



BANGALORE UNIVERSITY

DEPARTMENT OF BOTANY

JNANABHARATHI CAMPUS

BANGALORE – 560 056

SYLLABUS FOR I & II SEMESTER

BOTANY

PAPERS

UNDER GRADUATE (UG) PROGRAMME

**FRAMED ACCORDING TO
NATIONAL EDUCATION POLICY
(NEP) 2020**

SEPTEMBER 19, 2021

Preface

Greetings, from NEP 2020 Botany syllabus framing committee.

The committee members are thankful to the Government of Karnataka for initiating the process of implementation of NEP-2020 in our state. It is our privilege to be part of this process through a committee constituted to frame the syllabus for the UG 4 year (Honors) course in Botany.

The committee members conducted online meeting on 23.08.2021, 27.08.2021, 02.09.2021 04.09.2021 and 05.09.2021 for discussion and finalizing the course titles as per pattern given in Table II A. These deliberations also helped in preparing the syllabus for Semester I and Semester II and the programme and subject outcomes. The model draft curriculum structure and the syllabus for first 2 semesters was presented in the faculty committee on 9th September and the inputs are considered during further revision. The model draft document is ready for submitting to Karnataka State Higher Education Council for further action.

The committee will be working further to complete the remaining part of the syllabus for other papers and any academic inputs required to implement the syllabus in the spirit and philosophy of NEP 2020.

Prof. G R Naik
Vice Chancellor,
Garden City University and
Chairperson, Botany Syllabus Curriculum Committee NEP-2020

Preamble

The objective of a B.Sc. (Honors) programme in Higher Education system is to prepare its students for the society. The current pattern is designed to provide a focused learning outcome-based syllabus at the Honors level providing structured teaching-learning experiences catering to the needs of the students. The honors courses will prepare the students both academically and in terms of employability. The programme also inculcates various attributes at the Honors level. These attributes encompass values related to emotional stability, social justice, creative and critical thinking, well-being and various skills required for employability, thus preparing students for continuous learning and sustainability. The new curriculum based on learning outcomes of BSc (Honours) Botany offers knowledge of areas including Plant Systematics, Plant Biotechnology, Resource Botany, Genetics, Ecology, Conservation biology, Physiology and Bioinformatics, Medicinal plants, Plant diseases management etc. The courses define clearly the objectives and the learning outcomes, enabling students to choose the elective subjects broadening their skills in the field of Botany. The course also offers skills to pursue research and teaching in the field of Botany and thus would produce best minds to meet the demands of society. This curriculum framework for the bachelor-level program in Botany is developed keeping in view of the student-centric learning pedagogy, which is entirely outcome-oriented and curiosity-driven. To avoid a rote-learning approach and foster imagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum framework focuses on the pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field works.

MINUTES OF THE BoS (UG) MEETING

Chairperson welcomed the members to the meeting and thereafter the agenda was taken up for discussion

1. Discussed and finalized the syllabus for theory and practical of I and II semester B.Sc., Botany, question paper pattern, blue print question paper Formative assessment and scheme of valuation for choice based credit system of NEP Programme.
2. Members also discussed the titles of the papers for III, IV, V & VI Sem, open electives and disciplines specific elective papers.
3. The overall N.E.P Module for B.Sc., Botany was discussed, finalized and accepted with modifications wherever necessary.
4. The Chairperson is authorized to change / incorporate corrections as per the direction of University.

The meeting ended with a vote of thanks by the Chairperson.

1. M. R. D.
2. S. S. S.
3. U. P.
4. C. S. S.
5. K. S. S.
6. U. P.
7. M. R. D.

Mayer 19/19
Professor & Chairman
Department of Botany
Bangalore University
Bangalore - 560 008

Proceedings of the Board of studies in Botany (BoS UG) meeting held on 19-09-2021 (Sunday) in the Department of Botany, Bangalore University, Bangalore to discuss and finalize the syllabus of I and II Sem B.Sc., Botany,

Members Present

1. Dr. C. Maya, Professor & Chairperson
2. Dr. Sharanappa , External Member
3. Dr. Suresh Kumar. C
4. Dr. Mamatha. N
5. Dr. Kempegowda
6. Dr. Venkateshappa. S. M
7. Dr. Jayashree. Y. B
8. Smt. Shylaja. K. S
9. Dr. L. Rajanna

Signature

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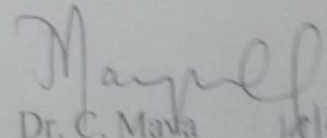
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Dr. C. Maya

19/9/20

Professor & Chairperson

Professor & Chairman
Department of Botany
Bangalore University
Bangalore - 560 056

Botany Syllabus for B.Sc / B.Sc (Honors) programme as per NEP 2020

The framework of curriculum for the Bachelor's program in Botany aims to transform the course content and pedagogy to provide a multidisciplinary, student-centric, and outcome-based, holistic education to the next generation of students.

Aside from structuring the curriculum to be more in-depth, focused, and comprehensive with significant skill-set for all exit levels; keeping in mind the job prospects; the emphasis has been to maintain academic coherence and continuum throughout the program of study and help build a strong footing in the subject, thereby ensuring a seamless transition into their careers.

Special attention is given to eliminate redundancy, discourage rote learning, and espouse a problem-solving, critical thinking, and inquisitive mindset among learners.

The curriculum embraces the philosophy that science is best learned through experiential learning, not limited to the confines of a classroom but rather through hands-on training, projects, field studies, industrial visits, and internships.

This updated syllabus, with modern technology, helps students stay informed on the leading-edge developments in plant sciences and promotes curiosity, innovation, and a passion for research, that will serve them well in their journey into scientific adventure and discovery beyond graduation.

The goal is to equip students with holistic knowledge, competencies, professional skills, and a strong positive mindset that they can leverage while navigating the current stiff challenges of the job market.

B. Sc. Botany Programme outcomes as per NEP 2020

Discipline Core: Botany

Total Credits for the Program: 186

Starting year of implementation: 2021-22

Program Outcomes:

By the end of the program the students will be able to:

(Refer to literature on outcome based education (OBE) for details on Program Outcomes)

PO1: Skill development for the proper description using botanical terms, identification, naming and classification of life forms especially plants and microbes.

PO2: Acquisition of knowledge on structure, life cycle and life processes that exist among plant and microbial diversity through certain model organism studies.

PO3: Understanding of various interactions that exist among plants and microbes; to develop the curiosity on the dynamicity of nature.

PO4: Understanding of the major elements of variation that exist in the living world through comparative morphological and anatomical study.

PO5: Ability to explain the diversity and evolution based on the empirical evidences in morphology, anatomy, embryology, physiology, biochemistry, molecular biology and life history.

PO6: Skill development for the collection, preservation and recording of information after observation and analysis- from simple illustration to molecular database development.

PO7: Making aware of the scientific and technological advancements- Information and Communication, Biotechnology and Molecular Biology for further learning and research in all branches of Botany..

PO8: Internalization of the concept of conservation and evolution through the channel of spirit of inquiry.

PO 9: To enable the graduates to prepare for national as well as international level competitive examinations like UGC-CSIR, UPSC, KPSC etc.

PO10: To enable the students for practicing the best teaching pedagogy as a biology teacher including the latest digital modules.

PO 11: The graduates should be knowledgeable and competent enough to appropriately deliver on aspects of global importance like climate change, SDGs, green technologies etc at the right opportunity.

PO 12: The graduate should be able to demonstrate sufficient proficiency in the hands-on experimental techniques for their area of specialization within biology during research and in the professional career.

Assessment: (Teaching, Learning and Evaluation)

Weightage for assessments (in percentage)

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	40	60
Practical	25	25
Projects	---	--
Experiential Learning (Internships etc.)	--	--

PROGRAMME STRUCTURE

Sem.	Discipline Core (DSC) (L+T+P)	Discipline Elective (DSE) / Open Elective (OE)	Ability Enhancement Compulsory Courses (AECC), Languages (L+T+P)		Skill Enhancement Courses (SEC)		Total Credits
					Skill based (L+T+P)	Value based (L+T+P)	
I	Discipline A 1(6) Microbial Diversity and Technology Discipline B 1(6)	OE-1 (3)	L1-1 (3), L2-1(3) (3+1+0 each)		SEC-1: Digital Fluency(2) (1+0+2)	Health and Wellness/ Social & Emotional Learning (2) (1+0+2)	25
II	Discipline A 2(6) Diversity of nonflowering plants Discipline B 2(6)	OE-2 (3)	L1-2(3), L2-2 (3) (3+1+0 each)	Environmental Studies (2)		Sports/NCC/NSS etc. (2) (1+0+2)	25
Exit option with Certificate (50 credits)							
III	Discipline A 3(6) Plant Anatomy and Developmental Biology Discipline B 3(6)	OE-3 (3)	L1-3 (3), L2-3(3) (3+1+0 each)	Constitution of India (2)	SEC-2: Artificial Intelligence (2)(1+0+2)		25
IV	Discipline A 4(6) Ecology and conservation biology Discipline B 4(6)	OE-4 (3)	L1-4 (3), L2-4(3) (3+1+0 each)		SEC-3: Cyber Security(2) (1+0+2)	Sports/NCC/NSS etc. (2) (1+0+2)	25
Exit option with Diploma (100 credits)							
Choose any one Discipline as Major, the other as the Minor							
V	Discipline A 5(5) Plant Taxonomy and resource botany Discipline A 6(5) Cell biology and Genetics Discipline B 5(5)	DSE A-1 (3) Algal and Fungal Biotechnology			SEC-3: (2) (2+0+2)	Ethics & Self Awareness (2) (1+0+2)	22
VI	Discipline A 7(5) Plant Physiology and biochemistry Discipline A 8(5) Plant Biotechnology Discipline B 6(5)	DSE A-2 (3) Herbal Technology			SEC-4: Professional/ Societal Communication (2)		24
Exit option with Bachelor of Science, B. Sc. Basic Degree (146 credits)							
VII	Discipline A-9(5) Molecular Biology Discipline A-10(5) Seed biology and seed Technology Discipline A-11(4) Plant Health Technology.	DSE A-3 (3) Plant Propagation and Tissue Culture (3)					20
VIII	Discipline A-12(4) Medicinal Plants and Phytochemistry Discipline A-13(4) Bioinformatics and Computational Biology Discipline A-14(3) Research Methodology	DSE A-4 (3) Landscaping, Gardening and Green House Technology					20
Award of B.Sc. (Hons) degree (186 credits)							

COURSE PATTERN AND SCHEME OF EXAMINATION

SL. No.	SEMESTER	TITLE OF THE PAPER	TEACHING HOURS	HOURS/ WEEK		EXAMINATION PATTERN Max. & Min. / paper						DURATION OF EXAM (HOURS)		TOTAL MARKS PER PAPER	CREDITS	
						THEORY			PRACTICE			THEORY	PRACTICE		T	P
						Max.	Min.	IA	Max.	Min.	IA					
1	I	DSC- 1 : Microbial Diversity and Technology	56	4	-	60	25	40	-	-	-	03	-	100	4	-
		DSC- LAB-1 : Microbial Diversity and Technology	56	-	4	-	-	-	25	12	25	-	4	50	-	2
		Botany- OE- I : Plant and Human welfare	42	03	-	60	25	40	-	-	-	03	-	100	3	-
2	I	DSC-2 : Diversity of non flowering plants	56	4	-	60	25	40	-	-	-	03	-	100	4	-
		DSC- LAB-2 : Diversity of non flowering plants	56	-	4	-	-	-	25	12	25	-	4	50	-	2
		Botany- OE- II : Plant Propagation, Nursery management and Gardening	42	03	-	60	25	40	-	-	-	03	-	100	03	-

SCHEME OF INTERNAL ASSESSMENT MARKS: THEORY

SL. No.	PARTICULARS	IA MARKS (40)
1	ATTENDANCE	10
2	INTERNAL TESTS (Min. of two)	20
3	ASSIGNMENTS / SEMINAR	10
	TOTAL THEORY IA MARKS	40

SCHEME OF INTERNAL ASSESSMENT MARKS: PRACTICAL

SL. No.	PARTICULARS	IA MARKS (25)
1	PRACTICAL TEST	15
2	ACTIVE PARTICIPATION IN PRACTICAL CLASSES	10
	TOTAL PRACTICAL IA MARKS	25

Program Articulation Matrix:

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project, internships etc. Elective courses may be listed separately.

Semester	Title / NameOf the course	Program outcomes that thecourse addresses (not more than 3 per course)	Pre-requisite course(s)	Pedagogy##	Assessment\$
1	BOT A1 Microbial Diversity andTechnology	PO1	---	Ex. MOOC	Quiz
2	BOT A2 Diversity of Nonflowering Plants	PO2, PO3	BOT A1	Desk Work Problem solving,	Debate
3	BOT A3 Plant Anatomy and Developmental Biology	PO4, PO5	BOT A1 and A2		
4	BOT A4 Ecology and Conservation Biology	PO4, PO5	BOT A1 A2 A3		
5.	BOT A5 Plant Taxonomy and Resource Botany	PO6, PO7	BOT A1 A2 A3	Seminar,	Class work Seminar Project writing
	BOT A6 Cell Biology and Genetics	PO6, PO7	BOT A6 A1 A2 A3 A4 A5	Project based learning,	
6.	BOT A7 Plant Physiology and Biochemistry	PO6, PO7, PO9	BOT A5	Term paper Assignment,	Articles writing, Interpretation of results
	BOT A8 Plant Biotechnology	PO8. PO9	BOT A5		
7.	BOT A9 Molecular Biology	PO8, PO9	BOT A6 A8	Group Discussion	
	BOT A10 Seed Biology and Seed Technology	PO9, PO10	BOT A5 A8 A9		
	BOT A11 Plant Health Technology	PO9, PO10	BOT A5 A4 A8	Research Project Instrumentation	

8.	BOT A12 Medicinal Plants and Phytochemistry	PO9, PO10	BOT A4 A5 A7 A8		
	BOT A13 Bioinformatics and Computational Biology	PO9, PO10	BOT A5 A8 A9		
	BOT A14 Research Methodology	PO9, PO10	BOT A13		

Pedagogy for student engagement is predominantly lectures. However, other pedagogies enhancing better student engagement to be recommended for each course. The list includes active learning/ course projects/ problem or project based learning/ case studies/self-study like seminar, term paper or MOOC

\$ Every course needs to include assessment for higher order thinking skills (Applying/ Analyzing/ Evaluating/ Creating). However, this column may contain alternate assessment methods that help formative assessment (i.e. assessment for learning).

Semester I

Course Title: D.Sc –I : Microbial Diversity and Technology Botany - I	
Total Contact Hours: 56	Course Credits:04
Formative Assessment Marks: 40	Duration of Summative Assessment / ESA: 3hrs
Model Syllabus Authors: Dr. G.R.NAIK AND TEAM	Summative Assessment Marks: 60

Course Pre-requisite(s): PUC with Botany (Biology) – any equivalent

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

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 and Technology

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.
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 an 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 of seed production, certification and quality.

Semester VII (A-11): Plant Health Technology

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

BOTANY SYLLABUS FOR B.Sc / B.Sc Honours
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
<p>Chapter No. 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 of microbial diversity in nature.</p>			5
<p>Chapter No. 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).</p>			5
<p>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.</p>			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 -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 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. 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 and Cyanobacteria. Mycoplasmas and Phytoplasmas- General characteristics and diseases. Economic importance of Bacteria.	5
Chapter No. 11. Fungi- General characteristics and classification. Thallus organization and nutrition in fungi. Reproduction in fungi (asexual and sexual). Heterothallism and parasexuality. Type study of <i>Phytophthora, Rhizopus, Neurospora, Puccinia, Penicillium and Trichoderma</i> .	5
Chapter No. 12. Lichens – Structure and reproduction. VAM Fungi and their significance. Fungal 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.	5

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, 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.
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.

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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, 4th ed. Eaglewood Cliffts. N.J.Prentice- Hall. New Delhi.
4. Burnell JH and Trinci APJ. 1979. Fungal walls and hyphal growth, Cambridge UniversityPress. 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 Dagainawala. 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 World
5th edition. Prentice-Hall India, Pvt. Ltd. New Delhi.
13. Sullia SB. and Shantharam S. 2005. General Microbiology, Oxford and IBH,
NewDelhi.

Pedagogy:

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

Assessment Occasion/ type	Weightage in Marks
Formative Assessment / IA	40
Summative Assessment / ESE	60
Total	100

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 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 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 - *Albugo*, *Phytophthora*/*Pythium*, *Rhizopus*/*Mucor*, *Saccharomyces*, *Neurospora*/*Sordaria*, *Puccinia*, *Agaricus*, *Lycoperdon*, *Aspergillus*/*Penicillium*, *Trichoderma*.(Depending on local availability)

Practical 10: Preparation of agar slants, inoculation, incubation, pure culturing and preservation of microbes by oil overlaying.

Practical 11: Study of late blight of Potato, Downy mildew of Bajra, Citrus canker, Tobacco mosaic disease, Sandal spike disease.

Practical 12: Study of well-known microbiologists and their contributions through charts and photographs.

Practical-13: Visit to water purification units/Composting/ microbiology labs/dairy and farms to understand role of microbes in day today life.(Submission of Report compulsory)

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	42	0	00
Content of Theory Course 1			42 Hrs
Unit I			14 hrs
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).			3
Legumes: General account (including chief pulses grown in Karnataka- red gram, green gram, chick pea, soybean).			2
Cereals: Wheat and Rice (origin, evolution, morphology, post-harvest processing & uses).Green revolution. Brief account of millets and their nutritional importance.			3
Fruit Origin, distribution, classification, and utilization of Fruits: mango, banana, citrus, guava, grapes apple, cashewnut and walnut Fumigatories and masticatories: tobacco, betelvine, areacanut			3
Cash crops: Morphology, new varieties and processing of sugarcane, products and by-products of sugarcane industry. Natural Rubber –cultivation, tapping and processing.			03.
UNIT II			14
Spices: Listing of important spices, their family and parts used, economic importance with special reference to Karnataka. Study of fennel, cumin, clove, black pepper and cardamom.			03

Beverages: Tea,Coffee (morphology, processing & uses) Plantation crops: coconut, cocoa	03
Oils : General description, Botanical name, family & uses. : groundnut, coconut, sunflower and mustard, castor, safflower, oil palm, and linseed,. Neem oil	04
Essential Oils: General account. Extraction methods of sandal wood oil, rosa oil and eucalyptus oil. Economic importance as medicine, perfumes and insect repellents.	04
UNIT III	14
Narcotics: cannabis and opium Dye, tannin, gum and resin yielding plants;	05
Fibers: Classification based on the origin of fibers Morphology, processing and uses; Cotton, jute, silk cotton, sun silk cotton, sunnhemp, agave, flax	04
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. Principles and methods of conservation, in situ and ex situ methods Plant Quarantine Principles, objectives and relevance of plant quarantine	05

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.

Assessment Occasion / type	Weightage in Marks
Formative Assessment / IA	40
Summative Assessment / ESE	60
Total	100

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
<p>Chapter No. 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.</p>			5
<p>Chapter No. 2 Morphology and reproduction and life-cycles of Nostoc, <i>Oedogonium</i>, <i>Chara</i>, <i>Sargassum</i> and <i>Batrachospermum</i>. Diatoms and their importance. Blue-green algae-A general account. Algalblooms and toxins.</p>			5
<p>Chapter No. 3 Algal cultivation- Cultivation of microalgae-<i>Spirulina</i> and <i>Dunaliella</i>; 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.</p>			5
Unit – 2			15

Chapter No. 4. Bryophytes – General characteristics and classification of Bryophytes, Diversity-habitat, thallus structure, Gametophytes and sporophytes.	5
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. Fossil Bryophytes.	5
Chapter No. 6. . Pteridophytes- General characteristics and classification; Structure of sporophytes and life-cycles. Distribution, morphology, anatomy, reproduction and life-cycles in <i>Selaginella</i> , <i>Equisetum</i> , <i>Pteris</i> and <i>Salvinia</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. Study of the habitat, distribution, habit, anatomy, reproduction and life-cycles 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, Preservation of plant fossils - impressions, compressions, petrification's, moulds and casts, pith casts. Radiocarbon dating.	5
Chapter No. 12. Fossil taxa- <i>Rhynia, Lepidodendron, Lepidocarpon, Lyginopteris and Cycadeoidea</i> . Exploration of fossil fuels. Birbal Sahni Institute of Paleosciences.	4

Text Books

- 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.

References

1. Sambamurty, A.V.S.S.. A Text Book of Algae. I.K. International Private Ltd., New Delhi.
2. Agashe, S.N. 1995. Paleobotany. Plants of the past, their evolution, paleoenvironment and Allied plants. Hutchinson & Co., Ltd., London.
3. Anderson R.A. 2005, Algal cultural Techniques, Elsevier, London.
4. Publication, Application in exploration of fossil fuels. Oxford & IBH., New Delhi.

5. Eams, A.J., (1974) Morphology of vascular plants - Lower groups. Tata Mc Grew-Hill Publishing Co. New Delhi, Freeman & Co., New York.
6. Fritze, R.E. 1977. Structure and reproduction of Algae. Cambridge University Press.
7. Goffinet B and Shaw A.J. 2009, Bryophyte Biology, 2nd ed. Cambridge University Press, Cambridge. Gymnosperms.
8. Srivastava, H N, 2003. Algae Pradeep Publication, Jalandhar, India.
9. Kakkar, R.K. and B.R.Kakkar (1995) The Gymnosperms (Fossils and Living) Central Publishing House, Allahabad.
10. Kumar H. D., 1999, Introductory Phycology, Affiliated East-West Press, Delhi.
11. Lee, R.E., 2008, Phycology, Cambridge University Press, Cambridge. 4th edition. McGraw Hill Publishing Co., New Delhi.
12. Parihar, N.S. 1970. An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book, Allahabad.
13. Parihar, N.S. (1976) An Introduction to Pteridophytes, Central Book Depot, Allahabad.
14. Parihar, N.S. 1977. The Morphology of Pteridophytes. Central Book Depot., Allahabad. Press, Cambridge.
15. Rashid, A. 1998. An Introduction to Pteridophyta. II ed., Vikas Publishing House, New Delhi.
16. Smith, G.M. 1971. Cryptogamic Botany. Vol. II. Bryophytes & Pteridophytes. Tata Tata McGraw Hill Publishing, New Delhi.
17. Smith, G.M. 1971. Cryptogamic Botny. Vol.I Algae & Fungi. Tata McGraw Hill Publishing. New Delhi.

18. Sporne, K.R. 1965. The Morphology of Gymnosperms. Hutchinson & Co., Ltd., London.
19. Stewart, W.M. 1983. Paleobotany and the Evolution of Plants, Cambridge University Cambridge.
20. Sundarajan, S. 1997. College Botany Vol. I. S Chand & Co. Ltd., New Delhi.
21. Vanderpoorten, A. and Goffinet, B. 2009, Introduction to Bryophytes, Cambridge University Press, Cambridge.
22. Vashista, B.R. 1978. Bryophytes. S Chand & Co. Ltd., New Delhi.

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

Assessment Occasion / type	Weightage in Marks
Formative Assessment / IA	40
Summative Assessment / ESE	60
Total	100

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

Practical-1: Study of morphology, classification, reproduction and lifecycle 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 & 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, 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)

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.

1.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	42	0	0
Content of Theory Course 1			42 Hrs
Unit I			14
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.			07
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.			07
Unit II			14
Vegetative propagation: Aerial--Air-layering, cutting, Underground-rhizome, tuber, bulb, corm, sucker, collecting season, treatment of cutting, rooting medium and planting of cuttings.			06 04
Hardening of plants .Green house: mist chamber, shed root, shade house and glass house.			04

Unit III	14
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
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

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.

Assessment Occasion / type	Weightage in Marks
Formative Assessment / IA	40
Summative Assessment / ESE	60
Total	100

Job opportunities in Botany

Exit after ONE Year: Certificate Course

I Sem. - A1: Microbial Diversity and Technology

II Sem. – A2: Diversity and Conservation of Non- Flowering plants

Job opportunities in Botany

- Preparation of algal, fungal microbial, bryophyte, pteridophyte, and gymnosperm slides foreducational institutions and other line departments (Entrepreneurship).
- Providing algal, fungal microbial, bryophyte, pteridophyte, and gymnosperm materials foreducational institutions and other line departments (Entrepreneurship).
- Developing Nursery (Entrepreneurship).
- Nursery supervisor/manager
- Mushroom cultivation (Entrepreneurship).
- Cyanobacterial, algal and microbial culture (Entrepreneurship).
- Fermentation industries. Dairy farming industries. Dairy products industries. Spice Industries(Lichens)
- Quarantine dept., Quality control/analyst, packaging, Lab. assistant