



SOMAIYA
VIDYAVIHAR

K J Somaiya College of Science & Commerce
Autonomous (Affiliated to University of Mumbai)



Learning Outcomes based Curriculum Framework

(LOCF)

For

B.Sc. Botany

Undergraduate Programme

From

Academic year

2021-22



SOMAIYA
VIDYAVIHAR

K J Somaiya College of Science & Commerce
Autonomous (Affiliated to University of Mumbai)



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

Undergraduate and Postgraduate

	Name	Designation	Institute/Industry
Head of the Department			
1	Mrs. Supriya Janbandhu	Chairperson	K J Somaiya College of Science and Commerce
Subject Expert nominated by Vice-Chancellor			
1	Dr. Nisha Muni	Associate Professor	R. J. College Ghatkopar
2	Dr. Shailaja Nair	Associate Professor	Mithibai College
Subject experts			
1	Dr.Ajit Kengar	Associate Professor	Kelkar -Vaze College
2	Dr.Smita Jadhav	Associate Professor	Kirti College
3	Dr. Shahana Khan	Rtd. Associate Professor	Institute of Science, Mumbai
4	Dr. Nitin Labhane	Associate Professor	Bhavans College, Andheri
5	Dr. Manjushree Deodhar	Rtd. Associate Professor	Kelkar-Vaze College
Representative from Industry/corporate sector/allied area			

1	Dr. Kshitij Satardekar	Scientist	Colgate India Ltd
Meritorious Alumnus			
1	Ms. Uzma Shiekh	M.Sc.	K J Somaiya College of Science and Commerce
2	Deepika Mahto	M.Sc.	K J Somaiya College of Science and Commerce
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2	Dr. Meena Patankar	Assistant Professor	K J Somaiya College of Science and Commerce
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4	Dr. Ketan Thatte	Assistant Professor	K J Somaiya College of Science and Commerce



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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.

An Autonomous college carries 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 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 support and encouragement throughout the process of curriculum restructuring. I am also grateful to all the esteemed members of the Board of Studies, for their valuable inputs.

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

Mrs. Supriya Janbandhu

Chairperson

Board of Studies in Botany

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Preamble

The revised syllabus will be effective from the academic year 2021-22. 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.

The content caters to the current changing needs of the stakeholders, specifically to statistics and computation skills. 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 be taught topics through experiential learning also. 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 course will ignite the conscience about global issues amongst the learner to become a sensitive citizen.

1. Introduction

The B.Sc. Botany program has been designed with an interdisciplinary approach with focus on exploring the field of Botany. It connects traditional knowledge with modern tools for creating best strategies towards betterment of life. The holistic approach of the course allows the students to comprehend the theoretical knowledge and apply it in the most innovative manner. The skills acquired during research projects and internship opportunities, will prepare the learner to venture into the entrepreneurial sector with a thrust.

2. Learning Outcome based Curriculum Framework

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.

2.1 Nature and extent of B.Sc. Botany

The B.Sc. Botany programme is of three years duration. Each year is divided into two semesters. The Degree program in Botany has been framed to draw the principles from core botanical concepts, with their amalgamation of recent developments in the field of tissue culture, plant breeding and cytogenetics. Further, the experiential learning in Herbal Formulations, Cosmeceuticals, Post-Harvest Technology, and Landscape Architecture provide versatile avenues.

2.2 Programme Education Objectives

The overall aims of bachelor's degree program in botany are to:

1. Categorise the plant into respective Groups.
2. Correlate the functions of the biomolecule with their structure.
3. Recommend strategies to mitigate environmental degradation
4. Prioritise the conservation and management of biodiversity.
5. Validate the processes of Plant Tissue Culture and Post-Harvest Technology.
6. Investigate the mechanism of biological system with respect to genetics and biochemistry.

3 Graduate Attributes in Botany

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

Every student shall have following on completion of the programme:

- GA 1: Depth of core and disciplinary knowledge
- GA 2: Ability to motivate and the capability of handling independent work
- GA 3: Equipped to seek knowledge and to continue learning throughout their lives.
- GA 4: An understanding of international traditions and practices both within and beyond their discipline.
- GA 5: Set aspirational goals for continuous personal and professional growth.
- GA 6: The ability to communicate effectively with society and convince people to take a conversational approach.
- GA 7: Acquisition of knowledge and ability to troubleshoot through first-hand experience with real life scenarios.

4 Qualification Descriptors

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 to 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 employment areas provided by an undergraduate training 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. Agriculture Sector
4. Perfumery Industry
5. Cosmetic Industry
6. Forensic Science
7. Pharmaceuticals Industry

Job Roles for B.Sc. Botany graduate:

After graduation one can seek a professional career as:

1. Environmental consultant
2. Nursery or Greenhouse Manager
3. Farming Consultant
4. Teach Biology in Schools after applying for B.Ed.
5. Appear For Government Jobs
6. Conservationist
7. Paleobotanist

Higher Education options for B.Sc. Botany Graduate:

1. M.Sc. Botany by Papers or M.Sc. Botany by Research
2. M.Sc. in a Specialized Branch of Botany (Cytogenetics and Plant Biotechnology, Angiosperms, Plant Physiology, Environment Botany, Mycology and Plant Pathology), or Allied subjects (Nutraceuticals, Environmental Science, Biotechnology, Life Science)
3. Appear for Government Exams.
4. Enrol for an integrated course of M.Sc. + Ph.D.
5. Post Graduate Diploma in Perfumery and Cosmetics

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 Learning Outcomes

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

- PLO I: Categorise the plant into respective Groups.
- PLO II: Utilize various analytical techniques for validation.
- PLO III: Organize and analyse the data generated through experiments using computer software.
- PLO IV: Evaluate the interaction between various biomolecules and internal cellular environment.
- PLO V: Recommend strategies to mitigate environmental degradation.
- PLO VI: Prioritize the conservation and management of biodiversity.
- PLO VII: Improve in skill set required to perform practical techniques in Botany.
- PLO VIII: Analyse the effect of climate change and anthropological activities on biodiversity.
- PLO IX: Propose the strategies for conservation of biodiversity with NGO's.
- PLO X: Formulate basic plant-based products in Pharmaceutical and Cosmeceuticals Industry.
- PLO XI: Validate the processes of Plant Tissue Culture and post-Harvest Technology.
- PLO XII: Investigate the mechanism of biological system with respect to genetics and biochemistry.

5.1 Course Mapping

Semester	PLO	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Course													
I	CC I	√											
	CC II		√	√	√								
	CC III		√	√				√					
	CC IV							√					
	AECC I												
	FC*												
	SEC I												
	STPI												
II	CC I	√											
	CC II					√	√	√	√	√	√		
	CC III	√			√						√		
	CC IV					√	√		√	√			
	AECC I												
	FC*												
	SEC I												
	STP2												
III	CC I	√											
	CC II				√								
	CC III		√					√			√		
	CC IV		√		√								

	CC V										√		
	AECC I												
	FC*												
	SEC I												
	STP3												
	SEC II												
IV	ICH2***												
	CC I	√							√				
	CC II			√		√	√		√				√
	CC III					√	√	√	√	√			
	CC IV					√	√		√				
	CC V							√					
	AECC I												
	FC*												
	SEC I												
	STP4												
V	SEC II												
	ICH3***												
	CC I	√				√							
	CC II	√											
	CC III		√	√									√
	CC IV					√	√		√				
	DSE I										√		
	DSE II										√		
	DSE III						√	√			√		
	DSE IV						√	√			√		
AECC I													
EVS													

VI	SEC I			√				√					
	SEC II											√	
	CC I	√											
	CC II	√											
	CC III				√							√	
	CC IV					√	√		√	√			
	DSE I											√	
	DSE II							√					
	DSE III												√
	DSE IV							√					
	AECC I												
	EVS												
	SEC I						√	√	√	√			
	SEC II							√					
	SEC I												
	SEC II												

* FC = Foundation Course

** BCE = Basic communication in English

*** ICH = Indian Cultural Heritage (Value Education)

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 and six semesters (two semesters per year). To acquire a degree in B.Sc. Botany a learner must study-

I. Core Courses (CC):

- A course which is required to be opted by a candidate as a core course.
- There are eighteen Core courses (CC), two each, in semesters I and II; three each in semesters III and IV and four each in semesters V and VI (for 6 units).
- Core Courses I is compulsory. For Core Course II, Students can select either one course for two credits or two courses of one credit each.
- CC I is comprised of 2 credits for theory i.e., 30 hours; 3 lectures of 50 min each per week and 1 credit for practical of two hour per week in every semester.
- CC II is comprised of 2 credits for theory i.e., 30 hours; 3 lectures of 50 min each per week and 1 credit for practical of two hour per week in every semester.
- In semester III and IV, CC III is comprised of 2 credits for theory i.e., 30 hours; 3 lectures of 50 min each per week and 1 credit for practical of two hour per week in every semester.
- In semester I and II, CC III and IV are comprised of 1 credit each for theory i.e., 15 hours; 3 lectures of 50 min each per week and 1 credit for practical of two hour per week (together for CC III and CCIV) in both semesters.
- In semester III and IV, CC IV and V are comprised of 1 credit each for theory i.e., 15 hours; 3 lectures of 50 min each per week and 1 credit for practical of two hour per week (together for CC III and CCIV) in both semesters.
- The purpose of fixing core papers is to ensure that the institution follows a minimum common curriculum so as to adhere to common minimum standard with other universities/institutions.

- j) The course designed under this category aims to cover the basics that a student is expected to imbibe in that particular discipline.

2. Ability Enhancement Compulsory Courses (AECC)

- a) There are six AECC courses. Student must take two Ability Enhancement Compulsory Courses (AECC) in semester I and one AECC each in semesters II-VI.
- b) The AECC courses offered are:
AECC 1- Foundation Course (2 credits) (Semester I-IV),
AECC 2-Environmental Science (2 credits) (Semester V and VI).

3. Skill Enhancement Course (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 twelve skill enhancement courses offered. Each student is supposed to take one in Sem I (Sports) and two courses in each semester II- IV (Sports training Program, basic Communication in english and Indian Cultural Heritage) of 1 credit each. There are four discipline-related skill enhancement courses (SEC), two offered in each semester V and semester VI each of 2 credits. The student is supposed to choose one SEC in Semester V and VI.

4. Discipline Specific Elective Courses (DSE):

- a) Elective courses offered under the main discipline subject of study.
- b) There are eight discipline specific elective courses (DSE), four in each semesters V and VI. The student is supposed to choose two out of four in each semester V and VI.

- c) Each DSE theory course is of 2 credits i.e., 30 hours; 3 lectures of each 50 min per week and 1 credit for practical of two hour per week in every semester.
- d) Research Project is offered as an option for the student to choose in lieu of a regular DSE course.

5. Generic Elective Course (GE)

- a) Students can opt for one interdisciplinary Generic Elective Course (GE) in each of the semester V and VI.
- b) Generic elective courses are offered in cognate disciplines by different departments in the college.
- c) Credits for these courses are granted as additional credits.

6.1 Content

Sr. No	Semester	Course number	Course Code	Course title
Core Course (CC)				
1	I Students will select either CC II or CC III and CC IV together.	CC I	2IUSIBOCC1PLD	Plant Diversity - I
2		CC II	2IUSIBOCC2FBA	Fundamentals of Biomolecules and Analysis
3		CCIII	2IUSIBOCC2EBS	Use of Excel in Biostatistics
4		CCIV	2IUSIBOCC2MIT	Microtechniques
5		CC P	2IUSIBOCCP	Based on CC I and CC II Based on CC I and CC III + CC IV
4	II	CC I	2IUS2BOCC1PLD	Plant Diversity - II
5		CC II	2IUS2BOCC2BTS	Botanical skills

	Students will select	CC III	21US2BOCC2NAC	Nutraceuticals and Cosmeceuticals
6	either CC II or CC III and CC IV together.	CC IV	21US2BOCC2BAC	Biodiversity and Conservation
		CC P	21US2BOCCP	Based on CCI and CC2
7	III	CC I	22US3BOCC1PLD	Plant Diversity - III
8	Students will select	CC II	22US3BOCC2FAF	Forms and Function I
9	either CC III or CC IV and	CC III	22US3BOCC3APB	Applied Botany I
	CC V together.	CC IV	22US3BOCC3IAP	Instrumentation and Phytochemistry
		CC V	22US3BOCC3INB	Industrial Botany I
10		CC P	22US3BOCCP	Based on CCI, CC2, and CC3
11	IV	CC I	22US4BOCC1FUB	Functional Botany I
12	Students will select	CC II	22US4BOCC2DDM	DNA Technology and Data Management
13	either CC III or CC IV and	CC III	22US4BOCC3APB	Applied Botany II
	CC V together.	CC IV	22US4BOCC3FOS	Forestry I
		CC V	22US4BOCC3HOC	Horticulture
14		CC P	22US4BOCCP	Based on CC I, CC II, and CC III Based on CC I, CC II, and CC IV and CC V
15	V	CC I	23US5BOCC1MAP	Microbiology and Phycology
16		CC II	23US5BOCC2CRP	Cryptogams

17		CCP I	23US5BOCCP	Based on CC I and CC II
18		CC III	23US5BOCC3CCB	Cytogenetics and Computational Biology
19		CC IV	23US5BOCC4EVB	Environmental Botany
20		CC P II	23US5BOCCP	Based on CC III and CC IV
21	VI	CC I	23US6BOCCIVPD	Vascular Plants Diversity
22		CC II	23US6BOCC2FAF	Forms and Function II
23		CC P I	23US6BOCCP	Based on CC I and CC II
24		CC III	23US6BOCC3FUB	Functional Botany II
25		CC IV	23US6BOCC4FOS	Forestry II
26		CC P II	23US6BOCCP	Based on CC III and CC IV
Discipline Specific Electives (DSE)				
1	V	DSE I	23US5BODSIINB	Industrial Botany II
2		DSE II	23US5BODS2ECB	Economic Botany
3		DSE III	23US5BODS3MDB	Medicinal Botany
4		DSE IV	23US5BODS4PLP	Plant propagation
5		DSE P	23US5BODSP	Industrial Botany II Economic Botany Medicinal Botany Plant propagation
6	VI	DSE I	23US6BODSIAYB	Ayurvedic Botany
7		DSE II	23US6BODS2GHT	Green House Technology
8		DSE III	23US6BODS3PBT	Plant Biotechnology
9		DSE IV	23US6BODS4FLC	Floriculture
10		DSE P	23US6BODSP	Ayurvedic Botany Green House Technology Plant Biotechnology Floriculture

Skill Enhancement Courses (SEC)				
1	I	SEC I	2IUSISEISTP1	Sports Training Program Level I
2		SEC II	2IUSISE2BCE	Basic Communication in English
3	II	SEC I	2IUS2SEISTP2	Sports Training Program Level II
4		SEC II	2IUS2SE2ICHI	Indian cultural Heritage Level I (value education)
5	III	SEC I	22US3SEISTP3	Sports Training Program Level III
6		SEC II	22US3SE2ICH2	Indian cultural Heritage Level II (value education)
7	IV	SEC I	22US4SEISTP4	Sports Training Program Level IV
8		SEC II	22US4SE2ICH3	Indian cultural Heritage Level III (value education)
9	V	SEC I	23US5BOSEILNA	Landscape Architecture
10		SEC II	23US5BOSE2PHT	Post-Harvest Technology and Preservation
11	VI	SEC I	23US6BOSEISPF	Sustainable Practices (Subhash Palekar Natural Farming)
12		SEC II	20US6BOSE2ENT	Entrepreneurship
Ability Enhancement Compulsory Course (AECC)				
1	I	AECC I	2IUSIAEIFOC	Foundation Course
2	II	AECC II	2IUS2AEIFOC	Foundation Course
3	III	AECC I	22US3AEIFOC	Foundation Course



4	IV	AECC I	22US4AEIFOC	Foundation Course
5	V	AECC I	23US5AEIEVS	Environmental Science
6	VI	AECC I	23US6AEIEVS	Environmental Science

6.2 Credit distribution for B.Sc. Botany

Semester	Course number	Course title	Credits		
			Theory	Practical	Total
I	CC I	Plant Diversity - I	2	1	3
	CC II	Fundamentals of Biomolecules and Analysis	2	1	3
		OR	OR	OR	OR
		OR			
	CC III + CC IV	Use of Excel in Biostatistics + Microtechniques	1+1	1	3
	AECC I	Foundation Course	2		2
	AECC II	Basic Communication in English	1		1
	SEC I	Sports Training Program Level I	1		1
	SEC II	Basic Communication in English	1		1
II	CC I	Plant Diversity - II	2	1	3
	CC II	Botanical skills OR	2	1	3
	CC III + CC IV	Nutraceuticals and Cosmeceuticals + Biodiversity and Conservation	OR	OR	OR
			1+1	1	3

	AECC I	Foundation Course	2		2
	SEC I	Sports Training Program Level II	1		1
	SEC II	Indian cultural Heritage Level I (value education)	1		1
III	CC I	Plant Diversity - III	2	1	3
	CC II	Forms and Function I	2	1	3
	CC III	Applied Botany I OR	2	1	3
	CC IV + CC V	Instrumentation and Phytochemistry + Industrial Botany I	OR 1+1	OR 1	
	AECC I	Foundation Course	2		2
	SEC I	Sports Training Program Level III	1		1
	SEC II	Indian cultural Heritage Level II (value education)	1		1
IV	CC I	Functional Botany I	2	1	3
	CC II	DNA Technology and Data Management	2	1	3
	CC III CC IV + CC V	Applied Botany II OR Forestry I + Horticulture	2 OR 1 + 1	1 OR 1	3

	AECC I	Foundation Course	2		2
	SEC I	Sports Training Program Level IV	1		1
	SEC II	Indian cultural Heritage Level III (value education)	1		1
V	CC I	Microbiology and Phycology	2	1	3
	CC II	Cryptogams	2	1	3
	CC III	Cytogenetics and Computational Biology	2	1	3
	CC IV	Environmental Botany	2	1	3
	DSE I/II	Industrial Botany II/ Economic Botany	2	1	3
	DSE III/IV	Medicinal Botany/ Plant Propagation	2	1	3
	AECC I	Environmental science	1		1
	SEC I/II	Landscape Architecture/Post-Harvest Technology and Preservation	2		2
VI	CC I	Vascular Plants Diversity	2	1	3
	CC II	Forms and Function II	2	1	3
	CC III	Functional Botany II	2	1	3

	CC IV	Forestry II	2	1	3
	DSE I/II	Ayurvedic Botany/ Green House Technology	2	1	3
	DSE III/IV	Plant Biotechnology/ Floriculture	2	1	3
	AECC I	Environmental science	1		1
	SEC I/II	Sustainable Practices (Subhash Palekar Natural Farming)/ Entrepreneurship	2		2

6.3 Semester Schedule

Semester	Core Course number	Core Course (CC) title	Discipline Specific Electives (DSE)	Generic Elective Course (GE)	Skill Enhancement Course (SEC)	Ability Enhancement Compulsory Course (AECC)
I	CC I	Plant Diversity - I	-	-	1] Sports Training Program Level I	Foundation Course
	CC II CC III + CC IV	Fundamentals of Biomolecules and Analysis OR Use of Excel in Biostatistics Microtechniques	-	-	2] Basic Communication in English	
II	CC I	Plant Diversity - II	-	-	1] Sports Training Program Level II	Foundation Course
	CC II CC III + CC IV	Botanical skills OR Nutraceuticals and Cosmeceuticals +	-	-	2] Indian cultural Heritage Level I	

		Biodiversity and Conservation			(Value Education)	
III	CC I	Plant Diversity - II	-	-	1] Sports Training Program Level III	Foundation Course
	CC II	Forms and Function I	-	-	2] Indian cultural Heritage Level II (Value Education)	
	CC III + CC IV + CC V	Applied Botany I Or Instrumentation and Phytochemistry + Industrial Botany I	-	-		
IV	CC I	Plant Diversity - II	-	-	1] Sports Training Program Level IV	Foundation Course
	CC II	Functional Botany I	-	-	2] Indian cultural Heritage Level III (Value Education)	
	CC III + CC IV + CC V	Applied Botany II Or Forestry I + Horticulture	-	-		
V	CC I	Microbiology and Phycology	DSE I/II Industrial Botany II	GE	SEC I/II	Environmental Science
	CC II	Cryptogams				

	CC III	Cytogenetics and Computational Biology	Economic Botany and DSE III/IV			
	CC IV	Environmental Botany	Medicinal Botany/ Plant Propagation			
VI	CC I	Vascular Plants Diversity	DSE I/II	GE	SEC I/ II	Environmental Science
	CC II	Forms and Function II	Botany/ Green House			
	CC III	Functional Botany II	Technology			
	CC IV	Forestry II	& DSE III/IV Plant Biotechnology. / Floriculture			

6.4 Course Learning Objective

The three-year undergraduate Botany Programme is designed to acquaint the learners with the significant development of the field. The objectives of structured curriculum in Botany are to strengthen the basic concepts of plant diversity. The core purpose of this structure is to develop a holistic approach towards conservation and troubleshooting. It is certain that in a time of information overload, the learner must acquire the skills of identifying the critical aspects towards formulation of constructive strategies. The current syllabus allows the learner to develop this unique ability which is vital in the current scenario.

7. Detailed B.Sc. Botany Syllabus

F. Y. B.Sc. Syllabus with effect from the Academic year 2021-2022

Syllabus - F. Y. B.Sc. Botany

Course No.	Course Title	Course Code	Credits	Hr.	Periods (50 min)	Module	Lectures per module (50 minutes)	Examination		
								Internal Marks	External Marks	Total Marks
SEMESTER I										
Core courses THEORY										
I	Plant Diversity - I	2IUSIBOP LD1	2	30	36	3	12	40	60	100
II	Fundamentals of Biomolecules and Analysis OR Use of Excel in Biostatistics. Microtechniques	2IUSIBOF BA2	2	30	36	3	12	40	60	100
		OR 2IUSIBOE BS2.1								
		2IUSIBO MIT2.2	1	15	18					
			1	15	18					
Core courses PRACTICAL										
			2	75	90			40	60	100

SEMESTER II										
Core courses THEORY										
I	Plant Diversity - II	2IUS2BO PLD1	2	30	36	3	12	40	60	100
II	Botanical skills OR Nutraceuticals and Cosmeceuticals + Biodiversity and Conservation	2IUS2BO BTS2 Or 2IUS2BO CC2NAC + 2IUS2BO CC2BAC	2	30	36	3	12	40	60	100
Core courses PRACTICAL										
		2IUS2BO P	2	75	90			40	60	100

F.Y. B. Sc. (BOTANY) SEMESTER I

Core Course- I

COURSE TITLE: Plant Diversity - I

COURSE CODE: 2IUSIBOCCIPLD [CREDITS - 02]

Course Learning Outcomes

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

1. Differentiate various life forms based on external morphology.
2. Classify the organisms to respective groups.
3. Interpret the evolutionary features of organisms.
4. Illustrate the internal structure of various life forms using microscopy.
5. Correlate significance of bacteria, algae and fungi with human welfare.
6. Connect the impact of environmental change on the existence of biodiversity.
7. Narrate the transitory stages of non-vascular plants to vascular plants with reference to terrestrial habitat.

Module I

Microbiology and Phycology

[12L]

Learning Objectives:

The module is intended:

1. To overview general and reproductive features of bacteria and algae.
2. To explore the economic importance of bacteria.

Learning Outcomes:

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

1. Differentiate features of bacterial and algal cells and categorize the organism based on phylogeny.

I.1

Bacteria –

[6L]

- I.1.1 Morphology and Classification of bacteria based on mode of nutrition.

	1.1.2 Reproduction in bacteria. 1.1.3 Economic importance of bacteria	
1.2	Algae – 1.2.1 Introduction of Algae with general characteristics and outline of classification of Algae upto class as defined by G. M. Smith. 1.2.2 Structure, and reproduction of <i>Cosmarium</i> . 1.2.3 Economic importance of algae	[6L]
References: <ul style="list-style-type: none"> • Pelczar and Reid., General Microbiology • Kale and Bhusari., General Microbiology • Ananthanarayan., Basics of Microbiology • Vasishta, B. R., Botany for Degree Students • Smith, G. M. Cryptogamic Botany Vol. I • Sharma, O. P. Textbook of Algae • Gangulee and Kar, College Botany 		
Module 2	Mycology and Lichens	[12L]
Learning Objectives: This module is intended: <ol style="list-style-type: none"> 1. To review general and reproductive features of fungi and lichens 2. To explore the interrelation with the environment and lichens. 		
Learning Outcomes: After the successful completion of the module, the learner will be able to: <ol style="list-style-type: none"> 1. Develop an understanding of fungi and lichens and compare their adaptive strategies. 		
2.1	Fungi 2.1.1 General characteristics and outline of classification of	[7L]

	Fungi up to class as defined by G. M. Smith. 2.1.2 Structure and reproduction in <i>Rhizopus</i> . 2.1.3 Economic importance of Fungi.	
2.2	Lichen 2.2.1 Occurrence, Types, Thallus structure Reproduction and mode of Nutrition in lichens 2.2.2 Ecological significance and economic importance of lichens	[5L]
References: <ul style="list-style-type: none"> • Sharma, O. P., Textbook of Fungi • Dubey, H. C., An Introduction of Fungi • Vasishta, B. R., Botany for Degree Students • Sarbhoy, A.K. Textbook of Mycology • Gangulee and Kar, College Botany 		
Module 3	Bryophyta and Pteridophyta	[12L]
Learning Objective: The module is intended: <ol style="list-style-type: none"> 1. To configure general and reproductive features of Bryophyta and Pteridophyta. 		
Learning Outcomes: After the successful completion of the module, the learner will be able: <ol style="list-style-type: none"> 1. To develop critical understanding on morphology, anatomy and reproduction of Bryophyta and Pteridophyta. 2. To interpret the evolutionary journey of Bryophytes and Pteridophytes and their transition to the terrestrial habitat. 		
3.1	Bryophyta 3.1.1 General characters and classification of group	[6L]

	Bryophyta up to class as defined by G. M. Smith. 3.1.2 Structure, Reproduction of <i>Anthoceros</i> .	
3.2	Pteridophyta 3.2.1 General characters and classification of group Pteridophyta up to class as defined by G. M Smith. 3.2.2 Structure, and Reproduction of <i>Nephrolepis</i> .	[6L]
References: <ul style="list-style-type: none"> • Vasishta, B. R., Botany for Degree Students • Smith, G. M., Cryptogamic Botany Vol. I • Saxena and Sarabhai, Textbook of Botany., Vol. II • Gangulee and Kar, College Botany 		

Question paper Template

F.Y. B. Sc. (BOTANY) SEMESTER I

Core Course- I

COURSE TITLE: Plant Diversity - I

COURSE CODE: 2IUSIBOCCIPLD [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	4	4	4	4	4	-	20
II	4	4	4	4	4	-	20
III	4	4	4	4	4	-	20
Total marks per objective	12	12	12	12	12		60
% Weightage	20	20	20	20	20		100

F.Y. B. Sc. (BOTANY) SEMESTER I

Core Course- II

COURSE TITLE: Fundamentals of Biomolecules and Analysis

COURSE CODE: 2IUSIBOCC2FBA [CREDITS - 02]

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. Suggest suitable reagents for analysis of certain compounds. 2. Make use of specific instruments and equipment for experimental analysis of certain biomolecules. 3. Design experiments to measure physiological processes. 4. Predict the effect of phytohormones on growth and development of crops. 5. Organize the raw data and represent it in tabular and graphical form. 6. Analyse the data to determine general tendency of a character. 		
Module 1	Instrumentation	[12L]
<p>Learning Objectives:</p> <p>The module is intended:</p> <ol style="list-style-type: none"> 1. To show principle, working and applications of colorimeter, pH meter and simple compound microscope. 2. To depict different methods of planar chromatography techniques. 		
<p>Learning Outcomes:</p> <p>After the successful completion of the module, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Measure pH, absorbance of a solution and Prepare buffers, 2. Use Paper chromatography, TLC for separation of biomolecules 		
1.1	Instrumentation	
	1.1.1 Construction, Working, Principle of -Colorimeter and pH meter.	[4L] [4L]

	1.1.2 Chromatography- Principle and working of Paper chromatography and TLC.	[4L]
	1.1.3 Microscopy- Compound microscope	
References: <ul style="list-style-type: none"> • Upadhyay and Upadhyay. Biophysical Chemistry -Principles and Techniques • Wilson and Walker. Principles and Techniques of Biochemistry and Molecular Biology. 		
Module 2	Plant Physiology and Biochemistry	[12L]
Learning Objectives: This module is intended: <ol style="list-style-type: none"> 1. To grasp the fundamental properties of principle biomolecules and enzymes. 2. To introduce the basic concepts of plant growth regulators and their applications. 		
Learning Outcomes: After the successful completion of the module, the learner will be able to: <ol style="list-style-type: none"> 1. Correlate the behaviour of the biomolecules in physiological scenarios. 2. Use plant growth regulators to modify agricultural processes 		
2.1	Introduction of Biomolecules – 2.1.1 Water 2.1.2 Carbohydrates 2.1.3 Proteins 2.1.4 Lipids	[5L]
2.2	Enzymes – 2.2.1 Classification- Based on site of activity, Nature of Reaction.	[5L]

	2.2.2 Mechanism of Action 2.2.3 Inhibition	
2.3	Plant Growth Regulators – 2.3.1. Introduction 2.3.2. Natural and Synthetic 2.3.3 Applications with respect to agriculture and horticulture.	[2L]
References: <ul style="list-style-type: none"> • V. Verma, Plant Physiology • R. K. Sinha, Modern Plant Physiology • Kochhar. Plant Physiology. • U. Satyanarayana, Medical Biochemistry • V. Varma, Biochemistry • Noggle and Fritz. Introductory, Plant Physiology. 		
Module 3	Biostatistics	[12L]
Learning Objectives: The module is intended: <ol style="list-style-type: none"> 1. To decipher the basic terms of biostatistics. 2. To organize of data for analysis. 		
Learning Outcomes: After the successful completion of the module, the learner will be able to: <ol style="list-style-type: none"> 1. Classify and validate biological data 2. Interpret the nature of the character under study 		
3.1	3.1.1 Common terms used in statistics- Population, Sample, Data: Qualitative and Quantitative, Observation, Parameter, Characteristic: attributes and variables	[4L]

	3.1.2 Representation of data - Tabular and Graphical.	[2L]
	3.1.3 Central tendency - Mean, Median, Mode and	[3L]
	3.1.4 Dispersion -Range and Standard Deviation	[3L]

References:

- Mahajan, B. K., Methods in Biostatistics
- Veer Bala Rastogi. Biostatistics
- Arora, Biostatistics
- Kar Halder, Biostatistics
- Pranab Kumar Banerjee, Introduction to Biostatistics S. Chand Publication
- S. Prasad, Elements of Biostatistics

Question Paper Template

F.Y. B. Sc. (BOTANY) SEMESTER I

Core Course- II

COURSE TITLE: Fundamentals of Biomolecules and Analysis

COURSE CODE: 2IUSIBOCC2FBA [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	4	4	4	4	4	-	20
II	4	4	4	4	4	-	20
III	4	4	4	4	4	-	20
Total marks per objective	12	12	12	12	12	-	60
% Weightage	20	20	20	20	20	-	100

Question Paper Template

F.Y. B. Sc. (BOTANY) SEMESTER I

Core Course- II

COURSE TITLE: Use of Excel in Biostatistics

COURSE CODE: 2IUSIBOCC2EBS

[CREDITS - 01]

And

COURSE TITLE: Microtechniques

COURSE: 2IUSIBOCC2MIT

[CREDITS - 01]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	-	4	4	4	-	8	20
II	-	4	4	4	-	8	20
III	-	4	4	4	-	8	20
Total marks per objective	-	12	12	12	-	24	60
% Weightage	-	20	20	20	-	40	100

F.Y. B. Sc. BOTANY SEMESTER I

Core Course- III

COURSE TITLE: Use of Excel in Biostatistics

COURSE CODE: 2IUSIBOCC2EBS [CREDITS - 0I]

Course Learning Outcomes

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

1. Decipher the basic terms of Biostatistics.
2. Organise data for analysis.
3. Classify and Validate Biological data.
4. Interpret the nature of the character under study
5. Create a customized grid to analyse a unique set of data.

Course Learning Outcomes		
After the successful completion of the Course, the learner will be able to:		
<ol style="list-style-type: none"> 1. Decipher the basic terms of Biostatistics. 2. Organise data for analysis. 3. Classify and Validate Biological data. 4. Interpret the nature of the character under study 5. Create a customized grid to analyse a unique set of data. 		
1.1	<p>Learning Objective:</p> <p>Familiarize the learner with the fundamentals of Biostatistics. Demonstrate different functions of Microsoft Excel.</p> <p>Fundamentals of Biostatistics:</p> <p>1.1.1 Definition 1.1.2 Common Terms and Concepts in Biostatistics 1.1.3 Sampling 1.1.4 Data Organisation- Tabular, Graphical 1.1.5 Central Tendency, Dispersion</p>	[6L]
1.2	<p>Basics of Excel:</p> <p>1.2.1 Workbook and Worksheets 1.2.2 Basic Mathematical Operations 1.2.3 Creating Tables- Frequency Distribution- Discrete, Continuous (Non-overlapping, Overlapping), Pivot</p>	[6L]

	1.2.4 Creating Graphs- Scatter diagram, Line, Ogive (Greater than, Less than), Bar, Histogram, Pie chart, Pivot Chart	
1.3	<p>Functions in EXCEL:</p> <p>1.3.1 Mathematical Functions</p> <ul style="list-style-type: none"> · SUM and SUMIF · RoundUp · Random <p>1.3.2 Logical Functions</p> <ul style="list-style-type: none"> · IFTHEN · FALSE <p>1.3.3 Statistical Functions in EXCEL:</p> <ul style="list-style-type: none"> · Average · Count · CountIF · STDEV.P · STDEV.S <p>1.3.4 LOOKUP</p> <ul style="list-style-type: none"> · VLOOKUP · HLOOKUP 	[6L]
<p>References:</p> <ul style="list-style-type: none"> ● Mahajan, B. K. Methods in Biostatistics ● Veer Bala Rastogi. Biostatistics ● Arora. Biostatistics ● Kar Halder, Biostatistics ● Pranab Kumar Banerjee, Introduction to Biostatistics S. Chand Publication ● S. Prasad. Elements of Biostatistics 		

F.Y. B. Sc. BOTANY SEMESTER I

Core Course- IV

COURSE TITLE: Microtechniques

COURSE CODE: 2IUSIBOCC2MIT [CREDIT - 01]

Course Learning Outcomes

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

1. Prepare the reagents required in analysis.
2. Suggest the suitable stains in staining techniques.
3. Design an experiment to study anatomical features of plant material.
4. Demonstrate the process of microtechniques.
5. Use microscopes effectively for interpretation of tissue organization.

Course Learning Outcomes		
After the successful completion of the Course, the learner will be able to:		
<ol style="list-style-type: none"> 1. Prepare the reagents required in analysis. 2. Suggest the suitable stains in staining techniques. 3. Design an experiment to study anatomical features of plant material. 4. Demonstrate the process of microtechniques. 5. Use microscopes effectively for interpretation of tissue organization. 		
1.1	<p>Learning Objectives:</p> <ol style="list-style-type: none"> 1. To identify the suitable stains for plant tissue visualization. 2. To make the reagents and recognize the significance of accuracy in reagent preparation. 3. To demonstrate the method of plant collection and its sectioning. <p>Essentials of Microtechnique -</p> <p>1.1.1 Concentration measures: Mole, Molarity, Molality, Normality, Specific gravity, PPM solutions, Percent solutions (Problems)</p> <p>1.1.2 Staining Technique: Principle of Staining, Stains: Hematoxylin, Fast Green, Safranin, Eosin, Crystal Violet, Nigrosine, Acetocarmine. Mordent- Purpose with examples.</p>	[6L]

	1.1.3 Mounting Media: Glycerin, DPX, Canada Balsam	
1.2	<p>Basics of Microtechnique:</p> <p>1.2.1 Collection of plant material: Storage during transport, Dehydration processes with reference to plant materials</p> <p>1.2.2 Sectioning: Hand cut Section (Double Staining), Maceration, Serial Section (Microtome- Block preparation, Ribbon cutting, Fixation, Staining, Mounting), Permanent Section</p> <p>1.2.3 Squash - Spread Preparation</p>	[6L]
1.3	<p>Microscopy:</p> <p>1.3.1 Principle of Light Microscopy</p> <p>1.3.2 Types of Microscopes: Dissecting, Simple, Compound (External Light source, Internal light source)</p> <p>1.3.3 Handling and Troubleshooting</p> <p>1.3.4 Applications of Light Microscopy: Haemocytometer, Micrometry</p>	[6L]
<p>References:</p> <ul style="list-style-type: none"> Annie Ragland. Plant Anatomy and Micro techniques. Saras Publication, Kanyakumari. 		

F. Y. B. Sc. (BOTANY)

SEMESTER I - Practical

COURSE CODE: 2IUSIBOCCP Credit- 01

Learning Objectives:		
The Practical is intended to		
<ol style="list-style-type: none"> 1. Overview general and reproductive features of cryptogams. 2. Distinguish bacteria based on staining characteristics. 		
Learning Outcomes:		
After the successful completion of the practical, the learner will be able to:		
<ol style="list-style-type: none"> 1. Differentiate various types of bacteria. 2. Identify morphological, anatomical, and reproductive features of cryptogams. 		
Core Course I	Plant Diversity -I	
1	Simple staining – Positive Staining	
2	Study of Bacterial capsule using suitable staining technique	
3	Study of the following types with the help of fresh or preserved material / permanent slides / photomicrographs – <i>Anabaena, Cosmarium, and Zygnema</i> Economic importance of algae in agriculture, food and medicine.	
4	Study of the following types with the help of fresh or preserved material / permanent slides / photomicrographs – <i>Rhizopus, Aspergillus, S. cerevisiae.</i> Positive aspects of fungi in the baking and	

	brewing industry and agriculture.	
5	Study of types of lichens with reference to thallus structure with examples prescribed in theory Ecological and Economic importance of lichens	
6	Study of the following types with the help of fresh or preserved material / permanent slides / photomicrographs – <i>Riccia</i> , <i>Anthoceros</i>	
7	Study of the following types with the help of fresh or preserved material / permanent slides / photomicrographs – <i>Selaginella</i> - External morphology, T.S. of Stem, L.S. of Strobilus T.S. of Rhizophore (Permanent Slide) <i>Nephrolepis</i> - External morphology, Mounting of Hydathode and Ramenta. Section of Pinna passing through sori. T.S. of Rachis (Permanent slide)	
Core Course II	Fundamentals of Biomolecules and Analysis	
1.	Demonstration of Colorimeter, pH meter, Compound microscope	
2.	Verification of Beer Lambert's Law using dil. solution of KMnO_4 or Dil solution of $\text{K}_2\text{Cr}_2\text{O}_7$	
3.	Determination of pH of various solutions using pH meter.	

4.	Qualitative Tests for Sugars (Benedict's Test, Molisch Test)	
5.	Qualitative Tests for Proteins (Biuret Test, Ninhydrin Test)	
6.	Paper Chromatography of sugars/ amino acids.	
7.	TLC of fatty acids.	
8.	Study of activity of the enzyme pectinase extracted from suitable plant material (qualitative)	
9.	Problems based on frequency distribution table.	
10.	Representation of data using suitable graphs.	
11.	Measurement of central tendency: Mean, Median and Mode	
12.	Problem based on Standard deviation.	

References:

- Vasishta, B. R., Botany for Degree Students
- Smith, G. M., Cryptogamic Botany Vol. I
- Saxena and Sarabhai, Textbook of Botany., Vol.II
- Gangulee and Kar, College Botany
- Upadhyay and Upadhyay. Biophysical Chemistry -Principles and Techniques
- Wilson and Walker. Principles and Techniques of Biochemistry and Molecular Biology.
- V. Verma, Plant Physiology

- R. K. Sinha, Modern Plant Physiology
- Kochhar. Plant Physiology.
- U. Satyanarayana, Medical Biochemistry
- V. Varma, Biochemistry
- Noggle and Fritz. Introductory, Plant Physiology.
- Mahajan, B. K., Methods in Biostatistics
- Veer Bala Rastogi. Biostatistics
- Arora, Biostatistics
- Kar Halder, Biostatistics
- Pranab Kumar Banerjee, Introduction to Biostatistics S. Chand Publication
- S. Prasad, Elements of Biostatistics

OR

Use of Excel in Biostatistics + Microtechniques		
1	Identification of appropriate sampling method for given case.	
2	To classify the given data in a suitable frequency distribution table using excel.	
3	To plot the tabulated data into suitable graphical form using excel.	
4	Determination of mean, median, mode and standard deviation for a given data set using excel.	
5	Create grids in excel for performing specific	

	operations (Mean / Median / Mode / Standard Deviation) for a given data set using LOOKUP function.	
6	Preparation of solutions.	
7	Study of stains with reference to application as prescribed in theory.	
8	Collection of plant material.	
9	Hand cut section (Double staining, Maceration, Serial section	
10	Block preparation and Ribbon cutting	
11	Squash preparation for the study of mitosis and meiosis.	
12	Use of Haemocytometer and Micrometry.	

References:

- Mahajan, B. K., Methods in Biostatistics
- Veer Bala Rastogi. Biostatistics
- Arora, Biostatistics
- Kar Halder, Biostatistics
- Pranab Kumar Banerjee, Introduction to Biostatistics S. Chand Publication
- S. Prasad, Elements of Biostatistics
- Wilson and Walker. Principles and Techniques of Biochemistry and Molecular Biology.
- Plant anatomy, Pijush Roy

F.Y. B. Sc. (BOTANY) SEMESTER II

Core Course- I

COURSE TITLE: Plant Diversity II

COURSE CODE: 2IUS2BOCCIPLD [CREDITS - 02]

Course Learning Outcomes		
<p>After the successful completion of the Course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Correlate type of fossils with the process of fossilization. 2. Justify the existence of particular species in the Geological time zone. 3. Identify the Gymnosperms with potential applications in industry. 4. Classify the plants to respective families and comment on interrelationships between them. 5. Select the plants having economic importance for betterment of life. 6. Explain the structural organization of tissues in plants. 		
Module 1	Paleobotany and Gymnosperms	[[2L]
<p>Learning Objectives:</p> <p>The module is intended:</p> <ol style="list-style-type: none"> 1. To consolidate the process of fossilization and principle types of fossils. 2. To prove the evolutionary relationship with prehistoric evidences 3. To compare the features of gymnosperms and angiosperms with reference to morphological and reproductive features of <i>Cycas</i>. 		
<p>Learning Outcomes:</p> <p>After the successful completion of the module, the learner will be able:</p> <ol style="list-style-type: none"> 1. To categorize fossil specimens according to geological time scale. 2. To recognise different Gymnosperms with industrial potential 		
1.1	<p>Paleobotany-</p> <p>1.1.1 Types of fossils: Petrification, Cast, Impression</p>	[6 L]

	Compression, Amber. 1.1.2 Application of Fossil fuels, C ¹⁴ dating.	
1.2	Gymnosperm- 1.2.1 General characters and classification of group Gymnosperm up to class as defined by D. D. Pant 1.2.2 Structure and Reproduction of <i>Cycas</i> . 1.2.3 Economic importance of Gymnosperms	[6 L]
References: <ul style="list-style-type: none"> • Das Datta Gangulee, College Botany, Vol II • Cheshter Arnold, Paleobotany • Vashishtha, Gymnosperm. • Sharma, O. P., Gymnosperm. 		
Module 2	Angiosperms	[12L]
Learning Objectives: This module is intended to: <ol style="list-style-type: none"> 1. To employ the morphological peculiarities to classify the plants to respective families. 2. To overview the economic importance of plants for human welfare. 		
Learning Outcome: After the successful completion of the module, the learner will be able to: <ol style="list-style-type: none"> 1. Identify plants based on key characteristics of the families. 2. To use the economic importance of plants for the betterment of mankind. 		
2.1	Study of the following families according to Bentham and Hooker system of classification with special emphasis on morphological peculiarities and economic importance. 2.1.1 Malvaceae 2.1.2 Leguminosae (Subfamily: Papilionaceae (Fabaceae),	[3L] [4L]

	Caesalpiniaceae, Mimosaceae)	
2.1.3	Rubiaceae	[2L]
2.1.4	Apocynaceae	[2L]
2.1.5	Amaryllidaceae	[1L]
References:		
<ul style="list-style-type: none"> • R. K. Sinha. Taxonomy of Angiosperms • Gangulee, Das, Dutta., College Botany volume I • A. V. S. S. Sambamurthy. Taxonomy of Angiosperms • Sutaria, Textbook of Systematic Botany 		
Module 3	Anatomy	[12L]
Learning Objectives:		
The module is intended to		
1. To compare structure and function of plant tissues with reference to specific organs.		
Learning Outcome:		
After the successful completion of the module, the learner will be able to:		
1. Explain internal organization and functioning of various plant tissue systems.		
3.1	Tissue system in plants:	[8L]
	3.1.1 Introduction to various tissue systems in plants	
	3.1.2 Types of vascular bundles	
	3.1.3 Stomata (Dicot and Monocot - Graminaceous)	
3.2	Study of primary structure of –	[4L]
	3.2.1 Dicot and Monocot root	
	3.2.2 Dicot and Monocot stem	
References:		
<ul style="list-style-type: none"> • Pijush Roy, Plant Anatomy. 		

- Sinha, S K. The Textbook of Plant Anatomy
- Pande, B. P. Plant Anatomy

Question Paper Template

F.Y. B. Sc. (BOTANY) SEMESTER II

Core Course- I

COURSE TITLE: Plant Diversity -II

COURSE CODE: 2IUS2BOCCIPLD [CREDITS - 02]

Marcellus	Remembering / Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	4	4	4	4	4	-	20
II	4	4	4	4	4	-	20
III	4	4	4	4	4	-	20
Total marks per objective	12	12	12	12	12	-	60
% Weightage	20	20	20	20	20	-	100 %

F.Y. B. Sc. (BOTANY) SEMESTER II

Core Course- II

COURSE TITLE: Botanical skills

COURSE CODE: 2IUS2BOCC2BTS [CREDITS - 02]

Course Learning Outcomes

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

1. Formulate various Nutraceuticals and Cosmeceuticals products.
2. Infer the quality of natural resources like honey.
3. Reframe the strategies for forest management.
4. Collaborate with government agencies and NGO's for conservation of biodiversity.
5. Apply propagation techniques for large scale cultivation of important crops.
6. Utilize different propagation practices in nursery

Module 1	Nutraceuticals and Cosmeceuticals	[12L]
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Learning Objectives:

The module is intended:

1. To impose the significance of the plants and plant products in Cosmeceuticals and Nutraceuticals.
2. To familiarise with types of honey.

Learning Outcomes:

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

1. To use plants for Cosmeceuticals and Nutraceuticals applications.
2. To identify the source and analyse honey samples.

1.1	1.1.1	Concept and Advantages of Prebiotics, Probiotics, Synbiotics.	[6L]
	1.1.2	Functional food and Phytonutraceuticals- Scope involved in industry, Benefits and Uses of functional	

	food	
1.2	1.2.1 Cosmeceuticals - General Introduction, Plants for skin care, Hair care	[6L]
	1.2.2 Honey Types, Use of Honey in herbal cosmetics.	

References:

- Handbook of Nutraceuticals and Functional Foods Edited by Robert E.C. Wildman, Routledge Publishers.
- Nutraceuticals by L. Rapport and B. Lockwood, Pharmaceutical Press.
- Methods of Analysis for Functional Foods and Nutraceuticals Edited by W. Jeffrey, Hursts, Routledge Publishers.
- Food is Medicine by P. J. Cousion; Duncan Baird Publishers, London.
- Dietary Supplements of Plant Origin, M. Maffei (Ed.), Taylor & Francis, 2003.
- Nutraceutical beverages Chemistry, Nutrition and health Effects, Shahidi and Weerasinghe (Ed.), American Chemical Society, 2004.

Module	Forest Soil and Biodiversity management	[12L]
2		

Learning Objectives:

This module is intended:

1. To apply the basics of soil science to conserve the natural resources required in forestry.
2. To recognize the role of Biodiversity and conservation as natural resources

Learning Outcome:

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

1. To troubleshoot the difficulties encountered in forest management.
2. To propose the strategies for conservation of biodiversity

2.1	2.1.1 Forest Soil Management: Component of soil, Soil fertility- criteria of essentiality (Micro, Macro elements).	[4L] [2L]
	2.1.2 Silvicultural practices- Objective, Advantages	[3L]
	2.1.3 Biodiversity management and Conservation strategies	[3L]
	2.1.4 Organizations associated with Biodiversity; IUCN, NBPGR	

References:

- Indian Forestry, Manikandan And S. Prabhu
- Biodiversity: Concept, Threats and Conservation, December 2015, Environment Conservation Journal 16(3):19-28, DOI:10.36953/ECJ.2015.16303, https://www.researchgate.net/publication/294876262_Biodiversity_Concept_Threats_and_Conservation
- <https://www.safeworldhse.com/2020/04/biodiversity-types-importance-loss-conservation.html>

Module 3	Garden Operations	[12L]
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Learning Objective:

The module is intended:

1. To be acquainted with different propagation practices.

Learning Outcome:

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

1. To perform Garden operations independently.
2. To select ideal method of propagation for plants.

3.1	Definition, Branches, Importance and Scope of horticulture	[1L]
3.2	Garden operations	[6L]
	3.2.1 Soil types	
	3.2.2 Soil preparation	

	3.2.3 Digging and sowing 3.2.4 Watering 3.2.5 Weed Management	
3.3	Propagation Practices: 3.3.1 Method of propagation by Seed, Cutting, Layering, Budding and Grafting	[5L]
<p>References:</p> <ul style="list-style-type: none"> ● M K Sadhu. Plant propagation, New Age International Publisher, New Delhi ● R R Sharma. Propagation of Horticultural Crops, Kalyani Publications ● V L Sheela. Horticulture, M J P Publication, Chennai ● Christopher Brickell. Encyclopaedia of Gardening, Dorling Kindersley, London. ● Gauri Shankar. Handbook of Horticulture, Agro India Publication, Allahabad. 		

Question Paper Template

F.Y. B. Sc. (BOTANY) SEMESTER II

Core Course- II

COURSE TITLE: Botanical skills

COURSE CODE: 2IUS2BOCC2BTS [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	-	4	4	4	-	8	20
II	-	4	4	4	-	8	20
III	-	4	4	4	-	8	20
Total marks per objective	-	12	12	12	-	24	60
% Weightage	-	20	20	20	-	40	100

F.Y. B. Sc. BOTANY SEMESTER II

Core Course- III

COURSE TITLE: Nutraceuticals and Cosmeceuticals

COURSE CODE: 2IUS2BOCC2NAC [CREDITS - 01]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to:		
<ol style="list-style-type: none"> 1. Suggest plant-based products as therapeutic adjuvants. 2. Extract bioactive compounds from plants 3. Formulate Nutraceuticals and Cosmeceuticals products as effective therapeutic agents 		
Module 1		[18L]
1.1	<p>Learning Objectives</p> <ol style="list-style-type: none"> 1. To match the plants with specific therapeutic properties. 2. To demonstrate purification of secondary metabolites from plants. 3. To develop Nutraceuticals and Cosmeceuticals products. <p>Nutraceuticals:</p> <p>1.1.1 Concept and Sources</p> <p>1.1.2 Applications of Nutraceuticals: Dietary fiber, Probiotics, Prebiotics, Synbiotics, Polyunsaturated fatty acids, Antioxidants, Vitamins, Polyphenols, Spices</p> <p>1.1.3 Functional Food Supplements, Therapeutic adjuvants</p>	[6L]
1.2	<p>Cosmeceuticals:</p> <p>1.2.1 Introduction, Scope of algae and aromatic plants in perfumery and cosmetic industry.</p> <p>1.2.2 Essential oils used in perfumery: Cinnamon oil,</p>	[6L]

	<p>Sandalwood oil</p> <p>1.2.3 Vegetable oils and fats used in cosmetics: Kokum Butter</p> <p>1.2.4 Natural dyes in Cosmeceuticals- Coffee, Teak leaf, Parijat</p>	
1.3	<p>Herbal Formulations:</p> <p>1.3.1 Nutraceuticals product: Khakhra- millets</p> <p>1.3.2 Nutraceuticals product: Dry chutney powder- Sesame and Curry leaves</p> <p>1.3.3 Cosmeceuticals product: Skin care- Anti-aging cream</p> <p>1.3.4 Cosmeceuticals products: Hair care- Shampoo, Conditioner</p>	[6L]

References:

- Kalra EK. Nutraceutical – Definition and introduction. *AAPS Pharm Sci*. 2003;5:E25.
- Chauhan B, Kumar G, Kalam N, Ansari SH. Current concepts and prospects of herbal nutraceutical: A review. *J Adv Pharm Technol Res*. 2013; 4:4–8.
- Hardy G. Nutraceuticals and functional foods: Introduction and meaning. *Nutrition*. 2000;16:688–9.
- Zhao J. Bentham. Nutraceuticals, Nutritional Therapy, Phytonutrients, and Phytotherapy for Improvement of Human Health: A Perspective on Plant Biotechnology Application. Science Publishers; 2007
- <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/nutraceutical#:~:text=A%2Onutraceutical%2Ois%2Odefined%2Oas,Nutritional%2OAspects%2Oof%2OBuckwheat%2C%2O2016>
- Amarendra Pandey; Gurpoornam K. Jatana; Sidharth Sonthalia. Cosmeceuticals
- <https://www.ncbi.nlm.nih.gov/books/NBK544223/>

- Lintner K, Mas-Chamberlin C, Mondon P, Peschard O, Lamy L. [Cosmeceuticals and active ingredients](#). Clin Dermatol. 2009 Sep-Oct;27(5):461-8.
- [Zoe Diana Draelos](#) Cosmeceuticals: undefined, unclassified, and unregulated, Clin Dermatol, Sep-Oct 2009;27(5):431-4.

F.Y. B. Sc. BOTANY SEMESTER II

Core Course- II

COURSE TITLE: Biodiversity and Conservation

COURSE CODE: 2IUS2BOCC2BAC [CREDITS - 01]

Course Learning Outcome

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

1. Propose the strategies for conservation of biodiversity.
2. Collect biodiversity data using PBR (Public Biodiversity Register) guidelines.
3. Correlate the climate change and loss of biodiversity.
4. Infer the role of ethnomedicinal plants as traditional medicine.

Module 1		[18L]
1.1	<p>Learning Objectives:</p> <ol style="list-style-type: none"> 1. To illustrate current status, threats, and significance of biodiversity. 2. To inspect different conservation methods. 3. To correlate the plants used by tribals having medicinal properties. <p>Biodiversity:</p> <p>1.1.1 Introduction, Concept, Definition</p> <p>1.1.2 Levels of Biodiversity</p> <p>1.1.3 Biodiversity Hotspots- Characteristic flora and fauna</p>	[6L]

	<p>1.1.4 Status of Biodiversity- Biodiversity Centers- Ramsar Wetland, Species Diversity</p> <p>1.1.5 Threats to Biodiversity- Loss of Biodiversity, Genetic variation, Ecological variations, Invasive species, Man-Animal Conflicts</p> <p>1.1.6 Significance of Biodiversity</p>	
1.2	<p>Conservation Strategy:</p> <p>1.2.1 IUCN Database</p> <p>1.2.2 <i>In Situ</i> Conservation- National Parks, Sanctuary</p> <p>1.2.3 <i>Ex Situ</i> Conservation- Botanical Garden</p> <p>1.2.4 <i>In Vitro</i> Conservation- Germplasm Conservation</p> <p>1.2.5 Legislative Measures- Biodiversity ACT, People Biodiversity Register</p> <p>1.2.6 Case Study</p>	[6L]
1.3	<p>Ethnobotany:</p> <p>1.3.1 Plants used in traditional medicine</p> <p>1.3.2 Plants used by tribals as traditional medicine.</p> <p>1.3.3 Exploitation of Natural Resources by Pharmaceutical Industry- Survey</p> <p>1.3.4 Loss of Ethnomedicinally important plants- Case study</p> <p>1.3.5 Strategies to conserve diversity in Ethnomedicinal plants.</p>	[6L]
<p>References:</p> <ul style="list-style-type: none"> Biodiversity, 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 		

- Biodiversity and Conservation, <https://ncert.nic.in/ncerts/l/lebo115.pdf>
- Ulysses Paulino
- Albuquerque Marcelo Alves Ramos Washington Soares Ferreira Júnior
Patrícia Muniz de Medeiros. Ethnobotany for beginners,
<https://link.springer.com/content/pdf/10.1007%2F978-3-319-52872-4.pdf>
- Gary Martin. Ethnobotany, A Method Manual,
<https://link.springer.com/content/pdf/bfm%3A978-1-4615-2496-0%2F1.pdf>
- S. K. Jain. An Introduction to Ethnobotany, Deep Pub. New Delhi
- N. C. Shah. Ethnobotany in India,
https://link.springer.com/referenceworkentry/10.1007%2F978-1-4020-4425-0_8578
- Bir Bahadur. Ethnobotany of India, Volume II
- https://www.researchgate.net/publication/343222343_ETHNOBOTANY_OF_INDIA_Volume_2_Western_Ghats_and_West_Coast_of_Peninsular_India/link/5f1d80d345851515ef4afc3d/download

F. Y. B. Sc. (BOTANY)

SEMESTER II - Practical

COURSE CODE: 2IUS2BOCCP

Credit- 01

Learning Objectives:

The Practical is intended:

1. To overview general and reproductive features of Gymnosperms and Angiosperms.
2. To illustrate the structural and a functional organization of plant tissues.

Learning Outcomes:

1. To identify morphological, anatomical and reproductive features of Gymnosperms.
2. To correlate the plants with economic importance.
3. To differentiate various tissues and their corresponding functions in specific plant organs.

Core Course I	Plant Diversity -II	
1.	<p>Study of <i>Cycas</i> with the help of fresh or preserved material- T. S. of Pinna</p> <p>Study using Permanent slides / Photomicrographs of Microsporophyll, megasporophyll, T.S. of Coralloid roots</p>	
2.	<p>Study of the following families with the help of fresh material</p> <ul style="list-style-type: none"> ● Malvaceae ● Leguminosae (Subfamily: Papilionaceae (Fabaceae), Caesalpinaceae, Mimosaceae) 	

	<ul style="list-style-type: none">● Rubiaceae● Apocynaceae● Solanaceae● Amaryllidaceae	
3.	Study of types of vascular bundles with the help of permanent slides and Study of Stomata (Dicot and Monocot- Gramineous)	
4.	Study of primary structure of Dicot root and Monocot root	
5.	Study of primary structure of Dicot stem and Monocot stem	

F. Y. B. Sc. (BOTANY)

SEMESTER II - Practical

COURSE CODE: 2IUS2BOCCP

Credit- 01

Learning Objectives:		
<ol style="list-style-type: none"> To identify the plants having potential applications in the Nutraceuticals and Cosmeceuticals Industry. To demonstrate plant propagation practices for commercial production. 		
Learning Outcomes: The learner will be able to:		
<ol style="list-style-type: none"> Choose specific plants which can be used as functional foods, and source of Cosmeceuticals. Adapt specific propagation practices for commercial cultivation of particular plants. 		
Core Course	Botanical skills	
II		
1.	Identification of Prebiotics, Probiotics, Synbiotics	
2.	Isolation of probiotic bacteria from curd and comparison with commercially available products	
3.	Identification of functional foods and their uses - Rice, Ragi, Wheat germ	
4.	Identification of plants used as Cosmeceuticals and their uses. Maka, Hibiscus, Amla, Cucumber, Neem, Turmeric, Aloe	
5.	Analysis of honey samples	
6.	Identification of endemic and endangered species from Western Ghats	

7.	Determination of soil texture of given sample by sieving method	
8.	Identification of weeds	
9.	Preparation of soil for plantation	
10.	Propagation practices by Seed, Stem cutting, Simple layering, T- budding, Whip and Splice grafting	

References:

- Kalra EK. Nutraceutical – Definition and introduction. *AAPS Pharm Sci.* 2003;5:E25.
- Chauhan B, Kumar G, Kalam N, Ansari SH. Current concepts and prospects of herbal nutraceutical: A review. *J Adv Pharm Technol Res.* 2013; 4:4–8.
- Hardy G. Nutraceuticals and functional foods: Introduction and meaning. *Nutrition.* 2000;16:688–9.
- Zhao J. Bentham. Nutraceuticals, Nutritional Therapy, Phytonutrients, and Phytotherapy for Improvement of Human Health: A Perspective on Plant Biotechnology Application. Science Publishers; 2007
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- <https://www.ncbi.nlm.nih.gov/books/NBK544223/>
- Lintner K, Mas-Chamberlin C, Mondon P, Peschard O, Lamy L. [Cosmeceuticals and active ingredients.](#) Clin Dermatol. 2009 Sep-Oct;27(5):461-8.
- [Zoe Diana Draelos](#) Cosmeceuticals: undefined, unclassified, and unregulated, Clin Dermatol, Sep-Oct 2009;27(5):431-4.

OR

F. Y. B. Sc. (BOTANY)

SEMESTER II - Practical

COURSE CODE: 2IUS2BOCCP

Credit- 01

Learning Objectives:

1. To identify the plants having potential applications in the Nutraceutical and Cosmeceuticals Industry.
2. To examine the biodiversity of a specific region.

Learning Outcomes: The Learner will be able to:

1. Choose specific plants which can be used as functional foods, and source of Cosmeceuticals.
2. Summarize the biodiversity of a specific region.

Core Course II	Nutraceuticals and Cosmeceuticals + Biodiversity and Conservation	
1	Identification of Prebiotics, Probiotics, Synbiotics	
2	Isolation of probiotic bacteria from different sources and comparison with commercially available products	
3	Identification of Functional Foods and their uses - Rice, Ragi, Citrus fruits	
4	Identification of plants used as	

	Cosmeceuticals and their uses- Maka, Shikakai, Musta, Brahmi, Papaya, Potato, Turmeric, Aloe	
5	Formulation of Anti-aging cream and Shampoo	
6	Identification of plants as a source of dye and essential oils-, Teak, Coffee, Parijat, Sandalwood, Cinnamon	
7	Identification of endemic and endangered species from western ghats using photomicrograph.	
8	Case study- Man-Animal conflicts	
9	Preparation of People Biodiversity Register.	
10	Study of ethnomedicinally important plants used by tribal communities in the nearby region of Mumbai.	
<p>References -</p> <ul style="list-style-type: none"> • Kalra EK. Nutraceutical – Definition and introduction. <i>AAPS Pharm Sci.</i> 2003;5:E25. • Chauhan B, Kumar G, Kalam N, Ansari SH. Current concepts and prospects of herbal nutraceutical: A review. <i>J Adv Pharm Technol Res.</i> 2013; 4:4–8. • Hardy G. Nutraceuticals and functional foods: Introduction and meaning. <i>Nutrition.</i> 2000;16:688–9. 		

- Zhao J. Bentham. Nutraceuticals, Nutritional Therapy, Phytonutrients, and Phytotherapy for Improvement of Human Health: A Perspective on Plant Biotechnology Application. Science Publishers; 2007
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- Lintner K, Mas-Chamberlin C, Mondon P, Peschard O, Lamy L. [Cosmeceuticals and active ingredients](#). Clin Dermatol. 2009 Sep-Oct;27(5):461-8.

8. Teaching learning process

- 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.
- The remedial coaching strengthens the slow learners while more interactive and challenging project activities stimulate the fast learners into more evolved understanding.

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) (60 M)- Duration:
2 hours Paper Pattern

Question No	Module	Marks with Option	Marks without Option
1	I	4M x 7 Q = 28 M	4M x 5 Q = 20 M
2	II	4M x 7 Q = 28 M	4M x 5 Q = 20 M
3	III	4M x 7 Q = 28 M	4M x 5 Q = 20 M

Each question will have two sub questions [A] and [B]. Part [A] consists of three questions and part [B] consists of two questions.

- For Internal Evaluation (40 M) : Continuous Evaluation based on multiple tests and assignments, case studies, report writing, presentations.

Evaluation pattern: Practical

- Continuous Practical evaluation 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 40 marks as per the following rubrics

	Activities defined for internal theory evaluation	Marks
	MCQ Test on each module	10
	Poster / Presentations / Assignments	10
	Product Designing / Case study / Biostatistics Problems	20
	Total Marks	40
In Semester II the entire internal theory component will be assessed based on the performance of Value-Added Course- Field Botany.		
	Total Marks	40

IO. 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 2IUSBO. For the further course codes programme code is amended as follows
5. To designate the semester, add the digit (1-6) after S in the programme code. (Eg: 2IUSIBO- for semester I)
For the further course codes, addition to the program code should be done as per the following instructions.
6. To represent core courses (CC) followed by course number digit (1/2/3/4) and three lettered codes representing the title of the course.
7. For Ability enhancement course code, (AE) alphabets followed by a digit (1/2) followed by 'FOC'- Foundation course, 'EVS'-Environmental science is used.
8. For Skill enhancement courses code (SE) followed by digits (1/2/3) followed by letters 'STP'-Sports training program, 'ICH'-Indian cultural heritage and 'BCE'-Basic communication in English, followed by digits (1/2/3) representing the levels are 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.
9. 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.



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10. 'P' followed by digit indicates practical course number. (Practical course number will be added for semesters only where there is more than one course.)