed Corporation Ltd.
2. Bose TK and 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 MK. 1989. Plant Propagation. Madras, Bangalore: Wile Eastern Ltd.

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

Total	30

B.Sc. BOTANY: Open Elective Course (OE-2.2)
II Semester
Title of the Course: Bio-fuels

Paper Outcome:

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

Number of Theory Credits	Number of Lecture hours/ Semester	Number of Practical Credits	Number of Practical Hours/ Semester
3	30	0	00

Contents of Theory Course 1	30 Hrs
UNIT-I:	
Introduction, definition, scope and Importance of Bio-fuel. Institutions related to biofuels in India and worldwide. Public awareness of biofuel. Biofuels scenario -in India and worldwide. History of biofuel; Advantages and disadvantages of biofuels. Generation of biofuels: first, second, third and fourth generation of biofuels and present status.	6
UNIT-II:	
Biofuel feed stocks: Agricultural waste, farm waste, forestry waste, organic wastes from the residential, institutional and industrial waste and its importance.(Biomass-plant, animal and microbial based waste). Algal biofuel.	10
UNIT-III:	
Biodiesel species: *Pongamia pinnata, Simarouba gluca, Jatropha curcas, Azardirachta india,madhuca indica* and *Callophyllum innophyllum* etc.; oil content analysis and characterization.	4
UNIT-IV:	
Introduction to biodiesel, bioethanol, biogas and biohydrogen; production technology of biofuels, quality analysis of biodiesel, bioethanol and biogas and its comparison with national and international standards.	8
UNIT-V:	
Biofuel sustainability; Biofuel Policy in India and around the worldwide; Biofuel production statistics: production of Biodiesel, bioethanol, biogas in Countrywide	4

- **Text Books and References**

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
Total	30

B.Sc. BOTANY: Open Elective Course (OE-2.3)
II Semester
Title of the Course: Bio-fertilizers

Paper Outcome:

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

Number of Theory Credits	**Number of Lecture hours/ Semester**	**Number of Practical Credits**	**Number of Practical Hours/ Semester**
3	30	0	00

Contents of Theory Course 1	36 Hrs
UNIT-I: General account, isolation and mass multiplication	
General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. *Azospirillum:* isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. *Azotobacter*: classification, characteristics – crop response to *Azotobacter* inoculum, maintenance and mass multiplication	10
UNIT-II: Association of cyanobacteria and fungi	
Cyanobacteria (blue green algae), *Azolla* and *Anabaena Azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and	10

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distribution, phosphorus nutrition, growth and yield – colonization of VAM –its influence on growth and yield of crop plants	
UNIT-III: Applications of cyanobacteria and fungi	
Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – bio-compost making methods, types and method of vermin-composting – field Application.	10s

Suggested Readings

1. Dubey R. 2005. A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan V. 2005. Biotechnology, Saras Publications, New Delhi.
3. Prakash JJE. 2004. Outlines of Plant Biotechnology. Emkay _Publication, New Delhi.
4. Sathe TV. 2004. Vermiculture and Organic Farming. Daya publishers.
5. Rao NS. 2000. Soil Microbiology, Oxford & IBH Publishers, New _Delhi.
6. Vayas SC, Vayas S and Modi HA.1998. Bio-fertilizers and organic farming Akta Prakashan, Nadiad

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
Total	30

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DAVANGERE UNIVERSITY
I Semester B.Sc. Degree Examination- January 2022
(CBCS)
Paper-I: Microbial Diversity

Time: 3 Hours Maximum Marks: 60

Note:
1. All Parts are compulsory
2. Draw labeled diagram whenever necessary

PART-A

Write brief note on any **FIVE** of the following 2x 10=10 M

1.
2.
3.
4.
5.
6.
7.
8.

PART-B

Write short notes on any **FIVE** of the following 5x4=20 M

9.
10.
11.
12.
13.
14.
15.
16.

PART-C

Answer any **THREE** of the following 3x10=30M

17.
18.
19.
20.
21.

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