



SOMAIYA
VIDYAVIHAR

K J Somaiya College of Science & Commerce



Learning Outcomes based Curriculum Framework

(LOCF)

For

S.Y.B.Sc. Botany (Major)

Undergraduate Programme

Under NEP Guidelines

From

Academic year

2024 - 25



Vision & Mission

Mission:

- Equip the student with knowledge and skills of their chosen vocation,
- Inculcate values.
- Provide them opportunities for all round growth and prepare them for life.

Vision:

- To equip the students with advanced knowledge and skills in their chosen vocation.
- To provide value-based education and opportunities to students.
- To help them to face challenges in life.
- To nurture a scientific attitude, temperament and culture among the students.
- To continually review, develop and renew the approach to build India of the Founder's dream.

Goals and Objectives:

- To build a strong Academia-Industry bridge.
- To provide flexibility in the courses offered and proactively adapt to the changing needs of students and the society.
- To establish a centre for multidisciplinary activities.
- To mould individuals who would nurture the cultural heritage of our country and contribute to the betterment of the society.

Board of studies in Botany

	Name	Designation	Institute/Industry
Head of the Department			
1	Mrs. Supriya Janbandhu	Chairman	K. J. Somaiya college of science and commerce
Subject Expert nominated by Vice-Chancellor			
1	Dr. Nisha Muni	Rtd. Associate Professor	R. J. College Ghatkopar
Subject experts			
1	Dr. Ajit Kengar	Professor	Kelkar-Vaze College
2	Dr. Smita Jadhav	Associate Professor	Kirti College
3	Dr. Satnam Singh Sohal	Associate Professor	M.D College
Representative from Industry/corporate sector/allied area			
1	Dr. Kshitij Satardekar	Scientist	Colgate India Ltd
Student representative			
1	Mr. Abhijit Singh	Student	K. J. Somaiya college of science and commerce
Faculty of the specialisation			
1	Dr. Ajit Katdare	Associate Professor	K. J. Somaiya college of science and commerce
2	Dr. Meena Patankar	Assistant Professor	K. J. Somaiya college of science and commerce
3	Dr. Ketan Thatte	Assistant Professor	K. J. Somaiya college of science and commerce

Foreword

Autonomy reflects efforts for excellence in academic performances, capability of self-governance and enhancement in the quality of education. In the year 2012, the UGC and University of Mumbai conferred the Autonomous Status to K J Somaiya College of Science and Commerce. Post this recognition and having several accolades to our credit, we made significant changes to our existing syllabi to reflect the changing business, industrial and social needs. A holistic education that provides opportunities to gain and share knowledge, experiment and develop beyond curriculum, is offered at our College.

Autonomous college carry a prestigious image for the students and the teachers and we have made a collaborative attempt to maintain a high level of quality in the standard of education that we impart.

Structured feedback obtained from the students, alumni and the experts from the industry and the changes suggested by them were duly incorporated in the syllabi. The Board of Studies constituted for each department meets to carry out in depth discussions about different aspects of the curriculum taking into cognizance the recent trends in the discipline.

The IQAC team has facilitated the conduct of a number of workshops and seminars to equip the faculty with the necessary skill set to frame the syllabi and competencies to deliver the same. Training was also provided to employ innovative evaluation methods pertaining to higher cognitive levels of revised Bloom's taxonomy. This ensured the attainment of the learning outcomes enlisted in the syllabus. Audits are conducted to critically review the practices undertaken in teaching, learning and evaluation. Innovative learning methodologies such as project-based learning, experiential learning and flip- class learning practiced by a committed fleet of faculty, supported by several hands have been our unique outstanding propositions. All efforts have been made to nurture the academic ambitions as well as the skills in co-curricular activities of the most important stakeholder i. e. student.

With sincere gratitude, I acknowledge the constant support and guidance extended by Shri Samir Somaiya, President- Somaiya Vidyavihar, and all the esteemed members of the Governing board and Academic council of the College. I also would like to acknowledge the



SOMAIYA
VIDYAVIHAR

K J Somaiya College of Science & Commerce



Heads of the Departments and all the faculty members for their meticulous approach, commitment and significant contribution towards this endeavour for academic excellence.

Dr. Pradnya Prabhu
Principal



Acknowledgement

At the outset, I would like to thank our Principal Dr. Pradnya Prabhu for her guidance and support during the curriculum restructuring process. I am also grateful to all the esteemed members of the Board of Studies, for their constructive suggestions and contributions.

Above all, I am deeply indebted to all the young and vibrant colleagues in the Department of Botany for the long and arduous work they have put in during the compiling of the restructured syllabus.

Mrs. Supriya Janbandhu

Chairperson

Board of Studies in Botany

Table of Contents

Sr. No.	Contents	Page number
	Preamble	8
1	Introduction	10
2	Learning outcome-based approach to Curriculum Planning 1. Nature and extent of B.Sc. Botany 2. Programme Education Objectives (PEOs)	11
3	Graduate attributes in Botany	13
4	Qualification descriptors	14
5	Programme Learning Outcomes (PLOs) 5.1 Course Mapping	18
6	Structure of B.Sc. Botany Programme 1. Course Content 2. Credit distribution 3. Semester Schedule 4. Course Learning Objectives	20
7	Detailed B.Sc. Botany Syllabus S.Y.B.Sc. Botany	28
8	Teaching Learning Process	59
9	Assessment Methods	60
10	Programme and Course Code Format	62

Preamble

The revised syllabus will be effective from the academic year 2024-25. Autonomy has given us the flexibility to frame the syllabus with a blend of Classical and Applied Botany which will open an array of opportunities in Higher Studies. Skill based courses have been incorporated which will benefit the learners to develop entrepreneurial skills. Successful completion of these courses will provide employability to the learners. It has been prepared according to the unique requirements of Botany students in focus.

The content caters to the current changing needs of the stakeholders, specifically pertaining to entrepreneurial skills and sustainability goals. In this revision, the student will be introduced to the Interdisciplinary approach of learning. The syllabus has been made more relevant by addition of latest topics pertaining to Botany, so as to encourage core competencies and discovery-based learning. Learners will also be taught topics through experiential learning. Choice has been given for a skill-based core course in both semesters to engage them in the learning process. Elective courses will have more of a practical component over theory. Skill based courses will ignite the conscience about global issues amongst the learner to become a sensitive citizen. As the term suggests, LOCF works with curriculum aim and framework, learning goals and objectives at its focal point. It uses foundations of already existing examples of effective learning, teaching and assessments. Also, it allows the liberty of constant updating with reference to the current needs of the hour. This syllabus has been drafted to enable the learners to prepare them for future employment in various fields including academics and competitive examinations.

Education is one of the most critical yardsticks in any country's development. The new National Education Policy (NEP) 2020 is an essential and comprehensive policy framework that aims to revamp the country's educational system from its foundation and to bring it at par with global standards. The larger aim of this policy is to transform the Indian education system by making it more inclusive, flexible and relevant to the changing needs of the society. Some of the key features of this policy are the introduction of vocational training, elective courses, emphasis on cultural studies, development of global skill sets and the promotion of multilingualism. The policy seeks to bring about significant changes in the Higher Education structure, such as introducing a four-year undergraduate degree Programme, establishing multidisciplinary education and research universities, pooled credit bank and creating a



National research Foundation to promote and support research activities in various fields. The new education policy enables every student to get quality education irrespective of their socio-economic background, gender or disability. NEP 2020 enables teachers to use a variety of learning techniques and experiments.

In the current fast paced world, simply cascading the knowledge in the classroom is not sufficient especially when the global requirements keep changing. Every learner should be encouraged to exchange ideas and thoughts in a collaborative approach. This leads to develop an environment which is cognitive in nature and not a one-way information flow. Keeping all this in mind, the curriculum under Learning Outcome-based Curriculum Framework (LOCF) is designed. This Learning Outcome-based Curriculum Framework (LOCF) supports the fundamental principle of providing quality education in India. Our focus is to involve young minds to participate, contribute and add value at each stage in the field of their study. The introduction of Choice Based Credit System (CBCS) has maximized the benefits of the newly designed curriculum in multiple folds. The LOCF will certainly help teachers to envisage the outcome expected from the learners at the end of the programme. For students, it will be a guide which shows how this curriculum will help them acquire all the skills and knowledge which are essential in their personal and academic growth. Higher education qualifications such as Bachelor's Degree Programme are awarded on the basis of demonstrated achievement of outcomes and academic standards; and this is the very essence of this curriculum.

1. Introduction

The B.Sc. Botany programme is developed by keeping in mind the interest of learners to explore the field of Botany. The framework helps to maintain the standard of Botany degrees/programmes through periodic programme review within a broad framework of agreed/expected graduate attributes, qualification descriptors, programme learning outcomes and course-level learning outcomes. The BSc programme is planned in such a way that it allows flexibility and innovation in programme design, syllabi development, teaching-learning process and quality assessment of students' learning levels.

This curriculum framework is developed on the principles of student centric learning pedagogy. The platform intends to empower graduates with the skills required for pursuing Botany - related careers, higher education in Botany and allied subjects. The syllabus is based on a basic and applied approach with vigour and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research. Various graduate attributes are emphasized in this framework such as critical thinking, basic psychology, scientific reasoning, moral ethical reasoning, etc. While designing this framework, an important aspect considered was the measurable teaching-learning outcome to ensure employability of the graduates. Implementation of modern pedagogical tools and concepts such as flip-class, hybrid learning, MOOCs and other e-learning platforms are suggested through this framework. The framework also focuses on issues relevant to India and also of the rest of the world;

Every course is designed in such a way that students get decent exposure to each topic by keeping an equilibrium between these topics and thus creating interest to pursue further education in the field of Botany. It covers the basic concepts of Botany to establish a strong foundation of the subject and helps students to explore the subject more.

The practical sessions will help the students to gain sufficient skills in chemical analysis, preparations, solvent extraction, chromatography, as well as quantitative analysis. Students are also encouraged to improve their scientific writing skills through various assignments. The research-based project work in the curriculum ensures team building attitude within students and utilizes every aspect of the team members in the success of any project. The project evaluation method is designed in such a way that it helps in creating a strong background for the research, skills to generate systematic reports and create effective presentation.

2. Learning Outcome based Curriculum Framework

LOCF focuses on curriculum framework, curriculum aims, learning targets and objectives. The curriculum framework also provides examples of effective learning, teaching and assessment practices. As the curriculum development is a collaborative and an on-going enhancement process, the LOCF instructs periodic reviews and revisions of the curriculum in accordance with the ever changing needs of students, teachers and society.

The framework describes how students are given exposure towards core knowledge of the subject, specialization, choice based learning and other skill enhancement courses ensuring development of an integrated personality and employability. The template defines expected outcomes for the programme like core competency, communication skills, critical thinking, affective skills, problem-solving, analytical, reasoning, research-skills, teamwork, digital literacy, moral and ethical awareness, leadership readiness along with specific learning course outcomes at the starting of each course. The Learning Outcomes based Curriculum Framework (LOCF) for B.Sc. Botany will certainly be a valuable document in the arena of outcome-based curriculum design.

2.1 Nature and extent of B.Sc. Botany

Degree programme in Botany is designed to include cutting edge and core topics in a perfect balance. The scope of individual topics varies with the nature of specific Botany branch. In our endeavour to improve the employability of graduates of the Botany programme, the curriculum offers courses on business skills in chemistry and food/cosmetic analysis. The B.Sc. Botany programme is of three years duration. Each year is divided into two semesters. The total number of semesters are six. The teaching and learning in the B.Sc. Botany programme will involve theory classes (lectures) and practicals.

The curriculum will be taught through formal lectures with the aid of power-point presentations, audio and video tools and other teaching aids can be used as and when required. Wherever possible RBPT approach will be adopted to make the process of learning more learner-centric. ICT-based teaching-learning tools will be incorporated through which even the mundane aspects could be made more interesting and relevant.



2.2 Programme Education Objectives (PEOs):

The overall aims of bachelor's degree programme in Botany are to:

1. Create a great learning environment for students to inculcate deep interests in Subject.
2. Provide choice-based learning to students.
3. Empower students by providing appropriate tools of analysis to address issues and problems in the field of Botany.
4. Help students to develop the ability to use their knowledge and skills to handle the specific theoretical and applied problems in Botany.
5. Encourage students to pursue advanced studies related to Botany by creating a strong and profound base of fundamental concepts.
6. Assist students to develop an array of generic skills which are helpful in creating employment and business opportunities.



3. Graduate Attributes in Botany:

Attributes expected from the graduates of B.Sc. Botany Programme are:

Every student shall have following on completion of a programme:

GA 1: Disciplinary Knowledge – Depth of core and disciplinary knowledge

GA 2: Resourceful and Responsible – Ability to motivate, capable of handling independent work

GA 3: Learning and Research skills – Equipped to seek knowledge and to continue learning throughout their lives.

GA 4: Global Awareness – An understanding of international traditions and practices both within and beyond their discipline.

GA 5: Reflective Learning – Set aspirational goals for continuous personal and professional growth.

GA 6: Communication skills - The ability to communicate effectively with society and convince people to take a conversational approach.

GA 7: Self-Directed Learning - Acquisition of knowledge and ability to troubleshoot through first-hand experience with real life scenarios

4. Qualification descriptors:

Undergraduate degree programmes of either 3 or 4-year duration, with multiple entry and exit points and re-entry options, with appropriate certifications such as:

- A UG certificate is awarded to students who opt to exit after completing 1 year (2 semesters) of study in the chosen fields of study with having secured 44 credits and in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.
- A UG diploma is awarded to students who opt to exit after 2 years (4 semesters) of study with having secured 88 credits and in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.
- A bachelor's degree is awarded after a 3-year (6 semesters) programme of study in major discipline with having secured 132 credits and minimum credit requirements as follows

Sr. No.	Category of Courses	Minimum credit requirements
1	Major Core Course	48
2	Minor Stream Course	20
3	Discipline Specific Elective Course	06
4	Ability Enhancement Course	08
5	Skill Enhancement Course	06
6	Value Education Course	04
7	Vocational Skill Course	08
8	Indian Knowledge System	02

9	Co-curricular Course	20
10	Open Elective Course	10
Total		132

- After completing the requirements of three year Bachelor's degree, candidate who meet the minimum CGPA of 7.5 shall be allowed to continue studies in the fourth year of undergraduate program to pursue and complete Bachelor's degree with honours/research (subject to change).
- The 4-year bachelor's degree (honours) is awarded after eight semesters programme of study with having secured 176 credits and minimum credit requirements as follows:

Sr. No.	Category of Courses	Minimum credit requirements
1	Major Core Course	76
2	Minor Stream Course	24
3	Discipline Specific Elective Course	14
4	Ability Enhancement Course	08
5	Skill Enhancement Course	06
6	Value Education Course	04
7	Vocational Skill Course	08
8	Indian Knowledge System	02
9	Co-curricular Course	24
10	Open Elective Course	10
Total		176

- They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major



discipline. The students who secure 176 credits, including 12 credits from a research project/dissertation, are awarded UG Degree with Research.

The 4-year bachelor's degree programme is considered a preferred option since it would provide the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student.

Upon successful completion of the programme, students receive B.Sc. degree in Botany. B.Sc. Botany graduates of this department are expected to demonstrate the extensive knowledge of various concepts of botany and its application thus contributing in research, development, teaching, government and public sectors. This programme will establish a foundation for students to further pursue higher studies in Botany.

The list below provides a synoptic overview of possible career paths provided by an undergraduate training in Botany:

1. Academics
2. Research
3. Geneticist
4. Researcher
5. Ecologist
6. Botanist
7. Farming consultant
8. Plant biochemist
9. Greenhouse Manager or nursery manager
10. Environmental consultant
11. Horticulturist
12. Plant Protection Officer

Job Roles for B.Sc. Botany graduate:

After graduation one can seek a professional career as:

1. Lab chemist
2. R & D division
3. Production officer



-
4. Quality control and Quality assurance
 5. Academicist
 6. Environment analyst
 7. Project fellow
 8. Entrepreneur
 9. Civil services
 10. Competitive exams

Higher Education options for B.Sc. Botany graduate:

1. M.Sc. by papers in Botany, Nutraceutical, Bioanalytical sciences, Life sciences, Biotechnology, Environmental Science, Horticulture, Forestry
2. M.Sc. by Research
3. Integrated M.Sc.-Ph.D.
4. PG Diploma in advance instrumental analysis/drug design/Intellectual Property rights/ Clinical research/ Cosmetology/ Aroma therapy, etc
5. Courses in management - Human resources, Agricultural management.
6. B.Ed

The learners who complete three years of full-time study of an undergraduate programme of study will be awarded a Bachelor's degree in Botany.

5. Programme Specific Outcomes (PSOs)

After the successful completion of modules in different courses of B.Sc. Botany the learner will be able to:

PLO I: Categorize the plant into respective Groups.

PLO II: Utilize various analytical techniques for validation.

PLO III: Organize and analyze the data generated through experiments using computer softwares.

PLO IV: Evaluate the interaction between various biomolecules and the internal cellular environment.

PLO V: Recommend strategies to mitigate environmental degradation.

PLO VI: Prioritize the conservation and management of biodiversity.

PLO VII: Improved skill set required to perform practical techniques in Botany.

PLO VIII: Analyze the effect of climate change and anthropological activities on biodiversity.

PLO IX: Propose the strategies for conservation of biodiversity with NGO's.

PLO X: Competent to formulate basic plant-based products in the pharmaceutical and cosmeceutical industry.

PLO XI: Validate the processes of Plant Tissue Culture and post-Harvest Technology.

PLO XII: Investigate the mechanism of the biological system with respect to genetics and biochemistry.

5.1 Course Mapping

Semester	PSO	I	I	II	I	V	V	V	VI	I	X	X	X
		I	I	I	V	I	I	II	II	X	I	I	II
	Course												
III	MJ I		√					√			√		
	MJ II						√		√	√			
	MN												
	SEC												
	VS C												
	IKS												
IV	MJ I		√		√		√	√	√	√			
	MJ II		√				√	√					
	MN												
	SEC												
	VS C												
	Field Project												

6. Structure of B.Sc. Botany programme:

The curriculum frame work is designed around the choice-based credit system (CBCS). The programme consists of three years UG having six semesters (two semesters per year) or four years UG (Honours) having eight semesters (two semesters per year). Credit Distribution for Eight Semester is as follows:

Semester	M J	DS E	SE C	VS C	MN	AE C	VE C	IK S	CC	FP	INT/ APT	O E	Total
I	6	-	-	-	6	4	2	-	2	-	-	2	22
II	6	-	-	-	6	3	2	1	2	-	-	2	22
III	6	-	3	2	4	1	-	1	2	-	-	3	22
IV	6	-	3	2	4	-	-	-	2	2	-	3	22
V	12	-	-	-	-	-	-	-	-	2	8	-	22
VI	12	6	-	4	-	-	-	-	-	-	-	-	22

The curriculum framework is designed around the choice-based credit system (CBCS). The programme consists of three years UG having six semesters (two semesters per year) or four years UG (Honours) having eight semesters (two semesters per year). To acquire a degree in B.Sc. Botany a learner must study

1. Major Core Courses (MJ):

. A course which is required to be opted by a candidate as a major core course. The course designed under this category aims to cover the basics that a student is expected to imbibe in that particular subject or discipline.

. Students may be allowed to change major within the broad discipline at the end of the second semester by giving her/him sufficient time to explore interdisciplinary courses during the first year.

. There are sixteen Major Core courses (MJ), two each, in semesters I II, III and IV; and four each in semesters V and VI.

-
- . Each Major Core Courses is compulsory.
 - . Each Major Core Course is comprised of 2 credits for theory ie. 30 hours; 2 lectures of each 1 hr per week and 1 credit for practical of two hours per week in every semester.
 - . The purpose of fixing major core papers is to ensure that the institution follows a minimum common curriculum so as to adhere to common minimum standards with other universities/institutions.

2 Minor Stream Course (MN):

- . A course is chosen by a candidate from the interdisciplinary stream as a minor course. Minor Stream courses help a student to gain a broader understanding beyond the major discipline.
- . Students who take a sufficient number of courses in interdisciplinary area of study other than the chosen major will qualify for a minor in that discipline.
- . Students may declare the choice of the minor stream course at the end of the second semester after exploring various courses.
- . There are two each Minor stream course (MN), in semesters I and II. This Minor stream is comprised of 2 credits for theory i.e. 30 hours; 2 lectures of each 1 hr per week and 1 credit for practical of two hours per week in every semester.
- . There is one each Minor stream course (MN) in semester III and IV. This Minor stream is comprised of 2 credits for theory i.e. 30 hours; 2 lectures of each 1 hr per week and 2 credits for practical of four hours per week in every semester.
- . Each Minor stream Courses is compulsory.

3. Ability Enhancement Courses (AEC):

- a) The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading and expository and academic writing skills, that help students articulate their arguments and present their thinking clearly and coherently and recognize the importance of language as a mediator of knowledge and identity.
- b) Students are required to achieve competency in a Modern Indian Language (MIL) and in the English language with special emphasis on language and communication skills.
- c) There are five AE courses in spread

over three semesters (I to III). d) Each student is supposed to take two AE in semester I - English language and Modern Indian language of 2 credits each. e) There are two AE in semester 2 - English language of two credits and Modern Indian language of 1 credit. f) There is one AE in semester 3 - Modern Indian language of 1 credit.

4. Value Education Courses (VEC):

- a) The course seeks to equip students with the ability to apply the acquired knowledge, skills, attitudes and values required to take appropriate actions for mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources, forest and wildlife conservation, and sustainable development and living. b) The VEC courses offered are: VEC I- Environmental Science I (2 credits) (Semester I), VEC II- Environmental Science II (2 credits) (Semester II).

5. Co-Curricular courses (CC):

- a) They are designed to provide skill-based knowledge and contain both lab/hands on training/field work.
- b) The main purpose of these courses is to provide life skills in hands-on mode to increase employability.
- c) There are two CC each in semester I and II – NCC (compulsory 1 credit course) and other one from Music/Sports training program/Yoga/ Study Circle.
- d) CC in semester III is Emotional Intelligence and in semester IV – NCC (compulsory 1 credit course) and sports of 1 credit.

6. Open Elective (OE):

- a) They are designed to provide multidisciplinary education.
- b) Students can opt for one interdisciplinary Open Elective Course (OE) in each of the semester I and II of two credit each.
- c) Students can opt for one interdisciplinary Open Elective Course (OE) in each of the semester III and IV of three credit each.
- d) Open courses are offered in cognate disciplines by different departments in the college.

7. Indian Knowledge System (IK):

- . They are designed to recognize the rich heritage of ancient and eternal Indian knowledge and thought as a guiding principle.

-
- . Students can opt for one IK in semester III– Indian cultural Heritage of one credit.
 - a. There is one IK in semester III for 2 credits.

8. Skill Enhancement courses (SEC):

- a) They are designed to provide skill-based knowledge and contain both lab/hands on training/field work.
- b) The main purpose of these courses is to provide life skills in hands-on mode to increase employability.
- c) There are One SEC each in semester III to IV (1 Credit)

9. Discipline Specific Elective Courses (DSE):

- a) Elective courses offered under the major course subject of study.
- b) There are two discipline specific elective courses (DSE), offered in semesters VI of 2 credits theory and 1 credit practical.
- c) There is one discipline specific elective course (DSE), offered in semesters VII and VIII each of 2 credits theory and 2 credit practical.
- d) There is one advance level disciplinary course – Research Methodology of 4 credits offered in semester VII.

10. Vocational Course (VSC):

- a) They are designed to provide Practical Knowledge.
- b) Provide skill relevant to subject

11. On Job Training (OJT):

- a) On Job training of 4 credits is offered in semester VIII to enhance the specific skills and competencies required for a particular job
- b) OJT bridges the gap between theory and practical application, promoting a deeper understanding of concepts.

12. Field Projects/ Internship/ Apprenticeship/ Community Engagement:

- a) Field projects require students to participate in field-based learning activity generally under the supervision of an expert of the given external entity.

- b) The curricular component of ‘community engagement and service’ will involve activities that would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems.
- c) Internships involve working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.

6.1 Content:

Sr. No	Semester	Course number	Course Code	Course title
1	III	MJ I	24US3BOM J1GRV	Green Venture
2		MJ II	24US3BOM J2FAB	Forestry and Biodiversity
3		MJ P	24US3BOM JP	Based on MJ I and MJ II
4		MN		Minor from Zoology / Chemistry
5		MN P		Minor from Zoology / Chemistry
6		SEC	24US3BOS ECBF	Biofertilizer
7		VSC	24US3BOV SCP	Basics of Horticulture
8		IKS	24US3BOI KSSAG	Sacred Groves
	IV			
9		MJI	24US4BOM J1FAF	Forms and Functions

10		MJ II	24US4BOM J2FUB	Functional Botany
11		MJ P	24US4BOM JP	Based on MJ I and MJ II
12		MN		Minor from Zoology / Chemistry
13		MN P		Minor from Zoology / Chemistry
14		SEC	24US4BOS ECCDA	Crude drug analysis
15		VSC	24US4BOV SCP	Plant Biotechnology
16				Field Projects

6.2 Credit distribution for B.Sc. Botany

Semester	Course number	Course title	Credits		
			Theory	Practical	Total
III	MJ I	Green Venture	2	1	3
	MJ II	Forestry and Biodiversity	2	1	3
	MN	Minor from Zoology / Chemistry	2	1	3
	SEC I	Biofertilizer	2	1	3
	VSC	Basics of Horticulture		2	2
	IKS	Sacred Groves	1		1
		Total without Minor			12
IV	MJ I	Forms and functions	2	1	3
	MJ II	Functional Botany	2	1	3
	MN	Minor from Zoology / Chemistry	2	1	3
	SEC	Crude Drug Analysis	2	1	3

	VSC	Plant Biotechnology		2	2
			1		1
		Total without Minor			12

6.3 Semester Schedule

Semester	Major Courses (MJ)	Minor Stream Courses (MN)	Skill Enhancement Courses (SEC)	Vocational Course (VSC)	Indian Knowledge System (IKS)
III	MJI Green Venture MJ II- Forestry and Biodiversity	MN Minor from Zoology / Chemistry	SEC- I Biofertilizer	Basics of Horticulture	Sacred Grooves
IV	MJ I Forms and Functions MJ II- Functional Botany	MN I Minor from Zoology / Chemistry	SEC-I Crude Drug Analysis	Vocational Course - Plant Biotechnology	Field Project

6.4 Course Learning Objectives

The three-year undergraduate Botany programme is designed to familiarize students with significant developments in Botany. The objective of structured syllabus in Botany is to make the concepts and basics of Botany clear and interesting to students and also to ensure the development of vertical growth in the subject. The idea behind this is to enable students to develop analytical skills and critical thinking. It is our attempt that students achieve this objective through systematic reading and class lectures and through feedback on their written work-assignments, project/research papers, presentations, discussions, debates, etc. our



intention is to enable students to formulate cogent arguments, presenting the necessary evidence to establish these, based on a training in Botany.

7. Detailed B.Sc. Botany Syllabus

S. Y. B.Sc. Syllabus with effect from the Academic year 2024–2025

Course No.	Course Title	Course Code	Credits	Periods (1 Hr)	Module	Lectures per module (1 hr)	Examination		
							Internal Marks	External Marks	Total Marks
SEMESTER III									
Major courses THEORY									
I	Green venture	24US 3BO MJ1G RV	2	30	2	15	20	30	50
II	Forestry and Biodiversity	24US 3BO MJ2F AB	2	30	2	15	20	30	50
Major courses PRACTICAL									
		24US 3BO MJP	2	60			CIA		50
SEMESTER IV									
Major courses THEORY									
I	Forms and Functions	24US 4BO MJ1F AF	2	30	2	15	20	30	50
II	Functional Botany	24US 4BO MJ2F UB	2	30	2	15	20	30	50
Major courses PRACTICAL									
		24US 4BO MJP	2	60			CIA	50	2

S.Y. B. Sc. (BOTANY) SEMESTER III

Major Course- I

COURSE TITLE: Green Ventures

COURSE CODE: 24US3BOMJ1GRV

Course Learning Outcome		
<p>After the successful completion of the Course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Propose the project for grants to funding agencies. 2. Design a setup of a small scale industry. 3. Experiment with suitable plant sources for extraction of valuable compounds. 4. Formulate herbal products. 5. Suggest the cultivation practices for sugarcane. 6. Evaluate the use of sugarcane byproducts as potential resources. 7. Demonstrate cultivation practices for coffee and cocoa. 8. Narrate the sources and process of wine preparation. 		
Module 1	Industrial Botany	[15L]
<p>Learning Objectives: The module is intended to</p> <ul style="list-style-type: none"> ● Emphasize on the status of small scale industry. ● Define the production process of some valuable products. 		
<p>Learning Outcome: After the successful completion of the module, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Summarize the role of Government and funding agencies in development of small scale industry. 2. Suggest suitable enzymes for specific industrial processes. 3. Formulate the herbal products. 		
1.1	<p>1.1.1 Scope, Role and Importance of Small Scale Industry, Contribution of MSME.</p> <p>1.1.2 Project proposal for funding agencies.</p> <p>1.1.3 Khadi and Village Industry Commission.</p>	2 1 1
1.2	<p>1.2.1 Study of enzymes with reference to source, extraction and its uses in industry- Cellulase, Peroxidase, Pectinase.</p> <p>1.2.2 Edible pigments - Sources, Extraction and Applications of - Spinach, Beetroot, Carrot, Marigold.</p> <p>1.2.3 Cosmeceuticals- Introduction, History and Categories of cosmeceuticals. Formulation of herbal Shampoo, Herbal Soap</p> <p>1.2.4 Nutraceuticals- Introduction, History, Categories and Health benefits of nutraceuticals. Probiotics and Prebiotics. Formulation of energy bar, Tofu</p>	3 2 3 3

References:

- http://newhorizonindia.edu/nhc_kasturinagar/wpcontent/uploads/2017/10/Unit-2.pdf
- Annual report of Ministry of Micro, Small and Medium Enterprises –(MSME) of India, Government of India, www.msme.gov.in.
- Annual report of Ministry of Micro, Small and Medium Enterprise-[MSME] of India, (2010-11), Introduction: Background of MSMEs, Development Commissioner (MSME), Government of India. http://msme.gov.in/MSME_Annual-Report-2010-11-English.pdf, accessed on April 5, 2011.
- Sathya Prabhu, D., Apoorva, S., Nandita, J., Palani Chamy and Devi Rajeswari, V (2018) Purification of protease enzyme from the leaf, seed and pod samples of *Vicia faba L.* International Food Research Journal 25(5): 1904- 1911.
- Mali A. S., Karekar P, Yadav A. V. (2015) Formulation and Evaluation of Multipurpose Herbal Cream. International Journal of Science and Research (IJSR). 4 (11): 1495-1498.

Module 2

Economic Botany

[15L]

Learning Objectives:

This module is intended to:

- Correlate the cultivation practices and industrial production of valuable products.
- Identify the significance of plants as a source of commercial products.
- Explain the industrial production of economic products.

Learning Outcome:

After the successful completion of the module, the learner will be able to:

1. Suggest the cultivation and processing of plants used in economically important products.
2. Compile the properties and applications of byproducts of the sugarcane industry.
3. Experiment with different sources for wine production.

2.1	2.1.1 Sugarcane -Cultivation, Soil preparation, Propagation practices, varieties, climate, irrigation, harvest.	5
	2.1.2 Source, Processing and Uses of Sugar, Tadgur, Jaggery, Khanderry.	3
	2.1.3 Byproducts of sugar industry- Molasses, Bagasse, Press mud, Briquettes, Biochar	2
2.2	2.2.1 Alcoholic beverage - Wine production.	2
	2.2.2 Non-alcoholic beverage - Coffee and Cocoa- Cultivation, Soil preparation, Propagation practices, varieties, climate, irrigation, harvest and processing	3

References:

- Sen S (1992). Economic Botany, New Central Book Agency, Kolkata.

- Kochhar, S.L. (2012) Economic Botany in Tropics, MacMillan & Co. New Delhi, India.

Question Paper Template

S.Y. B. Sc. (Botany) SEMESTER III Major Course- I

COURSE TITLE: Green Ventures

COURSE CODE:24US3BOMJ1GRV [CREDITS - 02]

Module	Remembering / Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I		-	5	5	-	5	15
II	5	5	5		-	-	15
Total marks per objective	5	5	5	5	5	5	30
% Weightage	16.66	16.66	16.66	16.66	16.66	16.66	100

S.Y. B. Sc. (BOTANY) SEMESTER III

Major Course- II

COURSE TITLE: Forestry and Biodiversity

COURSE CODE: 24US3BOMJ2FAB

Course Learning Outcome		
<p>After the successful completion of the Course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Develop critical understanding of silvicultural practices. 2. Suggest suitable multipurpose species for social forestry. 3. Measure individual tree parameters. 4. Identify the rare, endangered and endemic plants of western ghats. 5. Report management strategies for biological resources. 6. Involve rural people in participating in the People's Biodiversity register. 		
Module 1	Forestry	[15L]
<p>Learning Objectives: The module is intended to:</p> <ul style="list-style-type: none"> ● To acquire information about forest mensuration. 		
<p>Learning Outcome: After the successful completion of the module, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Develop critical understanding of silvicultural practices. 2. Suggest suitable multipurpose species for social forestry. 3. Measure individual tree parameters. 		
1.1	<p>1.1.1 Silviculture practices-objectives, Methods of regeneration of forest, Advantages</p> <p>1.1.2 Social forestry- Objectives, Scope, Economics</p> <p>1.1.3 Afforestation of specific areas- Dry areas without irrigation, railway line strips</p>	3 2 2
1.2	<p>1.2.1 Forest mensuration- Definition, Objectives, Scope</p> <p>1.2.2 Measurement of individual tree parameters- Tree diameter and girth.</p> <p>1.2.3 Instruments used Measurement of Tree diameter and girth.</p> <p>1.2.4 Instruments used Measurement of Height - Direct and Indirect methods.</p>	2 2 2 2
<p>References:</p> <ol style="list-style-type: none"> 1. Sagwal S. S. (2016) Introductory Forestry. Kalyani Publisher, New Delhi. 2. Negi S.S. (2008) Handbook of Forestry. 3. Chaturvedi and Khanna. (1982) Forest Mensuration. International Book distributor, New Delhi. 		

Module 2	Biodiversity	[15L]
<p>Learning Objectives: This module is intended to:</p> <ul style="list-style-type: none"> State role of people's biodiversity register. 		
<p>Learning Outcome: After completing the module learner will be able to:</p> <ol style="list-style-type: none"> Identify the rare and endangered, endemic plants of western ghat. Report management strategies for biological resources. Involve rural people in participating into People's Biodiversity register. 		
2.1	<p>2.1.1 Biodiversity- definition</p> <p>2.1.2 Level of Biodiversity: genetic, species and ecosystem diversity,</p> <p>2.1.3 Significance, Threats, Management strategies- <i>in situ</i> and <i>Ex situ</i> methods</p> <p>2.1.4 Wetlands- Ramsar convention, case study</p>	<p>0.5</p> <p>0.5</p> <p>3</p> <p>2</p>
2.2	<p>2.2.1 Bioprospecting- Introduction, Traditional and Modern Bioprospecting, Bioprospecting and Conservation, Biopiracy</p> <p>2.2.2 Convention on Biological Diversity</p>	4
2.3	<p>2.3.1 People's biodiversity registers</p> <p>2.3.2 Rare, Endangered, Threatened and endemic plants of Western Ghats</p> <p>2.3.4 Kasturirangan report</p>	<p>2</p> <p>1</p> <p>2</p>
<p>References:</p> <ol style="list-style-type: none"> https://www.ugc.ac.in/oldpdf/modelcurriculum/Chapter4.pdf Rawat U.S. and Agarwal N.K. Biodiversity: Concept, Threats and Conservation, December 2015, Environment Conservation Journal 16(3):19-28. DOI: 10.36953/ECJ.2015.16303 Biodiversity and Conservation, https://ncert.nic.in/ncerts/l/lebo115.pdf 		



Question Paper Template

S.Y. B. Sc. (Botany) SEMESTER III Major Course- II

COURSE TITLE: Forestry and Biodiversity

COURSE CODE: 24US3BOMJ2FAB [CREDITS - 02]

Module	Rememberin g/ Knowledge	Understan ding	Applyin g	Analysi ng	Evaluati ng	Creati ng	Total mark s
I		-	5	5	-	5	15
II	5	5	5		-	-	15
Total marks per objective	5	5	5	5	5	5	30
% Weightage	16.66	16.66	16.66	16.66	16.66	16.66	100

S.Y. B. Sc. (BOTANY)

SEMESTER III Practicals

COURSE CODE: 24US3BOMJP

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Analyze the enzyme activity.
2. Prepare various nutraceutical products.
3. Formulate herbal cosmeceutical products.
4. Recognize the plant source for industrial production of sugar, coffee and wine.
5. Interpret the characteristics of woody species and different lifeforms from forest.
6. Perform silvicultural practices.
7. Prepare PBR of the campus.
8. Identify the Rare, endangered, threatened and endemic plants of Western Ghats.

Learning Objectives:

The module is intended to:

- Depict the mechanism of enzyme substrate reactions.
- Demonstrate of Formulate herbal products.
- Recognize the plant source for industrial production of sugar, coffee and wine.

Learning Outcome:

After the successful completion of the module, the learner will be able to:

1. Determine the enzyme activity.
2. Formulate herbal cosmetic products.
3. Perform organoleptic study and sensory evaluation of herbal products.
4. Demonstrate the use of instruments for measurement of individual tree parameters.
5. Create PBR of the campus.
6. Identify the Rare, endangered, threatened and endemic plants of Western Ghats.

Major Course I	<ol style="list-style-type: none"> 1. Qualitative estimation of enzymes- Cellulase, Peroxidase and Pectinase from suitable plant source. 2. Preparation of enzyme powder. 3. Extraction of edible pigments from Spinach, Beetroot, Carrot, Marigold. 4. Preparation of herbal shampoo and herbal soap. 5. Formulation of energy bar. 6. Preparation of Tofu. 7. Identification of by-products of sugarcane industry using specimen / photomicrograph. 8. Identification of sources and processing of Sugar, Tadgur, Jaggery, Khandserry using specimen / photomicrograph. 9. Production of wine using suitable source. 10. Estimation of caffeine content in given coffee varieties by titration method. 	
----------------	--	--

	11. Sensory evaluation of various brands of coffee and prepare an organoleptic sheet.	
Major Course II	<ol style="list-style-type: none"> 1. To study and collect different types of seeds from different locations. 2. Identification of woody species in forest using specimens/ photomicrographs. 3. To study silvicultural practices. 4. To study different lifeforms of forest. 5. Instruments used for measurement of diameter, girth and height. 6. Methods of pre sowing. 7. Determination of plant height using shadow method. 8. Identification of Rare, endangered, threatened and endemic plants of Western Ghats using Specimens/ Photomicrographs. 9. Identification of invasive alien species using specimens or photomicrographs. 10. Prepare a PBR of the campus. 11. Case Study. 12. Report on visit to Ramsar site. 	

S.Y. B. Sc. (BOTANY) SEMESTER IV

Major Course- I

COURSE TITLE: Forms and Function

COURSE CODE: 24US4BOMJ1FAF

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Justify the reasons for seed dormancy.
2. Summarise the mechanism of breaking seed dormancy and germination.
3. Identify the causes and effects of senescence and abscission in plants.
4. Identify problems and solutions of Climate change.
5. Analyse soil samples.
6. Elaborate on shifting of plant communities in habitat.

Module 1

Plant Physiology

[15L]

Learning Objectives:

The module is intended to

- Correlate the physiological changes in plants with growth and development.
- Describe the mechanisms of certain physiological processes in plants.

Learning Outcome:

After the successful completion of the module, the learner will be able to:

1. Criticise the factors for seed dormancy and germination.
2. Correlate the causes and effects of physiological reactions for senescence and abscission.

1.1	1.1.1 Dormancy and seed germination- Kinds of dormancy, factors causing dormancy of seeds, Mechanism of dormancy and methods of breaking seed dormancy. 1.1.2 Seed germination - Hypogeal, epigeal, viviparous. Structure of seed. 1.1.3 Physiology and biochemistry of seed germination.	4 1 2
1.2	1.2.1 Senescence, aging, abscission and polarity 1.2.2 Senescence: Introduction, Types of Senescence, Mechanism of Senescence: Nutritional Theory, Hormonal Theory and Suicidal Theory 1.2.3 Factors Affecting Abscission: Morphological, Anatomical and Biochemical Changes During Abscission, Role of Hormones in Abscission, Biological Significance of Abscission. 1.2.4 Factors Influencing Abscission, Aging, Polarity.	1 2 3 2

References:

1. Noggle and Fritz, 1999. Introductory Plant physiology. Prentice hall, London.
2. Salisbury, F.B. and Ross. C. 2000, Plant physiology. John Wiley & Sons, New Delhi.
3. Strafford, G.A. 1979 Essentials of Plant Physiology. Heinemann Publishing Co. New York.
4. Wilkins, M.B. (Ed) 1984. Advanced Plant Physiology, Pitman Publishing Co. New York. William G. Hopkins, 2002. Introduction to Plant Physiology. John Wiley & Sons. Inc. New York.
5. Hames, B.D. et al., 1999. Instant notes in Biochemistry. Viva books Pvt. Ltd. New Delhi.
6. Jain, J.L. 2000. Fundamentals of Biochemistry. S. Chand & Co. New Delhi.
7. Plummer, D.T. 1996. An Introduction to Practical Biochemistry. McGraw Hill.
8. Satyanarayana, U. 1999. Biochemistry. Books and Allied (P) Ltd. Calcutta.

Module 2

Environmental Botany

[15L]

Learning Objectives:

This module is intended to:

- To understand plant succession.
- To overview the causes and effects of climate change.

Learning Outcome:

After the successful completion of the module, the learner will be able to:

1. Identify problems and solutions of Climate change.
2. Analyse soil samples.
3. Elaborate on shifting of plant community in habitat.

2.1	2.1.1 Environmental factors: Temperature, wind, light	2
	2.1.2 Classification and Characteristics of soil in India	2
	2.1.3 Properties of soil- Soil profile, texture, soil organism, soil Water, air, temperature, organic matter	3
	2.1.4 Plant succession -Hydrosere, Xerosere	2
	2.1.5 Climate change- causes, effects, solution	2
	2.1.6 IPCC-Intergovernmental panel on climate change	2
	2.1.7 Case study Climate change	2

References:

1. Environmental Protection and Laws. Jadhav and Bhosale, V.M. Himalaya publ. House
2. Kormondy, E.J. (1996) Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.
3. Ambasht, R.S. and Ambasht, N.K. (2008) A text book of Plant Ecology, CBS Publishers & Distributors PVT. LTD.

4. Majumdar, R and Kashyap, R (2019) Practical Manual of Ecology and Environmental Science, Prestige Publishers, New Delhi.
5. Odum E.P. (1978) Ecology. Oxford and IBS Publishing Co., New Delhi.
6. Sharma P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut.
7. Fulekar M.H. (2014) Environmental Biotechnology. Science Publisher, USA.

Question Paper Template

S.Y. B. Sc. (Botany) SEMESTER IV Major Course- I

COURSE TITLE: Forms and Function

COURSE CODE: 24US4BOMJ1FAF [CREDITS - 02]

Module	Remembering/ Knowledge	Understand ing	Applying	Analysi ng	Evaluati ng	Creati ng	Total mark s
I		-	5	5	-	5	15
II	5	5	5		-	-	15
Total marks per objective	5	5	5	5	5	5	30
% Weightage	16.66	16.66	16.66	16.66	16.66	16.66	100

S.Y. B. Sc. (BOTANY) SEMESTER IV

Major Course- II

COURSE TITLE: Functional Botany

COURSE CODE: 24US4BOMJ2FUB

Course Learning Outcome		
<p>After the successful completion of the Course, the learner will be able to:</p> <ul style="list-style-type: none"> ● Explore the stages of embryogenesis ● Compare and contrast between the developmental stages of micro and megaspore in plants ● Distinguish between different pollen and spore sample ● Evaluate the quality of honey. ● Demonstrate test for pollen viability. 		
Module 1	Embryology	[15L]
<p>Learning Objectives:</p> <p>The module is intended to</p> <ol style="list-style-type: none"> 1. To comprehend structural features of anther and ovule. 2. To familiarise with the process of fertilization and development of embryo. 		
<p>Learning Outcome:</p> <p>After the successful completion of the module, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Explore the stages of embryogenesis. 2. Compare and contrast between the developmental stages of micro and megaspore in plants. 		
1.1	<p>1.1.1 Microsporangium – Structure of anther, Microsporogenesis, Development of male gametophyte.</p> <p>1.1.2 Megasporangium – Types of ovules, Megasporogenesis, Organisation of female gametophyte (Polygonum type of embryo sac).</p> <p>1.1.3 Fertilization – Double fertilization and its significance. Development of Embryo – Dicotyledonous type (Capsella type)</p>	5 5 5
<p>References:</p> <ol style="list-style-type: none"> 1. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd. New Delhi. 2. Johri, B.M. 1984. 1984. Embryology of Angiosperms. Springer Verlag. Berlin. 3. Maheswari, P. 1980. Recent Advances in the Embryology of Angiosperms. 4. Pandey, A.K. 1997. Introduction to Embryology of Angiosperms. CBS Publishers and Distributors, New Delhi. 		

Module 2	Palynology	[15L]
<p>Learning Objectives:</p> <p>This module is intended to:</p> <ul style="list-style-type: none"> • To recognise features of spore and pollen morphology. • To develop analytical methods for pollen grains. • to give insight on pollen morphology. 		
<p>Learning Outcome:</p> <p>After the successful completion of the module, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Distinguish between different pollen and spore sample. 2. evaluate the quality of honey. 3. demonstrate tests for pollen viability. 		
2.1	<p>2.1.1 Pollen and Spore morphology– Size and Shape, Polarity, Apertures (NPC), Exine stratification, Exine excrescences.</p>	5
	<p>2.1.2 Pollen viability and storage – Tests for pollen viability, Causes of loss of pollen viability, Pollen storage.</p>	5
	<p>2.1.3 Melissopalynology – Geographical and floral origin of honey, Physical adulteration, Honey as an environmental monitor.</p>	5
<p>References:</p> <ol style="list-style-type: none"> 1. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi. 2. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands. 3. Nair, P. K. K. (1970). Pollen Morphology of Angiosperms, Latest Ed., Scholar Publications. 		



Question Paper Template

S.Y. B. Sc. (Botany) SEMESTER IV Major Course- II

COURSE TITLE: Functional Botany

COURSE CODE: 24US4BOMJ2FUB [CREDITS - 02]

Module	Remembering/ Knowledge	Underst anding	Applying	Analysing	Evalu ating	Creating	Total marks
I	5	5	5	-	-	-	15
II	5	5	5	-	-	-	15
Total marks per objective	10	10	10	-	-	-	30
% Weightage	33.33	33.33	33.33	-	-	-	100

S.Y. B. Sc. (BOTANY)

SEMESTER IV Practicals

COURSE CODE: 24US4BOMJP

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Predict the effects of weed on seed germination.
2. Quantitate the enzyme activity during seed germination.
3. Estimate growth hormones and chlorophyll content present in plants.
4. Analyze the soil samples for chemical parameters.
5. Demonstrate the use of ecological instruments.
6. Explain the development of microspores and megaspore in plants.
7. Comment on the quality of honey samples.

Learning Objectives:

The module is intended to:

- Explain the physiology of seed germination.
- Determine the soil quality.
- Describe the process of microsporogenesis and megasporogenesis.
- Compile the data on pollen morphology and pollen germination.

Learning Outcome:

After the successful completion of the module, the learner will be able to:

1. Depict the allelopathic effect of weed on seed germination.
2. Demonstrate the activity of enzymes from germinating seeds.
3. Estimate growth hormones and chlorophyll content present in plants.
4. Determine chemical parameters of soil samples.
5. Identify various stages of microsporogenesis and megasporogenesis.
6. Compile data on pollen morphology.
7. Estimate pollen germination and viability.
8. Analyse honey samples.

Major Course I	<ol style="list-style-type: none"> 1. Study of Allelopathic effect of weed on seed germination. 2. Study of activity of alpha-amylase enzyme from germinating seeds. 3. Study of breaking seed dormancy using various techniques. 4. Qualitative estimation of auxin and gibberellins from normal senescent leaf tissue by TLC method. 5. Estimation of total chlorophyll content from normal and senescent leaf tissue. 6. Estimation of total soluble salts from soil sample. 7. Determination of organic matter content from soil sample. 8. Determination of primary productivity by Winkeler's 	
----------------	---	--

	<p>method.</p> <p>9. Study of plant population frequency and density by quadrat method.</p> <p>10. Determination of water holding capacity of oven dried soil sample.</p> <p>11. Detection of Heavy Metals-Hg, As, Pb, Zn, Cr and Cd by qualitative method.</p> <p>12. Demonstration of instruments used for measuring Temperature, Relative humidity, Rainfall, Wind velocity and Light intensity.</p>	
Major Course II	<p>1. Study of various stages of Microsporogenesis, Megasporogenesis and embryo development with the help of permanent slides and Photomicrograph.</p> <p>2. To mount embryo of Citrus, Cucurbita, Scoparia and Maize.</p> <p>3. Determination of Pollen viability.</p> <p>4. Observation of <i>in vivo</i> growth of pollen tube in <i>Portulaca</i>.</p> <p>5. To study the germination of pollen grain and growth of pollen tube in varying concentrations of sucrose.</p> <p>6. Study of Pollen morphology (NPC)of the following by Chitles method -Hibiscus, Datura, Ocimum, Pancratium, Canna.</p> <p>7. Analysis of Honey.</p>	

S.Y. B. Sc. BOTANY SEMESTER III

Skill Based Course- I

COURSE TITLE: Biofertilizer

COURSE CODE: 24US3BOSECBF [CREDITS - 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Suggest suitable microorganisms to be used as biofertilizers.
2. Perform an experiment to culture the microorganisms
3. Formulate biofertilizer using suitable carrier material.
4. Propose methods of application of biofertilizer.
5. Summarise advantages and disadvantages of biofertilizer.
6. Analyse and Comment on the quality of biofertilizer.

Module 1	Fundamentals of biofertilizers I	[15L]
-----------------	---	--------------

Learning Objectives:

This module is intended to:

- Discover the role of microorganisms as biofertilizers.

Learning Outcomes

After completing this module, learner will be able to

1. Perform an experiment to Isolate microorganisms on suitable nutrient medium.
2. Propose culture methods for mass cultivation of potential organisms to be used as biofertilizers.

1.1	Introduction, Classification	1L
1.2	Macronutrients solubilising bacteria and Micronutrients solubilising bacteria	7L
1.3	Mass production-Culture methods, Mass Production of- <i>Rhizobium</i> , <i>Azotobacter</i> , <i>Nostoc</i> , <i>Azolla</i>	5L
1.4	Nano biofertilizers	2L

References:

- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9523260/>
- <https://vikaspedia.in/agriculture/agri-inputs/bio-inputs/bioinputs-for-nutrient-management/biofertilizers>

Module 2	Fundamentals of biofertilizers II	[15L]
-----------------	--	--------------

Learning Objectives:

This module is intended to

- Comprehend advantages, disadvantages and methods of application of biofertilizer.
- Elaborate on the quality control and packaging of biofertilizer.

- Discuss various opportunities and challenges in the sector of biofertilizers.

Learning Outcomes

After completing this module learner will be able to:

1. Summarise advantages, disadvantages and methods of application of biofertilizer.
2. Perform quality control assessment for a given sample of biofertilizer.
3. Explain quality standards for biofertilizer.
4. Comment on carrier and packaging material for biofertilizer.

2.1	Advantages and Disadvantages.	2L
2.2	Quality standard for biofertilizers.	2L
2.3	Methods of quality control assessment in respect of biofertilizers.	4L
2.4	Carrier based inoculants- Charcoal, Lignite, Saw dust.	1L
2.5	Methods of application.	2L
2.6	Packing material- Adhesive, culture media, chemicals.	2L
2.7	Formulation of Beejamrut, Jeevamrut, Panchagavya.	2L

References:

1. <https://classroom.google.com/c/MjcwNTkwNDU3NTg3/m/NjMyMjIzNjAxNjUy/d/etails>
2. <https://classroom.google.com/c/MjcwNTkwNDU3NTg3/m/NjMyMjIwNTg2MDM4/details>
3. <https://classroom.google.com/c/MjcwNTkwNDU3NTg3/m/NjMyMjIwMDUwNjM3/details>

Question Paper Template
S.Y. B. Sc. (Botany) SEMESTER III
Skill Enhancement Course
COURSE TITLE: Biofertilizer
COURSE CODE: 24US3BOSECBF [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I		-	5	5	-	5	15
II	5	5	5		-	-	15
Total marks per objective	5	5	5	5	5	5	30
% Weightage	16.66	16.66	16.66	16.66	16.66	16.66	100

S.Y. B. Sc. BOTANY SEMESTER III
Skill Based Course- I Practicals**COURSE CODE: 24US3BOSECP [CREDITS - 01]**

Practicals	
Learning Objectives: This module is intended to <ul style="list-style-type: none">● Demonstrate the technique of isolation of microorganisms to be used as biofertilizer.● Elaborate various carrier and packaging materials for biofertilizer.	
Learning Outcomes After completing this module learner will be able to: <ol style="list-style-type: none">1. Isolate of microorganisms having potential of biofertilizer.2. Select specific carrier and packaging material for biofertilizer.3. Design commercial production of biofertilizer.	
Practicals: <ol style="list-style-type: none">1. Isolation of <i>Rhizobium</i> from root nodules using CRYEMA medium.2. Isolation of <i>Azotobacter</i> on Ashby's mannitol agar.3. Isolation of phosphate solubilising bacteria on Pikovasky's medium.4. Isolation of Zinc solubilising bacteria using suitable soil sample.5. Identification of different carrier materials used for biofertilizer.6. Identification of <i>Nostoc</i> and <i>Anabaena</i>, <i>Azolla</i> using photomicrograph or specimen.7. Study of effects of various biofertilizers on plant growth.8. Isolation of associative nitrogen fixing organisms from rice roots.9. Commercial production of <i>Azolla</i> and isolation of <i>Anabaena</i> from <i>Azolla</i> leaf.	
References: <ol style="list-style-type: none">1. https://classroom.google.com/c/MjcwNTkwNDU3NTg3/m/NjMyMjIzNjAxNjUy/details2. https://classroom.google.com/c/MjcwNTkwNDU3NTg3/m/NjMyMjIwNTg2MDM4/detail3. https://classroom.google.com/c/MjcwNTkwNDU3NTg3/m/NjMyMjIwMDUwNjM3/detail	

S. Y. B. Sc. BOTANY SEMESTER IV

Skill Based Course- I

COURSE TITLE: Crude Drug Analysis

COURSE CODE: 24US4BOSECCDA [CREDITS - 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Differentiate between organized and unorganized drugs.
2. Predict suitable time for collection and processing of drugs.
3. Comment on the variation in the quality of crude drugs.
4. Evaluate the drug on the basis of microscopic and physical parameters.
5. Analyze the crude drug for its active constituents.
6. Prepare Standard Operating Procedure (SOP) for instruments.
7. Formulate herbal products.

Module 1	Introduction to Pharmaceutical Botany	[15L]
-----------------	--	--------------

Learning Objectives:

The Module is intended to:

- Comprehend the quality of crude drug based on various parameters

Learning Outcomes:

After completing this module learner will be able to:

1. Differentiate between organized and unorganized drugs.
2. Predict suitable time for collection and processing of drugs.
3. Comment on the variation in the quality of crude drugs.
4. Evaluate the drug on the basis of microscopic and physical parameters.

1.1	Sources of drugs of Natural Origin- Organized and unorganized drugs.	2
1.2	Production of crude drugs -Collection, drying, garbling, storage, preservation.	2
1.3	Causes of variation in the quality of crude drugs.	2
1.4	Standardization of crude drugs- Organoleptic evaluation.	2
1.5	Microscopic evaluation of leaf and bark drugs.	3
1.6	Physical evaluation -Foreign matter, ash values, extractive values, swelling index, foaming index, bitterness value.	4

References:

- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3523529/#:~:text=Standardization%20of%20drugs%20means%20confirmation,formulations%20based%20on%20medicinal%20plants.>
- Kunle, Oluyemisi Folashade¹, Egharevba, Henry Omoregie¹ and Ahmadu, Peter Ochogu. (2012). International Journal of Biodiversity and Conservation. 4 (3): 101-112.

Module 2

Herbal Formulations

[15L]

Learning Objectives:

The module is intended to:

- Standardize the drug and formulate herbal products.

Learning Outcomes:

After completing the module, the learner will be able to:

1. Analyze the crude drug for its active constituents.
2. Prepare Standard Operating Procedure (SOP) for instruments.
3. Formulate herbal products.

2.1	Chemical evaluation - Chemical tests for the identification of chemical constituents- (Primary metabolites - polysaccharides, proteins, fixed oils and fats), (Secondary metabolites - alkaloids, glycosides, tannins, anthraquinones, saponins, flavonoids, phytosterols of crude drugs	6
2.2	Biological evaluation - Microbial assay	2
2.3	Good laboratory practices	1
2.4	Herbal formulations- Triphala churna, Pachakvati, Chyavanprash	6

References:

- <https://courseware.cutm.ac.in/wp-content/uploads/2021/03/Preparation-and-Standardization-of-Ayurvedic-Formulations-Asavas-Arista-Ghutika-Churna-Lehyas-Bhasma-1.pdf>
- <https://www.udyamimitra.in/uploads/gallery/media/Ayurvedi-Formulation.doc>

Question Paper Template
S.Y. B. Sc. (Botany) SEMESTER IV
Skill Enhancement Course
COURSE TITLE: Crude Drug Analysis
COURSE CODE: 24US4BOSECCDA [CREDITS - 02]

Module	Remembering / Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I		-	5	5	-	5	15
II	5	5	5		-	-	15
Total marks per objective	5	5	5	5	5	5	30
% Weightage	16.66	16.66	16.66	16.66	16.66	16.66	100

S.Y. B. Sc. BOTANY SEMESTER IV**Skill Based Course- I Practicals****COURSE CODE: 24US4BOSECP [CREDITS - 01]**

Practicals	
Learning Objectives: This module is intended to <ul style="list-style-type: none">● Determine quality of a crude drug.● Formulate herbal drugs.● Explore industries for careers in botany.	
Learning Outcomes After completing this module learner will be able to: <ol style="list-style-type: none">1. Evaluate quality of crude drug.2. Identify the presence of secondary metabolites in plants.3. Formulate herbal drugs.	
Practicals: <ol style="list-style-type: none">1. Study of crude drugs – physical, chemical and microscopic examinations.2. Qualitative determination of alkaloids, tannins, steroids and saponins from medicinal plants.3. Determination of water soluble and water insoluble ash from crude drugs.4. Determination of foaming index and swelling index from crude drugs.5. Determination of total phenol content from powdered drugs.6. Formulation of churna, pachakvati.7. Formulation of arishta, avaleha.8. Industry Visit9. Project	
References: <ul style="list-style-type: none">● https://courseware.cutm.ac.in/wp-content/uploads/2021/03/Preparation-and-Standardization-of-Ayurvedic-Formulations-Asavas-Arista-Ghutika-Churna-Lehyas-Bhasma-1.pdf● https://www.udyamimitra.in/uploads/gallery/media/Ayurvedi-Formulation.doc	

S. Y. B. Sc. (BOTANY)

SEMESTER III - Vocational Course

COURSE Title: Basics of Horticulture

COURSE CODE: 24US3BOVSCP

Credit- 02

Learning Objectives:		
The Practical is intended to:		
<ul style="list-style-type: none"> • Demonstrate skills in gardening. 		
Learning Outcome:		
After completing the module, learners will be able to:		
<ol style="list-style-type: none"> 1. To identify various media for propagating plants. 2. Demonstrate preparation of Nursery beds. 3. Critically evaluate information regarding hydroponics, vertical wall. 		
1	Identification of garden tools and implements Plant propagation -specialized vegetative structures, propagation on its own root system-cutting -root, stem, Leaf Propagation on the root system of other plant -budding, Grafting Layering-, Simple and Compound, Air layering	6
2	Nursery Layout- Demonstration of nursery layout and record Keeping. Media for propagating -Soil, Sand, Vermiculite, Cocopeat, Sphagnum moss Different irrigation systems. Types of Containers Potting and Repotting Preparation of nursery bed: raised bed, sunken bed, level beds Preparation of germination bed, transplant bed, storage bed, seedling bed and cutting bed Practicing raising and transplanting of seedling Types of enterprises	6
3	Methods of testing seed viability- Germination test, tetrazolium test Demonstration of seed treatment methods; chemicals and organic preparations used for seed treatment; Commercial seedling production of vegetables (chili, brinjal, spinach, cabbage) Cultural operations -Fertilizers applications, sowing, mulching, weeding.	6
4	Hydroponics, Microgreens Vertical wall garden	6



	Indoor plants Kitchen garden Organic Terrace Farming	
5	Visit to Nursery- Go Green Visit to Horticulture institute- Polyhouses, Horticulture Training Center, Talegaon Visit to Gardens- Maharashtra Nature Park Veer mata Jijabai Udyan, BPT Garden	6

S. Y. B. Sc. (BOTANY)
SEMESTER IV - Vocational Course
COURSE Title: Plant Biotechnology
COURSE CODE: 24US4BOVSCP
Credit- 02

Learning Objectives:		
The Practical is intended to:		
<ul style="list-style-type: none"> Experiment using different explant with tissue culture techniques for plant propagation. 		
Learning Outcome:		
After completing the module, learners will be able to:		
<ol style="list-style-type: none"> Prepare buffers and reagents required for the experiments. Suggest suitable tissue culture technique for large scale production of medicinal and aromatic plants. Propose start-up project of greenhouse. Apply for grants and funding agencies for tissue culture start-ups. 		
1	Designing and Layout of Plant Tissue Culture Laboratory	2
2	Concentration measures: Mole, Molarity, Molality, Normality, Specific gravity, PPM solutions, Percent solutions (Problems) Preparation of Buffers, Measurement of pH	5
3	Formulation of Gamborg's B5 and other nutrient medium.	7
4	Induction of callus using suitable explant of medicinal and aromatic plants.	4
5	Isolation of protoplasts using suitable enzymes.	4
6	Initiation of suspension culture using suitable explant.	3
7	Induction of somatic embryogenesis using suitable plant source.	4
8	Preparation of synthetic seeds.	4
9	Encapsulation of axillary buds.	4
10	Designing and Layout of GreenHouse	2
11	Hardening of Tissue Cultured plants	4
12	Cultivation of Bell pepper, Zucchini, Carnation and Gerbera in greenhouse	1
13	Visit to Hi-tech green house and Plant Breeding Institutes	5
14	Visit to Tissue Culture Industry	5



15	Report writing	1
16	Start-ups proposals- applying for subsidy from Govt, Proposals for funding from funding agencies, Overview of Patenting, drafting a patent, drafting letters for purchase, order	5

S.Y. B. Sc. (Botany) SEMESTER IV**Field Project****COURSE TITLE: Field Project****COURSE CODE: 24US4BOFP [CREDITS - 02]**

Course Learning Outcomes		
After the successful completion of the Course, the learner will be able to: <ul style="list-style-type: none">• Make students aware with recent research and work culture in research laboratories / industries.		
Module I	Field Project	60 L
Visit to nearby research institutes. Industrial visit. Report writing/presentation based on these visits		

S. Y. B. Sc. (BOTANY)

SEMESTER III - IKS

COURSE Title: Sacred grove

COURSE CODE: 24US3BOIKSSAG

Credit- 01

Learning Objectives:		
The Course is intended to:		
<ul style="list-style-type: none"> • Categorise major sacred groves in India 		
Learning Outcome:		
After completing the module, learners will be able to:		
<ol style="list-style-type: none"> 1. Identify traditional sacred grooves 2. Enlist Biodiversity rich Forest associated with religious and cultural beliefs 		
1	Introduction, Definition of Sacred grove	1
2	Sacred plants of India - Tree worship in the Vedas and in ancient Indian civilization Woman and tree Special trees	1
3	Significance, Threats to Sacred groves	1
4	Religious approach	1
5	Special emphasis on Western Ghats - Maharashtra	2
6	Sacred groves and religion	1
7	Sacred water bodies	1
8	socioeconomic characteristics of Sacred groves	1
9	Ecosystem management correlation with sacred groves	1
10	Conservation	1
11	Some major sacred groves of India	1
12	Case study -5	1
13	Visit	1
14	Report	1

8. Teaching learning process

The pedagogic methods adopted, involve direct lectures, tutorial discussions, as well as technology- supported presentations. We believe that education is interactive and all sessions between students and teachers are based upon reciprocity and respect.

- The lectures (of 1 hr duration) delivered to one whole class at a time systematically deal with the themes of the syllabus. This constitutes the core of the teaching- learning process. The students are provided with bibliographic references and encouraged to go through at least some readings so that they could be more interactive and ask more relevant questions in the class. This also helps obtain knowledge beyond the boundaries of the syllabi.
- Wherever needed, teachers use audio-video based technology devices (e. g. power point, YouTube videos) to make their presentations more effective. Some courses require that students see a documentary or feature film and course themes are structured so that discussions of these will further nuance the critical engagement of students with ideas introduced in their textual materials.
- Remedial coaching, bridge courses are adopted to enhance the scope of learning for the learners. Remedial sessions are conducted to offer assistance on certain advanced topics. Bridge courses facilitate the development of a concrete basis for the topics to be learnt in the coming academic year. The remedial coaching strengthens the slow learners while more interactive and challenging project activities stimulate the fast learners into more evolved understanding.
- Cooperative Learning Strategy - Flipped classroom is used by faculty members. Learners are provided with links to videos, study material in advance and discussions are encouraged to gauge their understanding thereof. Learners are distributed in small groups and peer assessment among them is encouraged to facilitate interactive learning. The project-based learning provides a better grip for the learners on the concepts reviewed theoretically.
- Review of Literature - Research articles from renowned journals are used to constantly update the information in the scientific field. At the same time the exercise of drawing key information from these articles trains the learner to develop a comprehensive habit.

9. Assessment Methods

Evaluation Pattern: Theory

- Assessments are divided into two parts: Continuous Internal Assessment (CIA) & Semester End Examination.
- The Semester End Examination shall be conducted by the College at the end of each semester.
- Semester End Examination (external) (30 M)- Duration:
1 hours Paper Pattern

Question No	Module	Marks with Option	Marks without Option
1	I	5M x 5 Q = 25 M	4M x 3 Q = 15 M
2	II	5M x 5 Q = 25 M	4M x 3 Q = 15 M

- For Internal Evaluation (20 M): Continuous Evaluation based on multiple tests and assignments, case studies, report writing, presentations.

Evaluation pattern: Practical

- Continuous Practical evaluation of MJ1 and MJ 2 will be of 50 marks.

	Activities defined for continuous practical evaluation	Marks
1	Experimental Work/ Slide preparation	15
2	Experimental Documentation / Biostatistics Problems / Quiz	15
3	Journal	5
4	Field Report	5
5	Viva	5
6	Attendance	5
	Total Marks	50



-
- Continuous internal evaluation 20 marks as per the following rubrics.

	Activities defined for internal theory evaluation	Marks
	MCQ Test on each module	10
	Poster / Presentations / Assignments	05
	Product Designing / Case study/ Biostatistics Problems	05
	Total Marks	20

10. Program and Course Code Format

The course is coded according to following criteria:

1. First two numbers in each course code indicates year of implementation of syllabus (21-year of implementation is 2021-22)
2. Third letter 'U' designates undergraduate
3. Fourth letter 'S' designate Science discipline and the digit followed is for semester number (S1 – 1st Semester)
4. Letter 'BO' is for Botany discipline (BO-Botany)

This forms the programme code 21USBO. For the further course codes programme code is amended as follows

To designate the semester, add the digit (1-6) after S in the programme code. (Eg: 21US1BO- for semester I)

For the further course codes, addition to the program code should be done as per the following instructions.

5. To represent core courses (CC) followed by course number digit (1/2/3/4) and three lettered codes representing the title of the course.
6. For Ability enhancement course code, (AE) alphabets followed by a digit (1/2) followed by 'FOC'- Foundation course, 'BCE'-Basic communication in English, 'EVS'- Environmental science is used.
7. For Skill enhancement courses code (SE) followed by digits (1/2/3) followed by letters 'STP'-Sports training program, 'ICH'-Indian cultural heritage, followed by digits (1/2/3) representing the levels used. In case of subject related SEC, (SE) followed by digits (1/2/3) followed by a three lettered code representing the title of the course are used.
8. For Discipline specific elective course (DS) of Semester V and VI, (DS) followed by digits (1/2/3/4) followed by a three lettered code representing the title of the course are used.
9. 'P' followed by digit indicates practical course number. (Practical course number will be added for semesters only where there is more than one course.