BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM

(Semester Scheme with Multiple Entry and Exit Options for Under Graduate Course)

Syllabus for Botany
(I & II Semester)

2021-22 onwards

Proceedings of the meeting of BOS (UG) in Botany held on 30th September 2021 at Senate hall,Department of Commerce, Bangalore City University, Bengaluru – 560 001

Reference:

1. G.O. ED: 260/USE/2019 (part-1), Bangalore
2. Email from HEC, GOK dated
3. University order dated

Adverting to above, the drafted syllabus prepared by Higher Educational Council (HEC), Government of Karnataka (GOK) pertaining to B.Sc. Botany was circulated by online mode (mailed on 24.09.2021) to all the members of BOS.

Agenda: Approval of syllabus for B.Sc. in Botany theory and practical and scheme of examination for I and II semesters of Bangalore City University, Bangalore.

Resolution: The proposed syllabus for B.Sc. in Botany and practical, Open Elective and Scheme of Examination for I and II semesters were scrutinized thoroughly, finalized with appropriate inclusions and deletions and finally approved.

Members Present		**Signature**
1. Zaiba Nishanth Banu	**Member**	
2. Dr. Mallikarjuna P.B.	**Member**	
3. Dr. B.L. Manjula	**Member**	
4. Smt. K.R. Kavitha	**Member**	K.R. Kavitha
5. Smt. N. Sarvamangala	**Co-opted Member**	
6. Smt. K.S. Shailaja	**Co-opted Member (ONLINE)**	
7. Dr. L. Rajanna	**Chairman**	30/9/21

Members Absent

1. **Dr. Deepak Bhat** — **Member**
2. **Dr. Jenifer lolitha** — **Member**
3. **Smt. Chandrakala S** — **Member**

MINUTES OF THE MEETING OF BOS (UG) IN BOTANY

Chairman welcomed the members of the BoS (UG) Board to the meeting and the agenda was placed for discussion

a. Discussed and finalized the syllabus and Scheme of examination for B.Sc. Botany (CBCS) III, IV, V and VI Semester (theory and practical) Question paper pattern, and scheme of valuation

b. The panel of Examiners was approved and recommended for UG Examinations for the academic year 2021-22.

c. Recommendations were made to constitute BoE for the academic year 2021-22.

d. Discussed and finalized the syllabus for theory and practical of I and II Semester B.Sc. Botany, question paper pattern, blue print of question Paper, formative assessment and Scheme of valuation for NEP programme to be implemented from the academic year 2021-22.

e. The Chairman was authorized to change/ incorporate the corrections as per the directions of the University.

The meeting ended with a vote of thanks by the Chairman

1. Dr. B.L. Manjula
2. Dr. P.B. Mallikarjuna, Associate Professor, GFGC Yelahanka
3. Zaiba Nishath Bano
4. Dr. K.R. KAVITHA K.R. Kavitha 30/9/2021
5. N. SARVAMANGALA. N. Sarvamangala 30.9.21.

30/9/21

Dr. L. RAJANNA
Professor & Chairman BoS (UG)
Dept. of Botany
Bangalore University
Jnanabharathi Campus,
Bangalore - 560056.
B.C.U.

Karnataka State Higher Education Council
BOTANY Syllabus Framing Committee

Sl No	Name	Designation	Signature
1.	Prof. G R Naik, Vice Chancellor, Garden City University, Bengaluru	Chairperson	
2.	Dr. A.H . Rajasab, Pro Vice Chancellor, KNB University, Kalaburagi	Member	
3.	Dr. G.R. Janardhana, Professor, University of Mysore, Mysuru	Member	
4.	Dr. H. Niranjanamurthy, Professor, Karnataka University, Dharwad	Member	
5.	Dr. L. Rajanna, Professor, Bangalore University, Bengaluru	Member	
6.	Dr. Krishna Kumar G, Professor, Mangalore University, Konaje	Member	
7.	Dr. M.B. Shivanna, Professor, Kuvempu University, Shivamogga	Member	
8.	Dr. Govindappa M, Professor, Davangere University, Davangare	Member	
9.	Dr H.Ramakrishnaiah, Registrar and Associate Professor, Maharani Cluster University, Bengaluru	Member	
10.	Shri. M. N. Mallikarjunaiah, Associate Professor, Mandya University, Mandya	Member	
11.	Shri. Rangaswamy R.K. Government Science College, Chitradurga	Member	
12.	Dr. Abdul Khayum, Associate Professor, Government Women's College, Kolar	Member	
13.	Dr. Mamtha, Associate Professor, Government First Grade College,Bengaluru	Member	
14.	Dr. Jayakara Bhandary, Associate Proessor, Government First Grade College, Mangalore	Member	

15.	Dr. R.J. Katti, Associate Professor, Kittel College Dharwad	Member	
16.	Shri L.S. Ramesh, Special Officer, Karnataka State Higher Education Council	Member Convener	

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

Index		
Sl.No.	**Content**	**Page No**
1.	Preamble	03
2.	Aims of Bachelor's degree programme in Botany	04-07
3.	B. Sc. Botany Course outcomes as per NEP	08
4.	BSc -Botany- Program Outcome	09-10
5.	Assessment - Teaching, Learning and Evaluation	11-16
6.	Table B1 & B2 showing Model Programme Structure in Botany as per BCU	17
7.	Curriculum Structure for the Undergraduate Degree Program -B.Sc. BOTANY	17-19
8.	List of Discipline Core Papers (DSC)	20
9.	Discipline Specific Elective Papers (DSE)	21
10.	Course Outcome (Cos)	22-26
11.	Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)	27
12.	Course pattern and scheme of Examination	28
13.	Table IIA showing Model Programme Structure in Botany as per NEP 2020	29
14.	Syllabus of I Semester	30-40
15.	Syllabus of II Semester	41-50
16.	Model Question paper and Blueprint	51-52
17.	Semester wise - Job Opportunities	53-56

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.

Aims of Bachelor's degree programme in Botany:

The broad aims of the bachelor's degree programme in Botany are:

1. To provide an environment that ensures the cognitive development of students in a holistic manner. A dialogue about plants and their significance is fostered in this framework, rather than didactic monologues on mere theoretical aspects
2. To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A botany graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment.
3. To mould a responsible citizen who is aware of the most basic domain-independent knowledge, including critical thinking and communication.
4. To enable the graduate to prepare for national as well as international competitive examinations, especially UGC-CSIR NET, and UPSC Civil Services Examination.

Program Learning Outcomes:

The students graduating with the Degree B.Sc. Three years and B. Sc. (Honors) Botany should be able to acquire.

Core competency: Students will acquire core competency in the subject Botany, and allied subject areas.

1. The student will be able to identify major groups of plants and compare the characteristics of lower (e.g. algae and fungi) and higher (angiosperms and gymnosperms) plants.
2. Students will be able to use the evidence-based comparative botany approach to explain the evolution of organisms and understand the genetic diversity on the earth. The students will be able to explain various plant processes and functions, metabolism, concepts of

gene, genome, and how organism's function is influenced at the cell, tissue, and organ level.

3. Students will be able to understand the adaptation, development, and behavior of different forms of life.
4. The understanding of networked life on earth and tracing the energy pyramids through nutrient flow is expected from the students.
5. Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Botany.

Analytical ability:

The students will be able to demonstrate the knowledge in understanding research and addressing practical problems.

1. Application of various scientific methods to address different questions by formulating the hypothesis, data collection, and critically analyze the data to decipher the degree to which their scientific work supports their hypothesis.

Critical Thinking and problem-solving ability:

An increased understanding of fundamental concepts and their applications of scientific principles is expected at the end of this course. Students will become critical thinkers and acquire problem-solving capabilities.

Digitally equipped:

Students will acquire digital skills and integrate the fundamental concepts with modern tools.

Ethical and Psychological strengthening: Students will also strengthen their ethical and moral values and shall be able to deal with psychological weaknesses.

Team Player: Students will learn team workmanship in order to serve efficiently institutions, industry, and society.

Independent Learner: Apart from the subject-specific skills, generic skills, especially in botany, the program outcome would lead to gain knowledge and skills for further higher studies, competitive examinations, and employment. Learning outcomes-based curriculum would ensure equal academic standards across the country and a broader picture of their competencies. The Bachelor's program in Botany and Botany honors may be mono-disciplinary or multidisciplinary with following broad objectives.

1. Critically evaluation of ideas and arguments by collecting relevant information about the plants, to recognize the position of the plant in the broad classification and phylogenetic level.
2. Identify problems and independently propose solutions using creative approaches, acquired through interdisciplinary experiences, and a depth and breadth of knowledge/expertise in the field of Plant Identification.
3. Accurately interpretation of collected information and use taxonomical information to evaluate and formulate a position of the plant in taxonomy.
4. Students will be able to apply the scientific method to questions in botany by formulating testable hypotheses, collecting data that address these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their hypotheses.
5. Students will be able to present scientific hypotheses and data both orally and in writing in the formats that are used by practicing scientists.
6. Students will be able to access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works.
7. Students will be able to apply fundamental mathematical tools (statistics, calculus) and physical principles (physics, chemistry) to the analysis of relevant biological situations.
8. Students will be able to identify the major groups of organisms with an emphasis on plants and be able to classify them within a phylogenetic framework. Students will be

able to compare and contrast the characteristics of plants, algae, and fungi that differentiate them from each other and other forms of life.

9. Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped plant morphology, physiology, and life history.
10. Students will be able to explain the ecological interconnectedness of life on earth by tracing energy and nutrient flow through the environment. They will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems
11. Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within biology.

B. Sc. Botany Course outcomes 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

Name of the Degree Program: B.Sc. **Discipline Core: Botany**

Total Credits for the Program: 176 **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, and 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	**40**	**60**
Experiential Learning (Internships etc.)	**80**	**20**

SUGGESTED METHODOLOGY FOR TEACHING, LEARNING AND EVALUATION TEACHING-LEARNING

The whole programme is an Outcome Based Education. Different methods are to be used for teaching learning evaluation; in order to attain the fixed outcomes.

Theory:

Student: Review of Literature, Assignment, Presentation, e-learning, Discussion and Debate with peer group, teachers and experts.

Teacher: Lecture, Demonstration, Presentation, Discussion and Debate.

Practical:

Student: Identification, Comparison, Differentiation and Categorization of different plants and their parts by observing Permanent Slides, Hand sectioning etc., Demonstration, Experimentation, Field visit, Report Writing and Keeping records

Teacher: Demonstration, Experimentation, Field visit, Certification.

Project: The finalization of the topic should be done at the beginning of the fourth semester and the list should be kept with the HOD for the perusal of the University Examination authorities. There should be at least three projects from a department. The selection of the topic and group should be student centered as far as possible. A project log book/register is to be maintained by each student and submitted along with the project report during the final submission.

Student: Suggestion of Topic, Discussion with the Project guide and Peer group, Review of Literature, Project planning and Designing, Experimentation, Data Analysis and Project Report Preparation and Presentation.

Teacher: Confirmation of Topic, Demonstration, Planning of Experimentation, Guidance and Correction and Certification.

Experiential Learning (Internships etc.):

Student should choose one of the topics for self-study from the beginning of the seventh semester. A report should be submitted by the end of Eighth Semester.

Suggested topics include: Studies on mangroves / Sacred groves / Campus flora; Cultivation of RET / Fruit / Vegetable / Medicinal plants / Mushroom; Topics related to Social responsibility-River restoration, PBR (People Biodiversity Register) preparation, Herbarium arrangement, VFC (Village Forest Committee), VNRC (Village Natural Resource Committee) formation, Landscaping and Green Auditing.

Field Study / Study Tour:

The plant diversity studies should be carried out with the support of Field Study / Study Tour. During each year there should be a field study of 1-5 days duration, with a minimum of 5 days for the completion of the programme.

EVALUATION

External Evaluation:

External assessment by the University level examinations on specified times announced by the University for all the courses, theory, practical and Project/Viva Voce. Each student should go through the evaluation process according to the University Regulations 2021-2022

End Semester Evaluation-Theory:

The components of external evaluation and their unit wise and each theory and practical course and the time of examination will be in accordance with the calendar prepared by the University for each academic year. At the end of each semester, there will be an examination for theory courses. The duration of examinations for all theory and practical courses in Botany will be three hours, except for the Generic Elective Course papers.

External –Practical:

Practical Courses have external examination for all semester. There will be an external practical examiner and an internal examiner / skilled assistant for every practical examination of three hour duration. The external evaluation should be carried out by the team of examiners.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Attendance**	**10**
2	**RECORD:**	
	Scientific Accuracy	**30**
	Completeness	**20**
	Neatness and Legibility	**10**
3	**Field Study Report/ Slide / Herbarium submitting**	**30**

EXTERNAL – PROJECT / FIELD STUDY / VIVA VOCE

The Project/Field Study/General Viva Voce will be conducted in I/II/III/IV/V/VI/VII/ VIII Semester Practical Examination.

Viva should be based on:

Project work

Experiential Learning (Internships etc)

Field Study

General Learning Activity of four years:

For the external evaluation the components and weightage of Project/Field Study/ Viva Voce can be discussed and determined finally by the Board of Examiners; the suggested components and their weightage is given below. The project viva should be based on the Project and importance should be given to the Scientific method undertaken in that project. The general viva should be on based the changes in the outlook of the student after the learning activity of the 4 year programme, field study and Experiential Learning (Internships etc.). Time taken for each practical batch should be 3 hrs, by giving nearly 10-15 minutes for each student. The project/field study/viva voce evaluation should be conducted by external examiners and internal examiner.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Attendance**	**10**
2	**PROJECT REPORT:**	
	Report With All General Parts – Relevance, Objective, Methodology, Data Analysis, Discussion, Conclusion And Reference etc.	**10**
	Presentation Skill	**30**
	Viva	**30**
3	Field Study Report	**10**
4	Viva	**10**

ELIGIBILITY TO APPEAR FOR PRACTICAL EXAMINATION

1. 80% Attendance (All Sem.)
2. Certified Bona-fide Record (All Sem.)
3. Herbarium and Field Book (Respective Sem.)
4. Field Study Reports (Respective Sem.)
5. Certified Bona-fide Project Report (Eighth Sem.)
6. Report on Experiential Learning (Internships etc.) (Eighth Sem.)

CONTINUOUS INTERNAL EVALUATION

Internal evaluation is a continuous evaluation in all types of courses- theory/ practical / Project / Field study. The teacher has flexibility in deciding the components and their weightage in accordance with the University Regulations, 2021-22. Internal evaluation should be very Transparent to the students and the components and relative weightage should be announced at the beginning of each learning activity by the concerned teacher. Internal evaluation should be published in the notice board, one week before the closure of each semester.

INTERNAL –THEORY

The percentile system can be adopted for calculating the internal component, test paper.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Attendance**	**10**
	Test Papers	**40**
2	**Assignment**	**20**
	Seminar	**20**
	Viva	**10**

INTERNAL – PRACTICAL

The internal evaluation may be regular internal assessment on hourly basis or unit wise, whichever is communicated with the student.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Regularity**	**25**
2	**Practical Skill-** (Sectioning, Drawing, Labeling, Record Keeping Etc)	**50**
3	**Regular Viva/Model Examination**	**25**

INTERNAL - PROJECT/FIELD STUDY/VIVA VOCE

Internal evaluation of the project should start with the beginning of the project and can be finalized by the project viva.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Participation**	**50**
2	**Viva**	**25**
3	**Field Study and other Assignment Reports**	**25**

B1. Model Programme Structure for Bachelor of Science (Basic/Hons.) Programme with Botany as Major and Zoology as Minor (bothy subjects with practical).

Sem.	Discipline Core (DSC) (Credits) (L+T+P)	Discipline Elective(DSE) / Open Elective (OE) (Credits) (L+T+P)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P)		Skill Enhancement Courses (SEC)			Total Credits
					Skill based (Credits) (L+T+P)	Value based (Credits) (L+T+P)		
I	Botany C1(4+2) Zoology C1(4+2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs. each)		SEC-1: Digital Fluency (2) (1+0+2)	Yoga (1) (0+0+2)	Health &Wellness (1) (0+0+2)	25
II	Botany C2(4+2) Zoology C2(4+2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs. each)	Environmental Studies (2)		Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1)(0+0+2)	25
Exit option with Certificate (with a minimum of 48 credits)								
III	Botany C3(4+2) Zoology C3(4+2)	OE-3 (3)	L1-3(3), L2-3(3) (4 hrs. each)		SEC-2: AI or some other SEC (2) (1+0+2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	25
IV	Botany C4(4+2) Zoology C4(4+2)	OE-4 (3)	L1-4(3), L2-4(3) (4 hrs. each)	Constitution of India (2)		Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	25
Exit option with Diploma in Science (with a minimum of 96 credits) OR Choose any one of the core subjects as Major and the other as Minor								
V	Botany C5(3+2) Botany C6(3+2) Zoology C5(3+2)	Vocational-1 (3)			SEC-3: Cyber Security or some other SEC (2) (1+0+2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	22
VI	Botany C7(3+2) Botany C8(3+2) Zoology C6(3+2)	Vocational-2 (3) Internship (2)			SEC-4: Professional Communication (2) (1+0+2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	24
Exit option with Bachelor of Science, B. Sc. Degree (with a minimum of 144 credits) or continue studies with the Major in the 4th year								
VII	Botany C9(3+2) Botany C10(3+2) Botany e C11(3)	Botany E-1 (3) Botany E-2 (3) Res. Methodology (3)						22
VIII	Botany C12(3) Botany C13(3) Botany C14(3)	Botany E-3 (3) Botany E-4 (3) Research Project (6)*						21
Award of Bachelor of Science Degree withy Honours, B.Sc. (Hons.) Degree in Botany (with a minimum of 186 credits)								

*In lieu of the research Project, two additional elective papers/ Internship may be offered.

B2. Model Programme Structure for Bachelor of Science (Basic/Hons.) Programme with both Botany & Zoology as Majors (subjects with practical) in the 3rd year.

Sem.	Discipline Core (DSC) (Credits)	Discipline Elective(DSE) / Open Elective (OE) (Credits)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P)		Skill Enhancement Courses (SEC)			Total Credits
					Skill based (Credits) (L+T+P)	Value based (Credits) (L+T+P)		
I	Botany C1(4+2) Zoology C1(4+2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs. each)		SEC-1: Digital Fluency (2) (1+0+2)	Yoga (1)(0+0+2)	Health &Wellness (1) (0+0+2)	25
II	Botany C2(4+2) Zoology C2(4+2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs. each)	Environmental Studies (2)		Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1)(0+0+2)	25
Exit option with Certificate (with a minimum of 48 credits)								
III	Botany C3(4+2) Zoology C3(4+2)	OE-3 (3)	L1-3(3), L2-3(3) (4 hrs. each)		SEC-2: AI or some other SEC (2)(1+0+2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	25
IV	Botany C4(4+2) Zoology C4(4+2)	OE-4 (3)	L1-4(3), L2-4(3) (4 hrs. each)	Constitution of India (2)		Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	25
Exit option with Diploma in Science (with a minimum of 96 credits) OR Choose both the core subjects as Majors and continue the study								
V	Botany C5(3+2) Botany C6(3+2) Zoology C5(3+2) Zoology C6(3+2)				SEC-3: Cyber Security or some other SEC (2) (1+0+2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	24
VI	Botany C7(3+2) Botany C8(3+2) Zoology C7(3+2) Zoology C8(3+2)				SEC-4: Professional Communication (2)	Sports (1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	24
Exit option with Bachelor of Science, B. Sc. Degree (with a minimum of 144 credits) or continue studies with one of the Majors in the 4th year								
VII	Zoology C9(3+2) Zoology C10(3+2) Zoology e C11(3)	Zoology E-1 (3) Zoology E-2 (3) Res. Methodology (3)						22
VIII	Zoology C12(3) Zoology C13(3) Zoology C14(3)	Zoology E-3 (3) Zoology E-4 (3) Research Project (6)*						21
Award of Bachelor of Science Degree with Honours, B.Sc. (Hons.) Degree in Zoology (with a minimum of 186 credits)								

*In lieu of the research Project, two additional elective papers/ Internship may be offered.

Curriculum Structure for the Undergraduate Degree Program

B.Sc. BOTANY

Total Credits for the Program: 176 **Starting year of implementation:**

2021-22 Name of the Degree Program: B.Sc. **Discipline/Subject: BOTANY**

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 / Name Of the course	Program outcomes that the course addresses (not more than 3 per course)	Pre-requisite course(s)	Pedagogy##	Assessment$
1	BOT A1 Microbial Diversity and Technology	PO1	---	Ex. MOOC Desk Work	Quiz
2	BOT A2 Diversity of Nonflowering Plants	PO2, PO3	BOT A1	Problem solving,	Debate
3	BOT A3 Plant Anatomy and	PO4, PO5	BOT A1 and A2		

	Developmental Biology			Book Chapter Seminar, Project based learning, Term paper Assignment, Group Discussion Research Project Instrumentation	Class work Class work Seminar Project writing Articles writing, Interpretation of results
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		
	BOT A6 Cell Biology and Genetics	PO6, PO7	BOT A6 A1 A2 A3 A4 A5		
6.	BOT A7 Plant Physiology and Biochemistry	PO6, PO7, PO9	BOT A5		
	BOT A8 Plant Biotechnology	PO8. PO9	BOT A5		
7.	BOT A9 Molecular Biology	PO8, PO9	BOT A6 A8		
	BOT A10 Seed Biology and Seed Technology	PO9, PO10	BOT A5 A8 A9		
	BOT A11 Plant Health Technology	PO9, PO10	BOT A5 A4 A8		

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 and II

Course Title: **B.Sc. BOTANY**	
Total Contact Hours: 56	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 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**

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

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 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 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 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.

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.

COURSE PATTERN AND SCHEME OF EXAMINATION FOR B.SC. / B.SC. (HONS.) AS PER NEP (2021-22 ONWARDS)																
SUBJECT : BOTANY																
Sl. No	Semester	Title Of The Paper	Teaching Hours	Hours/Week		Examination pattern Max. and Min. Marks/Paper						Duration of exam (hours)		Total marks/ paper	Credits	
						Theory			Practical							
				Theory	Practical	Max.	Min.	IA	Max.	Min.	IA	Theory	Practical		Theory	Practical
1	I	CORE SUBJECT	56	4	4	60	22	40	25	10	25	3	4	150	4	2
		OPEN ELECTIVE	42	3	-	60	22	40	-	-	-	3	-	100	3	-
		SKILL ENHANCEMENT COURSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	II	CORE SUBJECT	56	4	4	60	22	40	25	10	25	3	4	150	4	2
		OPEN ELECTIVE	42	3		60	22	40				3	-	100	3	-
		SKILL ENHANCEMENT COURSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-

IIA. Model Program Structures for the Under-Graduate Programs in Universities and Colleges in Karnataka Bachelor of Science (Basic/ Hons.) (Botany as Major)

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(5)	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)	24
II	Discipline A 2(5) **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)	24
Exit option with Certificate (48 credits)							
III	Discipline A 3(6) **Plant Anatomy and Developmental Biology** Discipline B 3(5)	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)		24
IV	Discipline A 4(5) **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)	24
Exit option with Diploma (96 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 Aware-ness (2) (1+0+2)	20
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)		20
Exit option with Bachelor of Science, B. Sc. Basic Degree (136 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 Bachelor of Bachelor of Science Honours, B.Sc. (Hons) degree in a discipline etc. (176 credits)							

Semester – 1

Title of the Paper: 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; 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.	5
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**).**	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 -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. A brief account of Vaccines.	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. Archaebacteria and Eubacteria. Ultrastructure of Bacteria; Bacterial growth and nutrition. Reproduction in bacteria- asexual and sexual methods. Study of *Rhizobium* and its applications. A brief account of Actinomycetes. Mycoplasmas and Phytoplasmas. 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 *Albugo, Neurospora, Puccinia, and Penicillium.*	5
Chapter No. 12. Lichens – Structure and reproduction. **VAM Fungi** and their significance. **Plant diseases-** Downy Mildew of Bajra, Grain smut of Sorghum, Sandal Spike and Citrus Canker. 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, NewDelhi.

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.

References:

1. Alexepoulos CJ and Mims CW. 1989. Introductory Mycology, Wiley Eastern Ltd., NewDelhi.
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 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 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

Formative Assessment	
Assessment Occasion/ type	**Weightage in Marks**
I TEST	15
II TEST	15
ASSIGNMENT	10
Total	40

Date **Course Co-ordinator** **Subject Committee Chairperson**

Contents of Practical Paper 1: Microbial Diversity and Technology
List of Experiments to be conducted

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

(Note: Submission of Practical record on the date of practical examination is compulsory)

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

Practical Question Paper I

Microbial Diversity and Technology

Time – 3 hrs **Max. marks - 25**

1. Conduct the Experiment 'A' Gram staining of the given sample (Root nodule/curd) **03 marks**

2. Perform the Experiment 'B' (Haemocytometer/Micrometry) **03 marks**

3. Identify the given sample 'C' & 'D' with reason **(2X2)** **05 marks**

4. Comment on the given slides 'E' & 'F' with labelled diagrams and reasons **(2X2)** **05 marks**

5. Identify and comment on 'G' & 'H' **(2X2)** **04 marks**

6. Record and submission **(2½ +2½)** **05 marks**

Scheme of Evaluation

1. A. – (root nodule / curd sample)
   Preparation & Identification = 2 marks, Procedure = 1 mark, **Total = 3 marks**
2. B. – Haemocytometer
   Preparation = **1½** marks, calculation= **1½** marks, **Total = 3 marks**
3. C & D – Specimens (Fungi)
   Identification & Classification = 1½ marks, Reasons = 1 mark **(2X2½)** **Total = 5 marks**
4. E & F – Fungal Slides
   Identification = 1 mark, Diagram & Reasons = 1½ mark **(2X2½)** **Total = 5 marks**
5. G & H – Mushroom Cultivation / instruments / Diseases/ colony characteristics / Scientists Photos Identification = 1 mark, Reasons = 1 **(2X2)** **Total = 4 marks**
6. Record – **2½** marks, Submission – **2½** marks (tour report) **Total = 5 marks**

I Semester

Open Elective Course (OE-1)

Title: 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	42	0	00

Content of Theory	42 Hrs
Unit – I	**14 Hrs**
Chapter – 1: 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.	**04 Hrs**
Chapter – 2: Cereals: Wheat and Rice (origin, evolution, morphology, post-harvest Processing & uses).Green revolution. Brief account of millets and their nutritional Importance.	**04 Hrs**
Chapter – 3: Legumes: General account (including chief pulses grown in Karnataka- red gram, green gram, chick pea, soybean). Importance to man and ecosystem.	**03 Hrs**
Chapter – 4: Fruits: Mango, grapes and Citrus (Origin, morphology, cultivation, processing and uses).	**03 Hrs**

Unit – II	**14 Hrs**
Chapter – 5: Cash crops: Morphology, new varieties and processing of sugarcane, products and by-products of sugarcane industry. Natural Rubber –cultivation, tapping and processing. **Chapter – 6: 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. **Chapter – 7: Beverages:** Tea, Coffee (morphology, processing & uses) **Chapter – 8: 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.	**04 Hrs** **03 Hrs** **03 Hrs** **04 Hrs**
Unit – III	**14 Hrs**
Chapter – 9: Essential Oils: General account. Extraction methods of sandal wood oil, rosa oil and eucalyptus oil. Economic importance as medicine, perfumes and insect repellents. **Chapter – 10: Drug-yielding plants:** Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Aloe vera and Cannabis. **Chapter – 11: Fibers:** Classification based on the origin of fibers; Cotton and jute (origin morphology, processing and uses). **Chapter – 12: 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.	**04 Hrs** **03 Hrs** **03 Hrs** **04 Hrs**

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.

Pedagogy:

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

Formative Assessment	
Assessment Occasion/ type	**Weightage in Marks**
I TEST	15
II TEST	15
ASSIGNMENT	10
Total	40

Date **Course Co-ordinator** **Subject Committee Chairperson**

Semester – 2

Title: 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	56Hrs
Unit –1	15
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.	5
Chapter No. 2 General characteristics of Cyanobacteria**.** Morphology and reproduction and life-cycles of *Nostoc*, *Oedogonium, Chara, Sargassum and polysiphonia*. Diatoms and their importance. Blue-green algae-A general account. Algal blooms and toxins.	5
Chapter No. 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 No. 4. Bryophytes – General characteristics and classification of Bryophytes, Diversity-habitat, Gametophytes and sporophytes.	5
Chapter No. 5 Distribution, morphology, anatomy, reproduction and life-cycles of *Riccia, Anthoceros*, and *Funaria.* Ecological and economic importance of Bryophytes.	5
Chapter No. 6. . Pteridophytes- General characteristics and classification; Structure of sporophytes and life-cycles. Distribution, morphology, anatomy, reproduction and life-cycles in *Selaginella*, *Equisetum* and *Pteris*.	5
Unit – 3	15
Chapter No. 7 A brief account of heterospory and seed habit. Stelar evolution in Pterodophytes. 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 *Cycas, Pinus* and *Gnetum*.	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.	5
Chapter No. 12. Fossil taxa- *Rhynia, Lepidodendron, and Cycadeoidea*. 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, Elsievier, 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 Unversity 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 Unversity Press, Cambridge. 4th edition.McGraw Hill Publishing Co., New Delhi.

12. Parihar, N.S. 1970. An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book, Allhabad.

13. Parihar, N.S. (1976) An Introduction to Pteridophytes, Central Book Depot, Allhabad.

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 Unversity 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.

Formative Assessment	
Assessment Occasion / type	**Weightage in Marks**
I TEST	15
II TEST	15
ASSIGNMENT	10
Total	40

Date **Course Co-ordinator** **Subject Committee Chairperson**

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

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

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

Practical-3: Study of morphology, classification, reproduction and life-cycle of *Anthoceros & Funaria.*

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.*

Practical -6: Study of morphology, classification & anatomy, reproduction in *Pinus*.

Practical -7: Study of morphology, classification & anatomy, reproduction in *Gnetum*.

Practical -8: Study of important blue green algae causing water blooms in the lakes.

Practical -9: Study of different methods of cultivation of ferns in a nursery.

Practical -10: Media preparation and cultivation of *Spirulina*.

Practical -11: Study different algal products and fossils impressions and slides.

Practical-12: Visit to algal cultivation units/lakes with algal blooms/Fern house/ Nurseries/Geology museum/lab to study plant fossils.

(Note: Submission of Practical record on the date of practical examination is compulsory)

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

Visit or cultivation of 1 fern (Visit 01 mark / Submission of 01 potted fern 01 mark).

Practical question paper – II
Diversity of Non- Flowering Plants

Time- 3 hrs **Max. marks - 25**

1. Identify and classify the specimens 'A', 'B' & 'C' with reasons **(3X $2^1/_2$)** **$7^1/_2$ marks**
2. Comment on the permanent slides 'D', 'E' & 'F' with labelled diagrams and reasons **(3X $2^1/_2$)** **$7^1/_2$ marks**
3. Mounting/Temporary slide preparation 'G' (Algae) **02 marks**
4. Comment on 'H' & 'I' (Mounting pollen/Sporangia & Fossil) **(2X2)** **04 marks**
5. Record and submission **(2 X 2)** **04 marks**

Scheme of Evaluation

1. A, B & C. (A - Bryophyte, B – Pteridophytes, C - Gymnosperms) **(3X $2^1/_2$)**
   Identification & Classification = **$1^1/_2$** marks, reasons = 1 mark, **Total = $7^1/_2$ marks**
2. D, E & F. (D – Algae / Bryophyte, E – Pteridophyte, F – Gymnosperms) **(3X $2^1/_2$)**
   Identification = 1 mark, Diagram & Reasons = **$1^1/_2$** marks, **Total = $7^1/_2$ marks**
3. G – (Mounting of Algal specimen)
   Mounting = 1 marks, Identification + Reasons = 1 marks, **Total = 2 marks**
4. H &I – (Pinus pollen grain / Fern sporangia & Fossil slides / photograph) **(2X2)**
   H - Mounting = 1 mark, Reasons = 1mark,
   I – Identification = 1 mark, Reasons = 1 mark **Total = 4 marks**
5. Record and submission
   Record = 2 marks, Tour report = 1 mark, 1 algal submission **or**
   1 potted fern plant grown by the student = 1 mark (student must be able to identify the fern with salient features) **Total = 4 marks**

II Semester

Open Elective (OE-2)

Title: 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.
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	
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.	08
Unit II	
Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy. Seed storage: Types of storage, Seed banks, factors affecting seed viability, seed germination and seed production technology. Seed testing and certification.	08

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.	08
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.	10
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.	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.

Pedagogy:

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

Formative Assessment	
Assessment Occasion/ type	**Weightage in Marks**
I TEST	15
II TEST	15
ASSIGNMENT	10
Total	40

Date **Course Co-ordinator** **Subject Committee Chairperson**

MODEL QUESTION PAPER

B.Sc. BOTANY (UG) SEMESTER I & II Examination

TIME: 3 Hrs **Max. Marks: 60**

Instructions: 1. Answer all questions

2. Draw diagrams wherever necessary

SECTION – A

I. Answer any FIVE of the following **5 X2=10**

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

SECTION – B

II. Answer any FOUR of the following **4X5=20**

9.
10.
11.
12.
13.
14.

SECTION – C

III. Answer any THREE of the following **3X10=30**

15.
16.
17.
18.
19. a).
b).

Blue print of the question paper

	No. of questions from each units		
Unit	**2 marks**	**5 marks**	**10 marks**
I	2	1 + 1	1
II	2	1 + 1	1
III	2	1	1 + ½
IV	2	1	1 + ½
Total No. of questions	**8**	**6**	**5**

Note: Equal importance and weightage is to be given to each units. **Section – C. Question No. 19**. a). and b). Which carries 5 marks each to be selected from the units III & IV.

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

Job opportunities in Botany

Exit After **TWO** Year: **Diploma Course**

III Semester: A3: Plant Anatomy and Developmental Biology

IV Semester: A4: Ecology and Conservation Biology

Job opportunities in Botany
In Addition to one year certificate • Preparation of Anatomy embryology and Ecological slides for educational institutions and other line departments (Entrepreneurship). • Providing Anatomy embryology and Ecological materials for educational institutions and other line departments (Entrepreneurship). • Lab technician • Garden / nursery supervisor • Developing his/her own nursery (Entrepreneurship). • Forest guard, Wild life watch guard.

Job opportunities in Botany

Exit After **THREE** Year: **Degree Course**

V Semester- A5: Plant Taxonomy and Resource

Botany V Semester- A6: Genetics and Cell Biology

VI Semester- A7: Plant Physiology and Biochemistry

VI Semester- A8: Plant Biotechnology

Job opportunities in Botany
In Addition to two year diploma • Supplying the angiosperm plants and cytological slides to the educational institutions and other line departments (Entrepreneurship). • Advisor for Health department • Marketing NTFPs species (Entrepreneurship). • RFO/ forest officers • Biochemical Laboratory (Soil, Water, Air testing etc). (Entrepreneurship). • Adviser to grow advanced crop (Biotech crop). • Farmer friendly liaison officer.

Job opportunities in Botany

Exit After FOUR Year: Degree Course (Honors)

VII Semester- **A9: Molecular Biology**

VII Semester- **A10: Seed Biology and Seed Technology**

VII Semester- **A11: Plant Health Technology**

VIII Semester- **A12: Medicinal Plants and Phytochemistry**

VIII Semester- **A13: Bioinformatics & Computational Biology**

VIII Semester- **A14: Research Methodology**

Jobs opportunities in Botany

In Addition to three year degree

- Assisting for Ayurvedic doctors.
- Medicinal plants Marketing (Entrepreneurship).
- R & D Botany, Biotechnology, Ayurvedic and Pharmaceutical Lab.
- Laboratory on checking food adulteration (Entrepreneurship).
- Soil and water assessment laboratory (Entrepreneurship).
- Biological material analysis Laboratory (Entrepreneurship).
- Teacher in primary and High Schools.
- Prepare for joining Research institution for Ph.D. programmes.
- Wild life photographer
- Separation and Analyzing phytochemical compounds.
- Seed technician.
- Plant health manager

ಬೆಂಗಳೂರು
ನಗರ ವಿಶ್ವವಿದ್ಯಾಲಯ

BENGALURU
CITY UNIVERSITY

ಆಗು ನೀ ಅನಿಕೇತನ
BE BOUNDLESS

BANGALORE CITY UNIVERSITY

DEPARTMENT OF BOTANY

SYLLABUS FOR

B.Sc. BOTANY (UG)

III & IV SEMESTERS

Choice Based Credit System (CBCS PATTERN)

Framed According to the National Educational Policy

(NEP 2020)

To be implemented from the academic year

2022-23

Proceedings of the meeting of BOS (UG) in Botany held on 7th September 2022 at Board Room, CBSMS, Central College Campus, Bangalore City University, Bengaluru – 560 001

Venue: Board Room, CBSMS, Central College Campus, Bangalore City University, Bengaluru – 560 001

Date: 07/09/2022 Time: 11:00 AM

Agenda:

1. To finalize the syllabus for III and IV Semester B.Sc. Botany (UG) (CBCS) NEP-2020 for approval.
2. To approve the panel of examiners recommended for the examinations of 2022-23.
3. To recommend and approve the constitution of BoE for the academic year 2022-23.

Members Present		Signature
1. Smt. Zaiba Nishanth Banu	Member	
2. Dr. Mallikarjuna P.B.	Member	
3. Dr. B. L. Manjula	Member	
4. Smt. K. R. Kavitha	Member	7/9/2022
5. Smt. N. Sarvamangala	Member	
6. Smt. K.S. Shailaja	Member	
7. Smt. Chandrakala S	Member	7/9/22
8. Dr. (Smt.) Anitha P	Co-opted Member	ABSENT
9. Dr. L. Rajanna	Chairman	7/9/2022

Members Absent

1. Dr. Jenifer Lolitha Member

MINUTES OF THE MEETING OF BoS (UG) IN BOTANY

Chairman welcomed the members of the BoS (UG) to the meeting and the agenda was placed for discussion.

a). Discussed and finalized the theory and practical syllabus of III and IV Semester B.Sc., Botany (CBCS), question paper pattern, blue print of question paper Formative assessment and Scheme of valuation for NEP programme to be implemented from the academic year 2022-23.

b). The panel of Examiners was approved and recommended for UG Examination for the academic year 2022-23.

c). Recommendations were made to constitute BoE for the academic year 2022-23.

d). The Chairman was authorized to change / incorporate the corrections as per the directions of Bangalore City University.

The meeting ended with a vote of tanks by the Chairman.

1 K.R. Kavitha

2 Shailaja J.S. Sli

3 N. SARVAMANGALA. N. Sarvamangala

4 ZAIBA NISHATH BANO Zai BB

5 Dr. P.B. Mallikarjuna, Associate Professor, GFGC Yelahanka-64, PB M

6 Dr. B.L. Manjula, Associate Professor, SJRC, Race Course road, B'lore-9 Manjula

7 Chandrakala. S. Assistant professor, SJRCW,

8. Dr. L. Rajanna Rajajinagar, B'lore-
07/9/2022 7/9/22.

Karnataka State Higher Education Council

BOTANY Syllabus Framing Committee

Sl No	Name	Designation	Signature
1.	Prof. G R Naik, Vice Chancellor, Garden City University, Bengaluru	Chairperson	
2.	Dr. A. H. Rajasab, Pro Vice Chancellor, KNB University, Kalaburagi	Member	
3.	Dr. G.R. Janardhana, Professor, University of Mysore, Mysuru	Member	
4.	Dr. H. Niranjanamurthy, Professor, Karnataka University, Dharwad	Member	
5.	Dr. L. Rajanna, Professor, Bangalore University, Bengaluru	Member	
6.	Dr. Krishna Kumar G, Professor, Mangalore University, Konaje	Member	
7.	Dr. M.B. Shivanna, Professor, Kuvempu University, Shivamogga	Member	
8.	Dr. Govindappa M, Professor, Davangere University, Davangare	Member	
9.	Dr H.Ramakrishnaiah, Registrar and Associate Professor, Maharani Cluster University, Bengaluru	Member	
10.	Shri. M. N. Mallikarjunaiah, Associate Professor, Mandya University, Mandya	Member	
11.	Shri. Rangaswamy R.K. Government Science College, Chitradurga	Member	
12.	Dr. Abdul Khayum, Associate Professor, Government Women's College, Kolar	Member	
13.	Dr. Mamtha, Associate Professor, Government First Grade College,Bengaluru	Member	
14.	Dr. Jayakara Bhandary, Associate Proessor, Government First Grade College, Mangalore	Member	
15.	Dr. R.J. Katti, Associate Professor, Kittel College Dharwad	Member	
16.	Shri L.S. Ramesh, Special Officer, Karnataka State Higher Education Council	Member Convener	

Index		
Sl. No.	**Content**	**Page No.**
1.	Index	05
2.	Course pattern and scheme of Examination	06
3.	Theory: Discipline Specific Core Course (DSCC) Syllabus of III Semester Paper: **BOT-A- 3.1**	07-08
4.	Practical: Discipline Specific Core Course (DSCC) **BOT-A-3.2**	09-10
5.	Scheme and Model Question paper for practical exam of **BOT-A-3.2**	11
6.	Model Question paper for Theory **BOT-A-3.1**	12
7.	Open Elective Course (OEC-3) (**OEC for other students**) **OEC- 3.3**	13-14
8.	Theory: Discipline Specific Core Course (DSCC) **BOT-A- 4.1**	15-16
9.	Practical: Discipline Specific Core Course (DSCC) **BOT-A- 4.2**	17-18
10.	Scheme and Model Question paper for practical exam of **BOT-A-4.2**	19
11.	Model Question paper for Theory **BOT-A-4.1**	20
12.	Open Elective Course (OEC-4) (OEC for other students) **OEC- 4.3**	21-22
13.	Formative Assessment for Theory PAPER DSCC **BOT-A-3.1** & **BOT-A-4.1** and Practical **BOT-A-3.2** & **BOT-A-4.2**	23
14.	Weightage of Marks	24
15.	Blueprint	25

COURSE PATTERN AND SCHEME OF EXAMINATION FOR B.SC. / B.SC. (HONS.) AS PER NEP (2022-23 ONWARDS)																
SUBJECT : BOTANY																
Sl. No	Semester	Title Of The Paper	Teaching Hours	Hours/Week		Examination pattern Max. and Min. Marks/Paper						Duration of exam (hours)		Total marks/ paper	Credits	
						Theory			Practical							
				Theory	Practical	Max.	Min.	IA	Max.	Min.	IA	Theory	Practical		Theory	Practical
1	III	CORE SUBJECT	56	4	4	60	21	40	25	09	25	3	4	150	4	2
		OPEN ELECTIVE	42	3	-	60	21	40	-	-	-	3	-	100	3	-
		SKILL ENHANCEMENT COURSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	IV	CORE SUBJECT	56	4	4	60	21	40	25	09	25	3	4	150	4	2
		OPEN ELECTIVE	42	3		60	21	40				3	-	100	3	-
		SKILL ENHANCEMENT COURSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-

B.Sc. BOTANY: Semester - 3

Theory: Discipline Specific Core Course (DSCC)

Title of the Course and Code:

BOT-A-3.1: PLANT ANATOMY AND DEVELOPMENTAL BIOLOGY

Course code	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
BOT-A-3.1	DSCC	Theory	04	04	56 Hrs.	3 Hrs.	40	60	100

Course Outcomes:

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

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. Induction of the enthusiasm on internal structure of locally available plants.
4. Understanding various levels of organization in a plant body with an outlook in the relationship between the structure and function through comparative studies.
5. Observation and classification of the floral variations from the premises of college and house.
6. Understanding the various reproductive methods sub-stages in the life cycle of plants
7. Observation and classification of the embryological variations in angiosperms.
8. Enthusiasm to understand evolution based on the variations in reproduction among plants.

PLANT ANATOMY

Unit 1: ANGIOSPERM ANATOMY AND PLANT TISSUES: 14 Hrs.

Introduction, objectives and scope of Plant Anatomy, Plant primary and secondary cell wall structure.

Tissue and tissue systems - Meristematic tissue, permanent tissue and secretary cells.

Classification of meristem: (apical, intercalary and lateral), primary and secondary meristems.

Apical meristem*:* Theories on organization of meristem (apical cell theory, Tunica-Corpus theory, histogen theory and Korper-Kappe theory).Quiescent centre, Root cap.

Unit II: DIFFERENTIATION 14 Hrs.

Differentiation of root, stem and leaf.

Types of vascular bundles and Vascular cambium

Structure of Dicot root: primary (*Tridax* and *Cicer)*.

Structure of monocot root (Maize).

Structure of Dicot stem: Primary and secondary growth (*Tridax* and *Cicer*).

Structure of Monocot stem (Maize).

Structure of Dicot and Monocot leaf: primary structure (*Tridax* and Maize), Stomatal types.

Anomalous secondary growth: *Boerhaavia* (dicot stem) and *Dracaena* (monocot stem)

DEVELOPMENTAL BIOLOGY

Unit III: MORPHOGENESIS 14 Hrs.

Differentiation, cell polarity and symmetry in unicellular and multicellular systems
Shoot Apical meristem (SAM): Origin, structure and function
Organogenesis: Differentiation of root, stem, leaf and axillary buds.
Mechanism of leaf primordium: initiation & development
Structure and function of root apical meristem (RAM): Root cap, quiescent centre and origin of lateral roots.
Transition from vegetative apex into reproductive apex.
Developmental patterns at flowering apex: ABC model specification of floral organs.

Unit IV: REPRODUCTIVE BIOLOGY 14 Hrs.

Introduction, Scope and contributions of Indian embryologists: P. Maheshwari and B G L Swamy.

Microsporangium: Structure and Development of anther,
Tapetum – Types, structure and functions and sporogenous tissue.
Microsporogenesis - Microspore mother cell, microspore tetrads, massulae and Pollinia.
Microgametogenesis – Formation of vegetative and generative cells,
Structure of male gametophyte. Pollen embryo sac (Nemec phenomenon).

Megasporangium – Structure of typical Angiosperm ovule (Anatropous).
Types of ovules- Anatropous, Orthotropous, Amphitropous and Circinotropous.
Megagametogenesis – Types of development of Female gametophyte/embryo sac-
Monosporic- *Polygonum* type, Bisporic – *Allium* type, Tetrasporic - *Fritillaria* type.
Structure of mature embryo sac.

Pollination and fertilization: Structural and functional aspects of stigma and style,
Double fertilization and its significance. Post fertilization changes.

Endosperm – Types and its biological importance. Free nuclear (*Cocos nucifera*)
Cellular (*Cucumis),* Helobial types and Ruminate endosperm.

Embryogenesis – Dicot (*Capsella bursa-pastoris)* embryo development.
A brief account of seed development.

B.Sc. BOTANY: Semester – 3

Practical: Discipline Specific Core Course (DSCC)
Title of the Course and Code:
BOT-A-3.2: PLANT ANATOMY AND DEVELOPMENTAL BIOLOGY

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
BOT-A-3.2	DSCC	Practical	02	04	52 hrs	3hrs	25	25	50

LIST OF EXPERIMENTS TO BE CONDUCTED

Practical No.1

Study of meristem (Permanent slides/ Photographs).
Study of Simple Tissues (Parenchyma, Collenchyma and Sclerenchyma)
Complex tissues (xylem and phloem).

Practical No.2

Maceration technique to study elements of xylem and phloem, Study of primary structure of dicot root, stem and leaf (*Tridax*) and monocot root, stem and leaf (Maize) Permanent slides.

Practical No.3

Study of Normal secondary growth structure in dicot stem and root (*Tridax*).
Anomalous secondary growth: *Boerhavia* (dicot stem) and *Dracaena* (monocot stem).

Practical No. 4

Study of trichomes (any three types) and stomata (any three types) with the help of locally available plant materials.

Practical No. 5

Permanent slides of Microsporogenesis and male gametophyte. Mounting of Pollen grains (Grass and *Hibiscus*) and Pollinia of *Calotropis*.

Practical No. 6

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

Practical No. 7

Permanent slides of types of ovules, Megasporogenesis and embryo sac development
Types of placentation: Axile, Marginal and Parietal. Sectioning of ovary (for the studied types of placentation).

Practical No. 8

Mounting of embryo: *Tridax* and *Cyamopsis*, Mounting of endosperm: *Cucumis*.

Practical No. 9, 10 and 11

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

a) Study of pollen morphology of different flowers with respect to shape, colour and apertures etc.,
b) Pollen germination of different pollen grains and calculate the percentage of germination.
c) Calculating percentage of germination of one particular type of pollen grain collected from different localities/ under different conditions.
d) Study of placentation of different flowers.
e) Any other relevant study related to Anatomy / Embryology.

(**Typed report to be submitted**)

REFERENCES:

1. Bhojwani and Bhatnagar (2003). Introduction to Embryology of Angiosperms – Oxford & IBH, Delhi
2. Bhojwani Sant Saran, (2014). Current Trends in the Embryology of Angiosperms**,** Woong-Young Soh, Springer Netherlands,
3. Coutler E. G., (1969). Plant Anatomy – Part I Cells and Tissues – Edward Arnold, London.
4. Dickison, W.C. (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA
5. Eames A. J. (1977). - Morphology of Angiosperms - Mc Graw Hill, New York.
6. Esau, K. (1990). Plant Anatomy, Wiley Eastern Pvt Ltd New Delhi
7. Evert, R.F. (2006) Esau's Plant Anatomy: Meristem, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc
8. Fahn, A. (1992). Plant Anatomy, Pergamon Press, USA
9. Johri, B.M. (1984).Embryology of Angiosperms, Springer-Verlag, Netherlands.
10. Karp G., (1985). Cell Biology; Mc.Graw Hill Company
11. Maheshwari, P (1950). An introduction to the embryology of angiosperms. New York: McGraw-Hill
12. Mauseth, J.D. (1988). Plant Anatomy, the Benjammin/Cummings Publisher, USA.
13. Nair P .K .K (1970). 1- Pollen Morphology of Angiosperms - Scholar Publishing House, Lucknow
14. Pandey S.N. (1997). Plant Anatomy and Embryology.A. Chadha, Vikas Publication House Pvt Ltd;
15. Pandey, B. P., (1997). Plant Anatomy, S.Chand and Co. New Delhi
16. Raghavan, V., (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
17. Saxena M. R. – Palynology – A treatise - Oxford & I. B .H. New Delhi.
18. Shivanna, K.R., (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt.Ltd. Delhi.
19. Vashishta .P.C., (1984). Plant Anatomy – Pradeep Publications – Jalandhar
20. Vashishta, P.C. (1997). Plant Anatomy, Pradeep Publications

(DSCC)

SCHEME OF BOTANY PRACTICAL EXAMINATION
III SEMESTER: PAPER BOT-A-3.2

MODEL QUESTION PAPER

Title of the Paper: PLANT ANATOMY AND DEVELOPMENTAL BIOLOGY

Time: 3 Hours **Max Marks- 25**

I. Prepare a temporary stained slide of the given material **A**, leave the preparation for Evaluation. **05 Marks**
(Dicot/Monocot: Root/ Stem)
(Preparation 1 Mark, Identification 1Mark, labelled diagram 1 Mark, Reasons-2 Marks)

II. Identify the given slides **B, C, D & E** **4X2 = 08 Marks**
(**B** from Tissues, **C, D** from Anatomy, **E** from Embryology)
(Identification-½ Mark, Diagram ½ Mark, reasons 1 Mark)

III. Mount the material **F** and comment **02 Marks**
(Pollen grain/Stomata/Trichomes)
(Mounting - 1 Mark, Diagram ½ Mark, Reasons-½ Mark)

1V. Mount the material **G** (Endosperm / Embryo) and comment / Perform pollen germination.
(Preparation 1 Mark, Diagram 1 Mark, reasons 1 mark) **03 Marks**

V. VIVA VOCE…….. 02 Marks

Mini Project……. 02 Marks

Practical record……. 03 Marks

(DSCC)

SCHEME OF BOTANY THEORY EXAMINATION III SEMESTER: PAPER BOT-A-3.1

MODEL QUESTION PAPER

Title of the Paper: PLANT ANATOMY AND DEVELOPMENTAL BIOLOGY

Time: 2½ Hours **Max Marks- 60**

Instructions: Draw neat labelled diagrams wherever necessary

I. Define/Explain any Four of the following: 2X4=8 Marks

1.
2.

3.

4.

5.

6.

II. Answer any Four of the following: 5X4=20 Marks

7.
8.

9.

10.

11.
12.

III. Answer any Four of the following: 8X4=32 Marks

13.
14.

15.

16.

17.

18.

B.Sc. BOTANY – III Semester

Open Elective Course (OEC-3) (OEC for other students)

Paper: Landscaping and Gardening

Code: OEC-3.3

Course code	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
OEC-3.3	OEC	Theory	03	03	42 hrs	2 hrs	40	60	100

Learning outcomes:

After the completion of this course the learner will be able to:

- Apply the basic principles and components of gardening
- Conceptualize flower arrangement and bio-aesthetic planning
- Design various types of gardens according to the culture and art of bonsai
- Distinguish between formal, informal and free style gardens
- Establish and maintain special types of gardens for outdoor and indoor landscaping

Unit I **14 Hrs.**

Principles of gardening, garden components, adornments, methods of designing rockery, water garden, etc. their walk-paths, bridges, constructed features. Special types of gardens, trees, their design, values in landscaping, propagation, planting shrubs and herbaceous perennials. Importance, design values, propagation, planting of climbers and creepers, palms, ferns, grasses and cacti succulents.

Unit II **14 Hrs.**

Flower arrangement: importance, production details and cultural operations, constraints, post-harvest practices. Bio-aesthetic planning: definition, need, round country planning, urban planning and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds.

Unit III **14 Hrs.**

Vertical gardens and public gardens. Landscape designs, Styles of garden, formal, informal and freestyle gardens, types of gardens, Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, road sides, traffic islands, dam sites, IT parks and corporate. Establishment and maintenance, Bio-aesthetic planning, eco-tourism, therapeutic gardening, non-plant components, water-scaping, xeri-scaping, hard-scaping; outdoor and indoor scaping, exposure to CAD (Computer Aided Designing).

REFERENCES:

1. Berry, F. and Kress, J. (1991). Heliconia: An Identification Guide. Smithsonian Books
2. Butts, E. and Stensson, K. (2012). Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd.
3. Sudhir Pradhan (2018). Landscape gardening. Scientific Publishers India.
4. Gavino Merlo (2018). Floriculture and landscaping. Scitus Academics LLC.
5. Percy Lancasters (2004). Gardening in India. Oxford & IBH publishers.
6. Laeeq Futehally (2008). Gardens. National book trust India Publishers.
7. Ekta Chaudhary (2022). Garden Up. Penguin Random House India publishers.
8. Prathap Rao M (2020). Landscape Design. Standard Publishers and Distributors Pvt.
9. Percy Lancasters (2008). Gardening in India. 2nd Edition, Oxford & IBH publishers

B.Sc. BOTANY: Semester - 4

Theory: Discipline Specific Core Course (DSCC)

Title of the Course and Code:

BOT-A-4.1: ECOLOGY AND CONSERVATION BIOLOGY

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures / Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
BOT-A-4.1	DSCC	Theory	04	04	56 hrs	3hrs	40	60	100

Course Outcomes:

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

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.

ECOLOGY

Unit 1: INTRODUCTION TO ECOLOGY AND CONSERVATION BIOLOGY: 14 Hrs.

Definition, Principles of Ecology, Brief history, Major Indian Contributions, Scope and importance.

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

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

Topographic Factors: Altitude.

Ecological groups of plants and their adaptations: Morphological and anatomical adaptations of hydrophytes, xerophytes, epiphytes and halophytes.

Unit 2: ECOSYSTEM ECOLOGY: 14 Hrs.

Introduction, types, Biotic and Abiotic components and structure of ecosystems with examples -terrestrial and Aquatic.

Ecosystem functions and processes: Food chain and Food web. Ecological pyramids – Pyramids of number, energy and biomass. Energy flow in ecosystem.

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

Community Ecology: Community and its characteristics – frequency, density, Abundance, cover and basal area, phenology, stratifications, life-forms. Concept of Ecotone and Ecotypes. Intra-specific and Inter-specific interactions with examples.

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

Unit 3: PHYTOGEOGRAPHY AND ENVIRONMENTAL ISSUES: 14 Hrs.

Theory of continental drift. Centres of origin of crop plants – Vavilov's concepts. Phytogeographical regions of India.

Vegetation types of Karnataka – Composition and distribution of evergreen, semi-evergreen, deciduous, scrub, mangroves, shola forests and grasslands.

An account of the vegetation of the Western Ghats of Karnataka.

Pollution: Water pollution: Types, causes and effects; water quality indicators, water quality standards in India and control of water pollution (Waste water treatment).

Water pollution disasters – National mission on clean Ganga, Handigudu and Minimata

Air pollution: Causes, effects, air quality standards, acid rain and control.

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

Unit 4: BIODIVERSITY AND ITS CONSERVATION: 14 Hrs.

Biodiversity: Definition, types of biodiversity - habitat diversity, species diversity and genetic diversity, Sustainable Development Goals (SDG's) in biodiversity conservation.

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

Concept of Biodiversity hotspots.

Concept of endemism and endemic species.

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

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

In-situ methods –Biosphere reserves, National parks, Sanctuaries and Sacred grooves.

Ex-situ methods-Botanical gardens, Seed bank, Gene bank and Pollen bank Cryopreservation.

B.Sc. BOTANY: Semester – 4

Practical: Discipline Specific Core Course (DSCC)

Title of the Course and Code:

BOT-A-4.2: ECOLOGY AND CONSERVATION BIOLOGY

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
BOT-A-4.2	DSCC	Practical	02	04	52 hrs	3hrs	25	25	50

LIST OF EXPERIMENTS TO BE CONDUCTED

Practical No.1

Determination of pH of different types of Soils. Estimation of salinity of soil/water.

Practical No.2

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

Practical No.3

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

Practical No. 4

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

Practical No. 5

Epiphytes: Morphological adaptations in *Acampe, Bulbophyllum, Drynaria*. Anatomical adaptations in epiphytic root of *Acampe/ Vanda.*Halophytes: Morphology and anatomy of Pneumatophores.

Practical No. 6

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

Practical No. 7

Demonstration of different types of vegetation sampling methods – transects and quadrats. Determination of Density and frequency.

Practical No. 8

Application of remote sensing to vegetation analysis using satellite imageries

Practical No. 9

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

Practical No. 10

Determination of water holding capacity of soil samples

Practical No. 11

Determination of Biological oxygen demand (BOD)

Practical No. 12

Determination of Chemical oxygen demand (COD).

Practical No. 13

Determination of soil texture of different soil samples.

REFERENCES:

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

DSCC

SCHEME OF BOTANY PRACTICAL EXAMINATION IV SEMESTER BOT-A-4.2

MODEL QUESTION PAPER

Title of the Paper: ECOLOGY AND CONSERVATION BIOLOGY

Time: 3 Hours **Max Marks- 25**

I. Conduct the BOD/COD of Water sample **A.** **06 Marks**
(Requirement and procedure -2,Marks, Principle 1Mark, Conducting -2 marks, Result – 1 Mark)

II. Write the ecological adaptations of **B ,C & D** **3X2 = 06 Marks**
(Hydrophytes, Xerophytes, Epiphyte and Halophyte)
(Identification-1 Mark, Labelled diagram and comments-1Mark)

III. Comment on **E** (Ecological instruments) **02 Marks**
(Instruments studied in Practical. Idenfiaction-1Mark, Diagram and description 1Mark)

IV. Identify the slides/Chart **F** & **G** **2X2 = 04 Marks**

(One from adaptations, one from remote sensing of Satellite image or quadrat) (Identification 1Mark, Labelled diagram and comment 1Mark)

V. VIVA VOCE……. **02 Marks**

Field Visit……. **02 Marks**

Practical record……. **03 Marks**

(DSCC)

SCHEME OF BOTANY THEORY
EXAMINATION III SEMESTER: PAPER
BOT-A-4.1

MODEL QUESTION PAPER

Title of the Paper: ECOLOGY AND CONSERVATION BIOLOGY

Time: 2½Hours **Max Marks- 60**

Instructions: Draw neat labelled diagrams wherever necessary

IV. Define/Explain any Four of the following: **2X4=8 Marks**

1.
2.

3.

4.

5.

6.

V. Answer any Four of the following: **5X4=20 Marks**

7.
8.

9.

10.

11.
12.

VI. Answer any Four of the following: **8X4=32 Marks**

13.
14.

15.

16.

17.

18.

B.Sc. BOTANY – IV Semester

Open Elective Course (OEC- 4) (OEC for other students)

Paper: Floriculture

Code: OEC-4.3

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures / Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
OEC-4.3	OEC	Theory	03	03	42 hrs	2 hrs	40	60	100

Learning outcomes:

After completing this course the learner will be able to:

- Develop conceptual understanding of gardening from historical perspective
- Analyse various nursery management practices with routine garden operations.
- Distinguish among the various Ornamental Plants and their cultivation
- Evaluate garden designs of different countries
- Appraise the landscaping of public and commercial places for floriculture.
- Diagnoses the various diseases and uses of pests for ornamental plants

Unit I **14 Hrs.**

Introduction: History of gardening; Importance and scope of floriculture and landscape gardening. Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.

Unit II **14 Hrs.**

Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and fern allies; Cultivation of plants in pots; Indoor gardening; Bonsai. Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flowerbeds, Shrubbery, Borders) Water-garden. Some Famous gardens of India.

Unit III **14 Hrs.**

Landscaping Places of Public Importance: Landscaping highways and Educational institutions. Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolus, Marigold, Rose, Lillium, and Orchids). Diseases and Pests of Ornamental Plants.

REFERENCES:

1. Randhawa, G.S. and Mukhopadhya, A. (1986).Floriculture in India. Allied Publishers.
2. Adams, C., M. Early and J. Brook (2011). Principles of Horticulture. 6th Edition, Routlledge Publishers London.
3. Chowdhari T.K.*et al* (2022) Text book on Floriculture Vol. 1 Narendra Publishing House New Delhi.
4. Anil K Singh and Anjana Sisodia (2017). Text Book of Floriculture and Landscaping. Nipa Genx Electronic resources and Solutions Pvt. Ltd.
5. Text Book of Floriculture & Landscaping by Anil K Singh, Anjana Sisodia (2020), New India Publishing Agency (Publisher)
6. Bharati Kashyap, Anil K. Thakur. (2020). Dinesh Gardening & Floriculture (Skill Enhancement Course) S Dinesh and Co Publishers.
7. Arvinder Singh and Nomita Laishram (2013). Objective Floriculture. Kalyani Publishers.
8. Subhash V. Ahire, Sharayu D. Sathe, Sanjay P. Ghanwat, Hemanthkumar A. Thakur, Bapu K. Avchar (2015). Horticulture And Floriculture, Success publishers, Pune.

Formative Assessment for Theory PAPER DSCC BOT-A-3.1 & A- 4.1	
Assessment	**40 Marks**
C1= Test I & II	(10+10) = 20 Marks
C2 = Assignment and continuous evaluation +Seminar	(10+10) = 20 Marks

Formative Assessment for Practical PAPER DSCCA-3.2 & A-4.2	
Assessment	**25 Marks**
C1= I A Test	15 Marks
C2 = Assignment+ Project Report	(5+5) = 10 Marks

Weightage of Marks DSCC B O T - A-3 & A-4				
Units	**2 marks**	**5 marks**	**8 marks**	**Total Marks.**
I	2X2=4	5X2=10	8X1=08	22
II	2X1=2	5X1=05	8X2=16	23
III	2X2=4	5X2=10	8X1=08	22
IV	2X1=2	5X1=05	8X2=16	23
S	12 Marks	30Marks	48 Marks	90 Marks

Blue print of the question paper

	No. of questions from each units		
Unit	**2 marks**	**5 marks**	**10 marks**
I	2	1 + 1	1
II	2	1 + 1	1
III	2	1	1 + ½
IV	2	1	1 + ½
Total No. of questions	**8**	**6**	**5**

Note: Equal importance and weightage is to be given to each units. **Section – C. Question No. 19**. a). and b). Which carries 5 marks each to be selected from the units III & IV.

BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM

(Semester Scheme with Multiple Entry and Exit Options for Under Graduate Course)

Syllabus for Botany
(V & VI Semester)

2023-24

Proceedings of the meeting of BoS (UG) in Botany held on 29th & 30th August 2023 at the Department of Biochemistry, Central College Campus, Bangalore City University, Bengaluru – 560 001

Venue: Department of Biochemistry, Central College Campus, Bangalore City University, Bengaluru – 560 001

Date: 30/08/2023 Time: 11:00 AM

Agenda:

1. To finalize the syllabus for V and VI Semester B.Sc. Botany (UG) (CBCS) NEP-2020 for approval.
2. To approve the panel of examiners recommended for the examinations of 2023-24.
3. To recommend and approve the constitution of BoE for the academic year 2023-24.

Members Present		Signature
1. Smt. Zaiba Nishaath Banu	Member	
2. Dr. Mallikarjuna P.B.	Member	
3. Dr. B. L. Manjula	Member	
4. Smt. K. R. Kavitha	Member	K.R.Kavitha 30/8/2023
5. Smt. Chandrakala S	Member	
6. Smt. K.S. Shailaja	Member	ABSENT
7. Dr. L. Rajanna	Chairman	

Members Absent

1. Dr. Jenifer Lolitha Member
2. Smt. N. Sarvamangala Member

MINUTES OF THE MEETING OF BoS (UG) IN BOTANY

Chairman welcomed the members of the BoS (UG) to the meeting and the agenda was placed for discussion.

a). Discussed and finalized the syllabus for theory and practical of **V** and **VI** Semester B.Sc., Botany (CBCS), question paper pattern, blue print of question paper Formative assessment and Scheme of valuation for NEP programme to be implemented from the academic year 2023-24.

b). The panel of Examiners was approved and recommended for UG Examination for the academic year 2023-24.

c). Recommendations were made to constitute BoE for the academic year 2023-24.

d). The Chairman was authorized to change / incorporate the corrections as per the directions of Bangalore City University.

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

Dr. B. L. Manjula, Associate Professor, SJRC – Race Course road, Blura-1

Smt. Chandrakala Shivakumar, Asst. Professor, SJRCW, Rajajinagar, B'lore-10

Zaiba Nushath Bano Associate Professor, Vijaya College RVRd - Zaiba

Dr. K.R.Kavitha, Professor, Nrupathunga Univ. B'lore-1 K.R.Kavitha 20/9/2023

Dr. P.B.Mallikarjuna, Professor, GFGC Yelahanka B'lore

Dr. L. RAJANNA
Professor
Dept. of Botany
Bangalore University
Jnanabharathi Campus,
Bangalore - 560056.

Chairman BOS (UG)
BCU

Karnataka State Higher Education Council

BOTANY Syllabus Framing Committee

Sl No	Name	Designation	Signature
1.	Prof. G R Naik, Vice Chancellor, Garden City University, Bengaluru	Chairman	
2.	Dr. A. H. Rajasab, Pro Vice Chancellor, KNB University, Kalaburagi	Member	
3.	Dr. G.R. Janardhana, Professor, University of Mysore, Mysuru	Member	
4.	Dr. L. Rajanna, Professor, Bangalore University, Bengaluru	Member	
5.	Dr. Y. L. Krishnamurthy Professor, Kuvempu University, Shivamogga	Member	
6.	Dr. K. Kotresha Professor, Karnataka Science College, Karnatak University, Dharwad	Member	
7.	Dr. Govindappa M, Professor, Davangere University, Davangare	Member	
8.	Shri. M. N. Mallikarjunaiah, Associate Professor, Mandya University, Mandya	Member	
9.	Dr. Abdul Khayum, Associate Professor, Government Women's College, Kolar	Member	
10.	Dr. P. Sharanappa Professor, Hassan University, Hassan	Member	
11.	Dr. Mamtha, Associate Professor, Government First Grade College, Bengaluru	Member	
12.	Dr. Lathadevi Karikal, Associate Professor, Sharanabasaveshwara University, Kalaburagi	Member	
13.	Dr. Kiran Kumar S. Associate Professor, Garden City University, Bengaluru	Member	
14.	Smt. Akshata Chandra Special Officer Karnataka State Higher Education Council	Member convener	

COURSE PATTERN AND SCHEME OF EXAMINATION FOR B.SC. / B.SC. (HONS.) AS PER NEP (2023-24 ONWARDS)																	
SUBJECT : BOTANY																	
Sl. No	Semester	Title Of The Paper	Teaching Hours	Hours/Week		Examination pattern Max. and Min. Marks/Paper						Duration of exam (hours)		Total marks/ paper	Credits	
						Theory			Practical							
				Theory	Practical	Max.	Min.	IA	Max.	Min.	IA	Theory	Practical		Theory	Practical
1	V	CORE SUBJECT	56	4	4	60	21	40	25	09	25	2 1/2	4	150	4	2
		CORE SUBJECT	56	4	4	60	21	40	25	09	25	2 1/2	4	150	4	2
		SKILL ENHANCEMENT COURSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	VI	CORE SUBJECT	56	4	4	60	21	40	25	09	25	2 1/2	4	150	4	2
		CORE SUBJECT	56	4	4	60	21	40	25	09	25	2 1/2	4	150	4	2
		SKILL ENHANCEMENT COURSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Government of Karnataka

BOTANY Curriculum

B. Sc. BOTANY – V Semester

Plant Morphology and Taxonomy (Theory)

Program Name	**B.Sc. in BOTANY**	Semester	**V**
Course Title	**Plant Morphology and Taxonomy (Theory)**		
Course Code:	**DSC – BOT-C9 - T**	No. of Credits	**04**
Contact hours	**56 Hours**	Duration of SEA/Exam	**2½ hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Pre-requisite(s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. Understanding the main features in Angiosperm evolution
CO2. Ability to identify, classify and describe a plant in scientific terms, thereby, Identification of plants using dichotomous keys. Skill development in identification and classification of flowering plants.
CO3. Interpret the rules of ICN in botanical nomenclature.
CO4. Classify Plant Systematic and recognize the importance of herbarium and Virtual Herbarium, Evaluate the Important herbaria and botanical gardens
CO5. Recognition of locally available angiosperm families and plants and economically important plants. Appreciation of human activities in conservation of useful plants from the past to the present.

Contents	**56 Hrs**
Unit 1:	**14 hrs**
Morphology of Root, Stem and Leaf. Their modifications for various functions. Inflorescence – types. Fruits–types. Structure of Flower - Floral diagram and floral formula. **Introduction to Taxonomy**: History, objectives, scope and relevance of Taxonomy **Systems of classification**: Artificial, Natural and Phylogenetic; brief account of Linnaeus', Bentham & Hooker's, Engler and Prantl's system and APG IV System (2016) - Merits and demerits of classifications. **Taxonomic literature:** Floras, Monographs and Journals. **Herbaria and Botanical gardens:** Important herbaria and botanical gardens of the world (Royal Botanical Garden, Kew, England) and India (National Botanical Garden, Calcutta). Role of botanical gardens. Technique of Herbarium Preparation **Virtual herbarium:** E-flora; Documentation.	

Unit 2:	**14 hrs**
Plant identification: Taxonomic dichotomous keys; intended (yolked) and bracketed keys. (Brief account only). **Plant descriptions**: Common Terminologies used for description of vegetative and reproductive parts of the following families **Study of the diagnostic features of Angiosperm families:** Annonaceae, Brassicaceae, Rutaceae, Fabaceae (Papilionoideae, Ceasalpinoideae and Mimosaideae), Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Commelinaceae, and Poaceae. **Plant Taxonomic Evidences:** from palynology, embryology, cytology, phytochemistry and molecular data.	
Unit 3:	**14 hrs**
Taxonomic Hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concepts (biological, morphological and evolutionary).Rank less system of phylogenetic systematics **Botanical Nomenclature:** Principles and rules (ICN); Latest code –brief account, Brief account of Ranks of taxa, Type concept (Typification), Rule of priority, effective and valid publication, Author citation., rejection of names, Nomenclature of hybrids/cultivated species.	
Unit 4:	**14 hrs**
Biometrics, Numerical Taxonomy; Phenetics and Cladistics: Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences). **Phylogenetic Systematics:** Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly, clades, synapomorphy, symplesiomorphy, apomorphy, lineage sorting, serial homology etc.). **Origin and evolution of angiosperms;** Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram). **Molecular taxonomy:** DNA sequences of chloroplast gene (rbcL)	

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Pedagogy: Teaching and learning, Seminar, Assignments

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Attendance	10
Test	10
Assignments	10
Seminar	10
Total	**40 Marks**
Formative Assessment as per NEP guidelines are compulsory	

B. Sc. BOTANY – V Semester

Plant Morphology and Taxonomy (Practical)

Program Name	**B. Sc. in BOTANY**	Semester	**V**
Course Title	**Plant Morphology and Taxonomy (Practical)**	Practical Credits	**02**
Course Code	**DSC – BOT - C10 - P**	Contact Hours	**52 Hours**
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**

Practical Content

1. Study of root, stem and leaf structure and modifications. Study of inflorescence types. Study o flower and its parts, Study of fruits. Floral diagram and floral formula.

08 hrs

2. Study of families mentioned in theory preferably two examples from each family and make suitable diagrams, describe them in technical terms (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification) and identify up to species using the flora.

28 hrs

3. Identify plants/plant products of economic importance belonging to the families mentioned in the syllabus; with binomial, family and morphology of useful parts. Red gram, Green gram, Horse gram, Black gram, Bengal gram, Indigo, Tamarind, Bitter gourd, *Luffa*, Asafoetida, Cumin, Coriander, Coffee, Rubber, Tapioca, Ricinus, Rice, Wheat, Ragi, Sugarcane, *Annona muricata*, *Ruta graveolens*, Mustard and *Leucas aspera*

16 hrs.

4. **Field visit**: Local or outside area/ Botanical garden/ tribal settlements minimum 1 to 3 days.
5. **Submission:** Record book, Tour report and Herbarium (Preparation of 10 properly identified herbarium specimens; mounting of a properly dried and pressed specimen of any common plants from your locality with herbarium label).

Pedagogy: Teaching and learning, conducting experiments, field visits and Identification skills

Formative Assessment for Practical	
Assessment Occasion/ type	**Marks**
Attendance	05
Test	10
Field visit (3 marks) and tour report (2 marks)	05
Submission (Economic Botany)	05
Total	**25 Marks**
Formative Assessment as per NEP guidelines are compulsory	

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with $2^{1}/_{2}$ hours duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

2. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions: 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

SCHEME OF PRACTICAL EXAMINATION

(Distribution of marks): 25 marks for the Semester end examination

Time: 4 hours **Max. Marks: 25**

1. Identify, classify and describe the specimen A & B taxonomically	6 Marks
2. Identify the given specimen C with technical description.	4 Marks
3. Draw the floral diagram and write the floral formula of the given specimen D	2 Marks
4. Identification of Specimen E, F and G	6 Marks
5. Submission (Herbarium)	2 Marks
6. Submission (Record)	5 Marks

General instructions:

Q1. Specimen from Dicotyledons (A) and Monocotyledons (B)
Q2. Specimen from family they studied (C)
Q3. Specimen from family they studied (D)
Q4. Specimen/materials from Root/Stem/ Leaf/ Inflorescence (E), Fruit (F) and Economic importance (G)
Q5. Submission of 4 herbarium
Q6. Submission (Record)

References	
1	Baker. H.G. 1970. Plant and Civilization, Wadsworth Publishing Company.
2	Datta S C, *Systematic Botany*, 4th Ed, Wiley Estern Ltd., New Delhi, 1988.
3	Eames A. J. - *Morphology of Angiosperms* - Mc Graw Hill, New York.
4	Hall, B.G. (2011). *Phylogenetic Trees Made Easy: A How-To Manual*. Sinauer Associates, Inc. USA
5	Heywood - *Plant taxonomy* - Edward Arnold London.
6	Jeffrey C .J. and A. Churchil - *An introduction to taxonomy* – London.
7	Jeffrey, C. (1982). An Introduction to *Plant Taxonomy*. Cambridge University Press, Cambridge
8	Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F., Donogue, M.J., 2002. *Plant Systematics: A Phylogenetic approach*, 2nd edition. Sinauer Associates, Inc., USA.
9	Lawrence - *Taxonomy of Vascular Plants* - Oxford & I B H, New Delhi.
10	Manilal, K.S. and M.S. Muktesh Kumar 1998. *A Handbook on Taxonomy Training*. DST, New Delhi.
11	Manilal, K.S. and A.K. Pandey, 1996. *Taxonomy and Plant Conservation*. C.B.S. Publishers & Distributors, New Delhi.
12	Manilal, K.S. 2003. *Van Rheede'sHortusMalabaricus. English Edition*, with Annotations andModern Botanical Nomenclature. (12 Vols.) University of Kerala, Trivandrum.
13	Naik V.N., *Taxonomy of Angiosperms*, 1991. Tata Mcgraw-Hill Pub. Co. Ltd., New Delhi.
14	Pandey, S. N, and S.P. Misra (2008)-*Taxonomy of Angiosperms*- Ane Books India, New Delhi.
15	Radford A B, W C Dickison, J M Massey & C R Bell, *Vascular Plant Systematics*, 1974,Harper & Row Publishers, New York.
16	Singh G.2012. *Plant systematics: Theory and Practice*. Oxford and IBH, Pvt. Ltd., New Delhi.
17	Singh V. & Jain - *Taxonomy of Angiosperms* - Rastogi Publications, Meerut.
18	Sivarajan V. V - *Introduction to Principles of taxonomy* - Oxford &I B H New Delhi.
19	Any local/state/regional flora published by BSI or any other agency.

B. Sc. BOTANY – V Semester

Genetics and Plant Breeding (Theory)

Program Name	**B.Sc. in BOTANY**	Semester	**V**
Course Title	**Genetics and Plant Breeding (Theory)**		
Course Code:	**DSC – BOT-C11 - T**	No. of Credits	**04**
Contact hours	**56 Hours**	Duration of SEA/Exam	**$2^{1}/_{2}$ hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Pre-requisite (s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:.

CO1.Understanding the basics of genetics and plant breeding

CO2.Abilitytoidentify, calculate and describe crossing over, allelic generations and frequencies of recombination.

CO3.Interprettheresults of mating and pollinations.

CO4.ClassifyPlantpollination methods

CO5.Recognitiono f modes of inheritance of traits/ phenotypes and Phenotype-genotype correlation.

Contents	**56 Hrs**
Unit 1:	**14 hrs**
Mendelian genetics – Introduction, History, Laws and concepts Non-Mendelian genetics - Allelic (Incomplete Dominance and Co-dominance) and non-allelic gene interactions (complementary, supplementary factors, dominant and recessive epistasis) and Multiple alleles. Extra chromosomal inheritance Chloroplast mutation: variegation in Four o'clock plant; Mitochondrial mutations in yeast.	
Unit 2:	**14 hrs**
Linkage, crossing over and chromosome mapping Linkage and crossing over - Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Sex Determination in plants - *Melandrium* Variation in chromosome number and structure Gene mutations –Types, Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations Fine structure of gene Population Genetics - Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection and mutation Evolutionary Genetics – Genetic drift. Genetic variation and Speciation.	

Unit 3:	**14 hrs**
Plant Breeding: Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding. Methods of crop improvement - Plant introduction, primary and secondary Plant genetic resources - Acclimatization Selection methods: For self-pollinating and cross pollinating crops Types of vegetative propagation in plants Hybridization – Types, Procedure, advantages and limitations.	
Unit4:	**14 hrs**
Quantitative inheritance: Concept, mechanism, examples of inheritance of Kernel colour in Wheat, Monogenic vs Polygenic inheritance. Inbreeding depression and heterosis History, genetic basis of inbreeding depression and heterosis; Applications. Crop improvement and breeding: Role of mutations, Polyploidy, Distant hybridization and role of biotechnology in crop improvement.	

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)

Course Outcomes (COs) / Program Outcomes (POs)	**Program Outcomes (POs)**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**

Pedagogy: Teaching and learning, Seminar, Assignments and skills of Hybridization

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Attendance	10
Test	10
Assignments	10
Seminar	10
Total	**40 Marks**
Formative Assessment as per NEP guidelines are compulsory	

B. Sc. BOTANY – V Semester

Genetics and Plant Breeding (Practical)

Course Title	**Genetics and Plant Breeding (Practical)**	Practical Credits	**02**
Course Code	**DSC – BOT – C12 - P**	Contact Hours	**52 Hours**
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**

Practical Content

Plant breeding:

1. Reproductive biology of self and cross pollinating plants
2. Vegetative reproduction – Cutting, Budding, , grafting and layering
3. Hybridization: Emasculation, bagging, pollination and production of hybrids
4. Pollen fertility – Tetrazolium test

Genetics:

6. Mendel's laws through seed ratios (monohybrid and dihybrid crosses)
7. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3).
8. Incomplete dominance and gene interaction through seed ratios (15:1, 12:3:1, 9:3:4).
9. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes (Photocopies).
10. Photographs showing Translocation Ring, Laggards and Inversion Bridge.

Pedagogy: Teaching and learning, conducting experiments, field / Lab.visits

Formative Assessment for Practical	
Assessment Occasion/type	**Marks**
Attendance	05
Test	10
Submission of solved problems	05
Submission of potted plant/Vegetative propagation	05
Total	**25 Marks**
Formative Assessment as per NEP guidelines are compulsory	

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with $2^1/_2$ hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

2. Question number 07- 11 carries 05 Marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions: 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

SCHEME OF PRACTICAL EXAMINATION

(Distribution of marks): 25 marks for the Semester end examination

Time: 4 hours **Max. Marks: 25**

1. Perform the emasculation / pollen viability / fertility of the given sample **A** 5 Marks
2. Solve the genetic problem **B** 4 Marks
3. Identification of specimen/ Photographs **C, D** and **E** 6 Marks
4. Viva Voce 5 Marks
5. Submission (Record) 5 Marks

General instructions:

Q1 Material Cassia / Hibiscus/ etc., (A)
Q2. Genetic problem (B)
Q3. Down's, Klinefelter's and Turner's syndromes any one for C, Translocation Ring, Laggards and Inversion Bridge any one for D and vegetative propagation for E
Q4. Viva voce
Q5. Submission (Record)

References	
1	Acquaah, G. (2007). Principles of Plant Genetics & Breeding.NewJearsey, U.S.: Blackwell Publishing.
2	Singh, B.D. (2005). Plant Breeding: Principles and Methods, 7th edition. New Delhi, Delhi: Kalyani Publishers.
3	Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding, 2nd edition. New Delhi, Delhi: Oxford – IBH.
4	Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, 8th edition. New Delhi, Delhi: John Wiley & sons
5	Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis, 10th edition. New York, NY: W.H. Freeman and Co.
6	Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics, 10th edition. San Francisco, California: Benjamin Cummings
7	Raven, F.H., Evert, R. F., Eichhorn, S.E. (1992).Biology of Plants. New York, NY: W.H. Freeman and Co.
8	Welsh, J. R. (1981). Fundamentals of Plant Genetics and Breeding. John Wiley and Sons, New York.
9	Poehlman, J.M. (1987). Breeding Field Crops, 3rd Ed. AVI Publishing Co. Inc., Westport, Connecticut
10	Chopra, V.L. (2000). Plant Breeding: Theory and Practice 2nd Ed. Oxford & IBH, New Delhi.

B. Sc. BOTANY – VI Semester

CELL AND MOLOECULAR BIOLOGY (THEORY)

Program Name	**B.Sc. in BOTANY**	Semester	**VI**
Course Title	**Cell and Molecular Biology (Theory)**		
Course Code:	**DSC-BOT- C13-T**	No. of Credits	**04**
Contact hours	**56 Hours**	Duration of SEA/Exam	**$2^{1}/_{2}$ hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Pre-requisite (s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO5. Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelles.

CO6. Contemporary approaches in modern cell and molecular biology.

CO7. To study the organization of the cell, cell organelles and biomolecules (i.e. Protein, carbohydrate, lipid and nucleic acid).

CO8. To gain knowledge on the activities in which the diverse macromolecule and microscopic structures inhibiting the cellular world of life are engaged.

CO9. To understand the various metabolic processes such as respiration, photosynthesis etc., which are important for life.

Contents	**56 Hrs**
UNIT 1	**14 hrs**
Plant cell – Ultrastructure and its components **Cell wall –** Types, composition and functions **Biological membranes** – Types, composition and transport (Plasma membrane, nuclear membrane and E R membrane) **Plant cell organelles** – Structure and function (Nucleus, Vacuole, mitochondrion and chloroplast) Cytoskeleton	
UNIT 2	**14 hrs**
Chromosome Biology – Types and structural organization of eukaryotic chromosomes (up to nucleosome model) **Types of Chromosomes** – Normal, giant and supernumerary chromosomes **Cell cycle** – Phases of eukaryotic cell cycle, check points and role of protein kinases **Cell division** – Mitosis and meiosis and its significance **Karyotype** – Types and significance. Programmed cell death (PCD).	
UNIT 3	**14 hrs**
Molecular Biology – Historical perspectives, DNA is the genetic material (Griffith's, Harshey and Chase experiments) **Nucleic acids** – DNA structure, composition, types and the mechanism of replication A brief account of DNA repair mechanism **RNA** – Structure, composition and types Central dogma of Molecular biology, genetic code – Salient features Gene expression in prokaryotes (Transcription and translation)	

UNIT 4	14 hrs
Gene concept, Genomics and proteomics Gene regulation- Lac operon concept Epigenetics – Gene editing, DNA methylation, Sn/mi RNAs and Ribozymes Genomic organization in Eukaryotes Recombinant DNA technology – A brief account Introduction to Bioinformatics and its applications	

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Core competency															
Critical thinking															
Analytical reasoning															
Research skill															
Team work															

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Attendance	10 Marks
Test	10 Marks
Assignments	10 Marks
Seminar	10 Marks
Total	40 Marks

Pedagogy: Teaching, learning seminar and assignment skills

B. Sc. BOTANY – VI Semester

CELL AND MOLOECULAR BIOLOGY (Practical)

Course Title	**Cell and Molecular Biology (Practical)**	Practical Credits	**2**
Course Code	**DSC-BOT - C14-P**	Contact Hours	**52 Hours**
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**

Practical Content

1. Study of plant cell structure with the help of epidermal peel mount of Onion/Rhoeo/ Crinum
2. Study of cell and its organelles with the help of electron micrographs
3. Study of different stages of mitosis and meiosis (Onion/Rhoeo/Crinum)
4. Study of Karyotype using Camera Lucida/chart
5. Salivary gland chromosome
6. Isolation of cell organelle – Chloroplast
7. **Molecular Biology** - Isolation of DNA by CTAB method (Cauliflower)
8. Estimation of RNA - by Orcinol method

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with $2^1/_2$ hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

2. Question number 07- 11 carries 05 marks each. Answer any 04 questions: 20 marks

Part-C

3**.** Question number 12-15 carries 10 marks each. Answer any 03 questions: 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

SCHEME OF PRACTICAL EXAMINATION

(Distribution of marks): 25 marks for the semester end examination

Cell and Molecular Biology

Time: 04 Hours **Max. Marks: 25**

1. Preparation of squash/smear of material **A**, Identify, sketch and label any two stages with reasons 06 marks
2. Isolation of DNA/Estimation of RNA of material **B** 06 marks
3. Identify the slides **C** and **D** 04 marks
4. Viva-voce 03 marks
5. Submission (Record + 4 slides) (4 + 2) 06 marks

General instructions:

Q1. Onion/Rhoeo/ Crinum plant **(A)**
Q2. Cauliflower/RNA sample **(B)**
Q3. Slides from Mitosis or meiosis **(C)** and Karyotype/Salivary gland chromosome **(D)**
Q4. Viva-voce
Q5. Submission (Record + 4 Slides)

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Practical	
Assessment	**Marks**
Attendance	05 Marks
Test	15 Marks
viva	05 Marks
Total	**25 Marks**

	References
1	1. Cooper, G.M., Hausman, R.E. (2009). The Cell: A Molecular Approach, 5th edition. Washington DC: ASM Press & Sunderland, Sinauer Associates, MA
	2. Karp. G. (2010). Cell Biology, 6th edition. New Jersey, U.S.A.. John Wiley & Sons.
	3. De Robertis, E. D. P. and De Robertis R. E. 2009. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.
	4. Becker W. M., Kleinsmith LJ, and Bertni G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San fransisco.
	5. Reven, F.H., Evert, R.F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H. Freeman and Company
	6. Alberts, B., Bray, D., Hopkin, K., Johnson, A. D., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2013). Essential cell biology (4th ed.). Garland Publishing.
	7. Raven, F.H., Evert, R. F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H. Freeman and Co.
	8. Verma, P. S. (2004). Cell Biology, Genetics, Molecular Biology: Evoloution and Ecology, India: S. Chand Limited.

B. Sc. BOTANY – VI Semester

PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY (THEORY)

Program Name	**B. Sc. in BOTANY**	Semester	**VI**
Course Title	**Plant Physiology and Plant Biochemistry (Theory)**		
Course Code:	**DSC-BOT-C15-T**	No. of Credits	**04**
Contact hours	**56 Hours**	Duration of SEA/ Exam	**$2^{1}/_{2}$ hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Pre-requisite (s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. Importance of water and the mechanism of transport.
CO2. To understand biosynthesis and breakdown of biomolecules.
CO3. Role of plant hormones in plant development and about secondary metabolites.
CO4. Preliminary understanding of the basic functions and metabolism in a plant body.
CO5. To understand the importance of nutrients in plant metabolism and crop yield.

Contents	**56 Hrs**
UNIT 1	**14 hrs**
Plant water relations: Importance of Water as a solvent, Diffusion, osmosis, imbibition, osmotic potential, turgor pressure, wall pressure, water potential and its components. Mechanism of water absorption, Factors affecting water absorption. **Transpiration:** Types, Stomatal apparatus and mechanism of stomatal movement. Antitranspirants. **Mechanism of ascent of sap:** Vital and physical force theories. **Phloem Transport:** Transport of organic solutes. Path of transport, vein loading and unloading. Transcellular hypothesis and mass flow hypothesis. **Mineral nutrition:** A brief account on Micro and macro nutrients**.**	
UNIT 2	**14 hrs**
Photosynthesis: Photosynthetic pigments (Chl a, b, Xanthophylls and Carotene) Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration. **Respiration**: Glycolysis, TCA cycle; Oxidative phosphorylation and Anaerobic respiration **Nitrogen metabolism:** Biological nitrogen fixation; Nitrate and ammonia assimilation.	
UNIT 3	**14 hrs**
Definition and classification of plant growth regulators – Hormones, site of synthesis, and influence on plant growth and development of individual group of hormones - Auxins, Gibberellins, cytokinins, ABA and ethylene **Synthetic growth regulators** - Classification, their effect on plant growth and development. Practical utility in agriculture and horticulture**.** **Sensory Photobiology** - Biological clocks, photoperiodism, function & structure of phytochromes, phototropin and cryptochrome. Senescence - Aging and Cell Death (PCD and Autophagosis). Plant Movements – Tropisms	

UNIT 4	14 hrs
Carbohydrate metabolism – Cellulose and starch – structure and function. **Enzymes** - Classification, kinetics and mechanism of action. **Proteins** - Classification, structure - primary, secondary, tertiary and quaternary. Amino acids – A brief account. **Vitamins** - Classification, distribution and function. **Lipids** - Classification, structure and function of fatty acids. **Secondary plant products**: Distribution of terpenes, phenolics and nitrogen containing compounds and their role in plants	

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Core competency															
Critical thinking															
Analytical reasoning															
Research skill															
Team work															

Formative Assessment for Theory paper DSC-BOT- C17-T

Assessment	Marks
Attendance	10 Marks
Test	10 Marks
Seminar	10 Marks
Assignment	10 Marks
Total	40 Marks

Pedagogy: Teaching, learning, Assignments, Practical and Seminar skills

B. Sc. BOTANY – VI Semester

PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY (Practical)

Course Title	**Plant Physiology and Biochemistry(Practical)**	Practical Credits	**2**
Course Code	**DSC-BOT- C16-P**	Contact Hours	**52 Hours**
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**

Practical Content/Experiments

1. Conduct the experiment to demonstrate the phenomenon of exosmosis and endosmosis.
2. Determine the osmotic pressure of the cell sap by plasmolytic method.
3. Demonstrate root pressure / transpiration pull in plants.
4. Compare the rate of transpiration from the two surfaces of leaf by cobalt chloride paper method.
5. Demonstrate that oxygen is liberated in the process of photosynthesis.
6. Separation of photosynthetic pigments by paper chromatography and measure their Rf values.
7. Separate the chloroplast pignments by Arnon method.
8. Isolate and identify the amino acids from a mixture using paper chromatography.
9. Study of Phototropism.
10. Qualitative tests for Starch, Protein, Reducing Sugars and Lipids.
11. Estimation of TAN (Titratable acid Number) from *Bryophllum l*eaves/*Aloe vera.*
12. Visit to Research Institute/Scientific laboratory.

Formative Assessment for Practical	
Assessment	**Marks**
Attendance	05 Marks
Test	10 Marks
Project report and Industrial visit (5 + 5)	10 Marks
Total	**25 Marks**

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with $2^{1}/2$ Hours duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions: 10 marks

Part-B

2. Question number 07- 11 carries 05 marks each. Answer any 04 questions: 20 marks

Part-C

3. Question number 12-15 carries 10 marks each. Answer any 03 questions: 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

SCHEME OF PRACTICAL EXAMINATION

PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

Time: 04 Hours **Max. Marks: 25**

1. Conduct Major Experiment **A.**		06 marks
2. Comment on minor Experiments **B & C.**	(3 + 3)	06 marks
3. Perform biochemical test of sample **D.**		04 marks
4. Viva-voce		04 marks
5. Practical Record		05 marks

General Instructions:

Q1. Osmotic potential/paper chromatographic separation of pigments **(A)**
Q2. $CoCl_2$ /O_2 evolution/Root pressure/transpiration pull experiments **(B & C)**
Q3. Qualitative tests for Starch, Protein, Reducing Sugars and Lipids **(D)**
Q4. Viva-voce
Q5. Practical record

Pedagogy: Teaching and learning, Seminar, Assignments, etc

REFERENCES

1. Fundamentals of Biochemistry 2nd Ed, John Wiley and Sons Inc. Wilson, K. and Walker, J. 1994
2 .JainV K, 2008. Fundamentals of Plant Physiology.S Chand andCo.
3. Kochhar P L, Krishnamoorthy H N. Plant Physiology. Atmaram and sons, Delhi.
4. Kumar and Purohit. Plant Physiology: Fundementals and Applications.Agrobotanical Publishers.
5. Malik CP, 2002. Plant Physiology. Kalyani publishers.
6. Mukherjii S, Ghosh AK, 2005. Plant Physiology. New Central Book Agency, Culcutta.
7. Noggle GR, Fritz GJ, Introductory Plant Physiology.Prentice Hall of India.
8. Pandey SN, Sinha BK, 2006. Plant physiology.Vikas Publishing House, NewDelhi.
9. Salisbury F B, Ross C W, 1992. Plant Physiology. CBS publishers and Distributers, NewDelhi.
10. Sinha A K, 2004. Modern Plant Physilogy. Narosa publishing House, NewDelhi.
11. Srivastava H S, 2004. Plant physiology and Biochemistry. Rasthogi publications.
12. Verma V, 2007.Text Book of Plant Physiology. Ane Books Pvt. Ltd.
13. Buchanan B B, Gruissem W and Jones R. L. 2004. Biochemistry and molecular biology of plants. I K international Pvt. Ltd.
14. Hopkins W G & Huner N P A 2009. Introduction to Plant |Physiology,4th edition,John Wiley.
15. Taiz L & Zeiger E, Max Moller I & Murphy A 2018. Fundamentals of Plant Physiology, Sinaur Associates.
16. Hans Walter – Heldt et al., 2011. Plant Biochemistry, Academic Press.

Internship for Graduate Programme **(As Per UGC & AICTE)**

Course title	Internship Discipline specific
No of contact hours	90
No credits	2
Method of evaluation	Presentations/Report submission/Activity etc.,

- Internship shall be Discipline Specific of 90 hours (2 credits) with a duration 4-6 weeks.
- Internship may be full-time/part-time (full-time during semester holidays and part-time in the academic session)
- Internship mentor/supervisor shall avail work allotment during 6th semester for a maximum of 20 hours.
- The student should submit the final internship report (90 hours of Internship) to the mentor for completion of the internship.
- The detailed guidelines and formats shall be formulated by the universities separately as prescribed in accordance to UGC and AICTE guidelines.