



Nehru Gram Bharati (Deemed to be University)
Prayagraj, Uttar Pradesh , INDIA

Syllabus

[As per NEP-2020 Regulations]

Bachelor of Science (Honours)/(Honours with Research)
in
Botany

[Department of Botany]

[Effective From 2023-24 Onwards]

Board of Studies

Dated: 06-06-2023

1. Dr. Adi Nath, Head, Department of Botany, NGB (DU), Chairperson
2. Mr. Pradeep Upadhyay, Assistant Professor, Dept. of Botany, NGB (DU), Member
3. Dr. Shakti Nath Tripathi, Assistant Professor, Dept. of Botany, NGB (DU), Member
4. Dr. Dheeraj Pandey, Assistant Professor, Dept. of Botany, NGB (DU), Member
5. Prof. D.K. Chauhan, Ex-Head, Department of Botany, University of Allahabad, External Member
6. Prof. N.B. Singh, Department of Botany, University of Allahabad, External Member

Attendance Sheet & Minutes

DEPARTMENT OF BOTANY
NEHRU GRAM BHARATI
(A Deemed to be University)
Kotwa- Jamunipur-Dubaval, Prayagraj 221505

Resolutions

A meeting of Board of Studies in Botany was held on Tuesday, June 06th, 2023 at 11:00 AM in the Shashi Campus, Jhuthi Tali, Prayagraj, of NGB, with following agenda:

The Agenda for the meeting is listed below:

1. Confirmation of minutes of the past meeting.
2. To consider, and accept the syllabus prepared for the 4 yrs UG Programme (under the NEP 2020) for the department of Botany and Regulations for 4 Year Undergraduate Degree Gazetted on November 7th, 2022.
3. To take into account and accept the vocational programmes, such as horticulture, mushroom cultivation, and herbal technology, that the Department of Botany has created.
4. The Department of Botany offered the minor elective courses Environmental Science and Sustainable Development.

The meeting was chaired by Dr. Adi Nath, HoD. Department of Botany, NGB (DU).

Following resolutions were adopted in the meeting:

1. The minutes of the last meeting held on January 23, 2023 was confirmed
2. The committee members agreed that the four-year B.Sc. Botany curriculum that revolves on a choice-based credit system has obtained full approval. It is included in Annexure A. As decided by the Governances on November 07, 2022, the 4-year B.Sc. Botany semester-based curriculum, choice-based credit system, and combat inclusive structure of the NEP-2020 shall be adapted in accordance with that decision for the academic year 2023-2024
3. It was accepted by the members of committee that the vocational programmes, such as horticulture, mushroom cultivation, and herbal technology, created by the Department of Botany, as per the directions of the NEP-2020 for academic session 2023-24
4. It was accepted by the members of committee that the Department of Botany offered the minor elective courses Environmental Science and Sustainable Development as per the directions of the NEP-2020 for academic session 2023-24

The meeting ended with a vote of thanks to the Chair.

Members present:

1. Dr. Adi Nath, Head, Department of Botany, NGB (DU), Chairperson
2. Mr. Pradeep Upadhyay, Assistant Professor, Dept. of Botany, NGB (DU), Member
3. Dr. Shakti Nath Tripathi, Assistant Professor, Dept. of Botany, NGB (DU), Member
4. Dr. Dheeraj Pandey, Assistant Professor, Dept. of Botany, NGB (DU), Member
5. Prof. D.K. Chauhan, Ex-Head, Department of Botany, University of Allahabad, External Member
6. Prof. N.B. Singh, Department of Botany, University of Allahabad, External Member

Spadyay
06.06.2023

Pradeep
06/6/23

Shakti Nath

Dheeraj
06/06/2023

D.K. Chauhan
06.06.2023

N.B. Singh
06/6/2023

Introduction of the Programme:

[a] Introduction:

The NEP-2020 offers an opportunity to effect a paradigm shift from a teacher-centric to a student-centric higher education system in India. It is based on Outcome Based Education, where the Graduate Attributes are first kept in mind to reverse-design the Programs, Courses and Supplementary activities to attain the graduate attributes and learning outcomes. The learning outcomes-based curriculum framework for a degree in B.Sc. (Honours/Honours with Research) in Botany is intended to provide a comprehensive foundation to the subject and to help students develop the ability to successfully continue with further studies and research in the subject while they are equipped with required skills at various stages. The framework is designed to equip students with valuable cognitive abilities and skills so that they are successful in meeting diverse needs of professional careers in a developing and knowledge-based society. The curriculum framework takes into account the need to maintain globally competitive standards of achievement in terms of the knowledge and skills, as well as to develop Scientific temper, spirit of enquiry, problem solving skills and human and professional values which foster rational and critical thinking in students.

[b] Graduate Attributes:

Type of learning outcomes	The Learning Outcomes Descriptors
Learning outcomes that are specific to disciplinary/interdisciplinary areas of learning	Disciplinary/ interdisciplinary Knowledge & Skills
Generic learning outcomes	<i>Critical Thinking & problem-solving Capacity</i>
	<i>Creativity</i>
	<i>Communication Skills:</i> The graduates should be able to demonstrate the skills that enable them to: <ul style="list-style-type: none">• listen carefully, read texts and research papers analytically, and present complex information in a clear and concise manner to different groups/audiences,• express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media,• confidently share views and express herself/himself,• construct logical arguments using correct technical language related to a field of learning, work/vocation, or an area of professional practice,• convey ideas, thoughts, and arguments using language that is respectful and sensitive to gender and other minority groups.
	<i>Analytical reasoning/thinking:</i> The graduates should be able to demonstrate the capability to: <ul style="list-style-type: none">• evaluate the reliability and relevance of evidence;• identify logical flaws in the arguments of others;• analyze and synthesize data from a variety of sources;• draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.

Research-related skills: The graduates should be able to demonstrate:

- a keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions,
- the ability to problematize, synthesize and articulate issues and design research proposals,
- the ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships,
- the capacity to develop appropriate methodology and tools of data collection,
- the appropriate use of statistical and other analytical tools and techniques,
- the ability to plan, execute and report the results of an experiment or investigation,
- the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work, regardless of the funding authority or field of study.

Coordinating/collaborating with others: The graduates should be able to demonstrate the ability to:

- work effectively and respectfully with diverse teams,
- facilitate cooperative or coordinated effort on the part of a group,
- act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.

Leadership readiness/qualities: The graduates should be able to demonstrate the capability for:

- mapping out the tasks of a team or an organization and setting direction.
- formulating an inspiring vision and building a team that can help achieve the vision, motivating and inspiring team members to engage with that vision.
- using management skills to guide people to the right destination.

'Learning how to learn' skills: The graduates should be able to demonstrate the ability to:

- acquire new knowledge and skills, including 'learning how to learn' skills, that are necessary for pursuing learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social, and cultural objectives, and adapting to changing trades and demands of the workplace, including adapting to the changes in work processes in the context of the fourth industrial revolution, through knowledge/ skill development/reskilling,
- work independently, identify appropriate resources required for further learning,
- acquire organizational skills and time management to set self-defined goals and targets with timelines.
- inculcate a healthy attitude to be a lifelong learner,

Digital and technological skills: The graduates should be able to demonstrate the capability to:

- use ICT in a variety of learning and work situations,
- access, evaluate, and use a variety of relevant information sources,
- use appropriate software for analysis of data.

- **National & International Perspective considering the current perspective of a Global Village.**

Value inculcation: The graduates should be able to demonstrate the acquisition of knowledge and attitude that are required to:

- embrace and practice constitutional, humanistic, ethical, and moral values in life, including universal human values of truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values,

- practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies,
- formulate a position/argument about an ethical issue from multiple perspectives
- identify ethical issues related to work, and follow ethical practices, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights,
- recognize environmental and sustainability issues, and participate in actions to promote sustainable development.

Autonomy, responsibility, and accountability: The graduates should be able to demonstrate the ability to:

- apply knowledge, understanding, and/or skills with an appropriate degree of independence relevant to the level of the qualification,
- work independently, identify appropriate resources required for a project, and manage a project through to completion,

Environmental awareness and action: The graduates should be able to demonstrate the acquisition of and ability to apply the 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 and biodiversity, forest and wildlife conservation, and sustainable development and living.

Community engagement and service: The graduates should be able to demonstrate the capability to participate in community-engaged services/ activities for promoting the well-being of society.

Empathy: The graduates should be able to demonstrate the ability to identify with or understand the perspective, experiences, or points of view of another individual or group, and to identify and understand other people's emotions.

[c] Flexibility:

The programmes are flexible enough to allow liberty to students in designing them according to their requirements. The Learner is given freedom of choice in selecting disciplines. Students may select his/her own stream. He/She may select three major disciplines from his/her own stream or two major disciplines from his own stream and one major discipline from any other stream. Along with major disciplines, a student can select minor disciplines from other streams, languages, generic electives, ability enhancement courses, Vocational/Skill Enhancement Courses (SEC) and Value added Courses including Extra Curricular activities.

Multiple Entry & Exit Options:

EXIT OPTIONS	Credits Required
Certificate upon the Successful Completion of the First Year (Two Semesters) of the multidisciplinary Four-year Undergraduate Programme. [NSQF Level 5]	44
Diploma upon the Successful Completion of the Second Year (Four Semesters) of the multidisciplinary Four-year Undergraduate Programme. [NSQF Level 6]	88
Basic Bachelor Degree at the Successful Completion of the Third Year (Six Semesters) of the multidisciplinary Four-year Undergraduate Programme.	136
Bachelor Degree with Honours/Honours with Research in a Discipline at the Successful Completion of the Fourth Year (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme.	180

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

The aim and objective of the B.Sc. Botany programme

PO1 To provide an environment that ensures the cognitive development of students in a holistic manner. A dialogue about plants and their significance is fostered in this framework, rather than didactic monologues on mere theoretical aspects

PO2. To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A botany graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment.

PO3. To mould a responsible citizen who is aware of the most basic domain-independent knowledge, including critical thinking and communication

PO4. To enable the graduate to prepare for national as well as international competitive examinations, especially UGC-CSIR NET, and UPSC Civil Services Examination.

BACHELOR IN BIOLOGICAL SCIENCE/LIFE SCIENCE

B.Sc. III Year-Programme specific Outcomes (POS)

PSO 1 Critically evaluation of ideas and arguments by collecting relevant information about the plants, to recognize the position of the plant in the broad classification and phylogenetic level.

PSO2 Identify problems and independently propose solutions using creative approaches, acquired through interdisciplinary experiences, and adopt hand breadth of knowledge/expertise in the field of Plant Identification.

PSO 3 Accurately interpretation of collected information and use taxonomical information to evaluate and formulate position of the plant in taxonomy.

PSO 4 Students will be able to apply the scientific method to questions in botany by formulating testable hypotheses, collecting data that address these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their hypotheses.

PSO 5 Students will be able to present scientific hypotheses and data both orally and in writing in the formats that are used by practicing scientists.

PSO 6 After completion of 3 years of the programme or 6 semesters, the student will be offered the 'BACHELOR DEGREE IN BOTANY'. This programme will enable students to go for higher studies like Masters and then pursue Ph.D. in Botany and allied subject

SUGGESTED METHODOLOGY FOR TEACHING, LEARNING AND EVALUATION TEACHING-LEARNING

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

Theory:

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

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

Practical:

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

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

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

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

Experiential Learning (Internships etc.):

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

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

Field Study / Study Tour:

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

EVALUATION

External Evaluation:

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

End Semester Evaluation-Theory:

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

External –Practical:

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

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

EXTERNAL – PROJECT / FIELD STUDY / VIVA VOCE

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

Viva should be based on:

Project work

Experiential Learning (Internships etc)Field Study

General Learning Activity of four years:

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

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

ELIGIBILITY TO APPEAR FOR PRACTICAL EXAMINATION

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

CONTINUOUS INTERNAL EVALUATION

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

INTERNAL –THEORY

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

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

INTERNAL – PRACTICAL

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

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

INTERNAL - PROJECT/FIELD STUDY/VIVA VOCE

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

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

Department of Botany
B.Sc.(Honours/Honours with Research) in Botany
SYLLABUS STRUCTURE OVER-All (Based on NEP – 2020)

B.Sc. (Honours/Honours with Research) in Botany											
Year	Semester	Nomenclature of the Courses/Title	Com/Ele.	Credit	Credit			Teaching Hours			
					Distribution			L	T	P	
					L	T	P				
First Year	I	Microbial Diversity and Technology (Major-I)	Compulsory	4	2		2	30	0	60	
		Introduction to IKS (Major-I)	Compulsory	3	2	1	0	30	15	0	
		Minor	Pool Elective	2	2	0	0	30	0	0	
		SEC-1	Pool Elective	3	1	0	2	15	0	60	
		VAC-1	Pool Elective	2	2	0	0	30	0	0	
		Other 02 Major	Pool Elective	8	4	0	4	60	0	120	
					22				0	0	0
	II	Diversity of Non-flowering Plants (Major-I)	Compulsory	5	3	0	2	45	0	60	
		Minor	Pool Elective	2	2	0	0	30	0	0	
		SEC-2	Pool Elective	3	1	0	0	15	0	0	
		VAC-2	Pool Elective	2	2	0	0	30	0	0	
		Other 02 Major	Pool Elective	10	6	0	4	90	0	120	
					22						
Exit Option : Certificate in Field of Learning/discipline											
Second Year	III	Plant Anatomy and Developmental Botany (Major-I)	Compulsory	4	2		2	30	0	60	
		Applied IKS-I (Major-I)	Compulsory	3	3	0	0	45	0	0	
		Minor Paper for other discipline i. Plants and Human Welfare-I	Pool Elective	2	2	0	0	30	0	0	
		SEC-3	Pool Elective	3	1	0	2	15	0	60	
		VAC-3	Pool Elective	2	2	0	0	30	0	0	
		Other 02 Major	Pool Elective	8	4	0	4	60	0	120	
					22						
	IV	Ecology and Conservation Biology (Major-I)	Compulsory	5	3	0	2	45	0	60	
		Minor Paper for other discipline i. Plants and Human Welfare - II	Pool Elective	2	2	0	0	30	0	0	
		SEC-4	Pool Elective	3	1	0	2	15	0	60	
		VAC-4	Pool Elective	2	2	0	0	30	0	0	
		Other 02 Major	Pool Elective	10	6	0	4	90	0	120	
					22						
Exit Option : Diploma in Field of Learning/discipline											
Third Year	V	Plant Taxonomy and Resource Botany (Major-I)	Compulsory	4	2	0	2	30	0	60	

		Applied IKS-II (Major-I)	Compulsory	3	3	0	0	45	0	0	
		Minor	Pool Elective	2	2	0	0	30	0	0	
		Note: Choose any one Course 1. Plant Health Technology 2. Plant Propagation and Tissue Culture	Elective	3	1	0	2	15	0	60	
		VAC-5	Pool Elective	2	2	0	0	30	0	0	
		Other 02 Major	Pool Elective	8	4	0	4	60	0	120	
				22							
	VI		Plant Physiology and Biochemistry (Major-I)	Compulsory	5	3	0	2	45	0	60
			Note: Choose any one Paper (Major-I) 1. Bioinformatics and Computational Biology 2. Landscaping, Gardening and Green House Technology	Elective	3	1	0	2	15	0	60
			Minor	Pool Elective	2	2	0	0	30	0	0
			VAC	Pool Elective	2	2	0	0	30	0	0
			Internship/Apprenticeship (Major-I)	Compulsory	4	0	0	4	0	0	120
			Other 02 Major	Pool Elective	10	6	0	4	90	0	120
					26						
	Exit Option : Basic UG degree in Field of Learning/discipline										
	Fourth Year	VII	Molecular Biology (Major-I)	Compulsory	6	4	0	2	60	0	60
2. Research Methodology (Hons. with Research) /Food Processing (Honours)			Compulsory	4	4	0	0	60	0	0	
Note: Choose any Two Course (4+4) 1. Medicinal Plants and Phytochemistry 2. Environmental Biotechnology 3. Plant Biotechnology			Elective	8	4	0	4	60	0	120	
Minor Paper From other discipline			Pool Elective	4	4	0	0	60	0	0	
				22							
VIII			Cell Biology ,Genetics and Plant breeding	Compulsory	6	4	0	2	60	0	60
			Note: Choose any two Course: (4+4) 1. Seed Biology and Seed Technology 2. Organic Farming 3. Natural Resource Management	Elective	8	4	0	4	60	0	120

	Dissertation/Research Project & Viva Voce (Hons. with Research) or Field Visit/Tour based Viva Voce (Honours)	Compursory	8	0	0	8	0	0	240
			22						
Completion : UG (Hons./Hons. with Research) degree in Field of Learning/discipline									
	Total Credits		180						

* SEC : Skill Enhancement Course; VAC: Value Added Course; IKS: Indian Knowledge System

Department of Botany
B.Sc.(Honours/Honours with Research) in Botany
SYLLABUS (Based on NEP – 2020)
Session 2023 – 24

YEAR	SEMESTER	PAPER TITLE	Course Code	MAJOR/MINOR	COM/EL	(L)	(T)	(P)	TOTAL CREDIT	TEACHING HOURS
1 ST	I ST	Microbial Diversity and Technology	BOT-23101	Major	COM	02	00	02	04	90 (30 + 60)
		Introduction to IKS	BOTIKS-2301	Major	COM	03	00	00	03	45
	II ND	Diversity of Non-flowering Plants	BOT-23102	Major	COM	03	00	02	05	105 (45 + 60)
2 ND	III RD	Plant Anatomy and Developmental Botany	BOT-23103	Major	COM	02	00	02	04	90 (30 + 60)
		Applied IKS-I	BOTIKS-2302	Major	COM	03	00	00	03	45
		Minor Paper for other discipline i. Plant and Human Welfare-I	POOL B	Minor	EL	02	00	00	02	30
	IV TH	Ecology and Conservation Biology	BOT-23104	Major	COM	03	00	02	05	105 (45 + 60)
		Minor Paper for other discipline i. Plants and Human Welfare-II	POOL B	Minor	EL	02	00	00	02	30
3 RD	V TH	Plant Taxonomy and Resource Botany	BOT-23105	Major	COM	02	00	02	04	90 (30 + 60)
		Applied IKS-2	BOTIKS-2303	Major	COM	03	00	00	03	45
		Minor	POOL B	Minor	ELE	02	00	00	02	30

		Note: Choose any one Course i. Medicinal Plants in Health Care ii. Plant Propagation and Tissue Culture	BOT-23106	Major	EL	01	00	02	03	75 (15+60) 45
		VAC	POOL D	VAC	EL	02	00	00	02	30
	VI TH	Plant Physiology and Biochemistry	BOT23107	Major	COM	03	00	02	05	105 (45 + 60)
		Note: Choose any one Course i. Bioinformatics and Computational Biology ii. Landscaping, Gardening and Green House Technology	BOT-23108A/ BOT23108B	Major	EL	01	00	02	03	75 (15+60)
		Minor	POOL B	Minor	EL	02	00	00	02	30
		VAC	POOL D	VAC	EL	02	00	00	02	30
		Internship/Apprenticeship	BOT-23109	Major	COM	0	0	04	04	120
			Molecular Biology	BOT-23110	Major	COM	04	00	02	06
4 TH	VII TH	1. Research Methodology (Honours with Research)/Food Processing (Honours)	BOT-23111A/ BOT23111B	Major	COM	04	00	00	04	60

	<p>Note: Choose any Two Course</p> <p>i. Medicinal Plants & Phytochemistry</p> <p>ii. Environmental Biotechnology</p> <p>iii. Plant Biotechnology</p>	BOT23112A/BOT23112B/BOT23112C	Major	EL	04	00	04	08	180 (60+120)
	<p>Minor Paper for Other Discipline []</p>	POOL B	Minor	EL	04	00	00	04	60
VIII TH	<p>Cell Biology, Genetics and Plant Breeding</p>	BOT23113	Major	COM	04	00	02	06	120 (60 + 60)
	<p>Note: Choose any two Courses:</p> <p>i. Seed Biology and Seed Technology</p> <p>ii. Organic Farming</p> <p>iii. Natural Resource Management</p>	BOT23114A/BOT23114B/BOT23114C	Major	EL	04	00	04	08	180 (60+120)
	<p>Dissertation/Research Project Viva Voce (Hons. with Research)/Field Visit, Educational Tour based Viva Voce</p>	BOT23115A/BOT23115B	Major	COM	00	00	08	08	240

SEMESTER-I
B.Sc. (Honours/Honours with Research) in Botany

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. Ist Year	Semester: I
Pedagogy:			
Course Code: BOT-23101		Course Title: Microbial Diversity and Technology	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Understand the diversity among bacteria, viruses & fungi CO.2 Know the systematic, morphology and structure of bacteria, viruses & fungi CO.3 Understand the lifecycle pattern of bacteria, viruses & fungi CO.4. Understand the useful and harmful activities of bacteria, viruses & fungi CO.5 Discriminates the steps of isolation, identification and purification of microbes			
Credit: 4		Paper: Core Compulsory	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials +Practical): 2+0+2			
Unit	Topics	No. of Lectures	
Unit I.	<p>Introduction to microbial diversity; methods of estimation; hierarchical organization and positions of microbes in the living world. Whittaker's five-kingdom system and Carl Richard Woese's three-domain system. Distribution of microbes in soil, air, food and water. Significance of microbial diversity in nature.</p> <p>Microbiologists and their contributions (Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Dmitri Iwanowski, Sergius Winogradsky and M W Beijerinck and Paul Ehrlich). Microscopy-Working principle and applications of light, dark field, phase contrast and electron microscopes (SEM and TEM). Microbiological stains (acidic, basic and special) and Principles of staining. Simple, Gram's and differential staining.</p>	6	
Unit II	<p>Natural and synthetic media, Routine media -basal media, enriched media, selective media, indicator media, transport media, and storage media. Principle of disinfection, antiseptic, tyndallisation and Pasteurization, Sterilization-Sterilization by dry heat, moist heat, UV light, ionization radiation, filtration. Chemical methods of sterilization-phenolic compounds, anionic and cationic detergents. Microbial growth and measurement. Nutritional types of Microbes- autotrophs and heterotrophs, phototrophs and chemotrophs; lithotrophs and organotrophs.</p>	6	
Unit III	<p>Microbial cultures. Pure culture and axenic cultures, sub culturing, Preservation methods-overlaying cultures with mineral oils, lyophilisation. Microbial culture collections and their importance. A brief account on ITCC, MTCC and ATCC. General structure and classification of Viruses; ICTV system of classification. Structure and multiplication of TMV, SARS-COV-2, and Bacteriophage (T2). Cultivation of viruses. Vaccines and types. General characteristics and structure of Potato Spindle Tuber Viroid (PSTVd); Prions - general characters and Prion diseases. Economic Importance of viruses.</p>	6	
Unit IV	<p>General characteristics and classification. Archaeobacteria and Eubacteria. Ultrastructure of Bacteria; Bacterial growth and nutrition. Reproduction in bacteria- asexual and sexual methods. Study of <i>Rhizobium</i> and its applications. A brief account of Actinomycetes and Cyanobacteria. Mycoplasmas and Phytoplasmas- General characteristics and diseases. Economic importance of Bacteria. General characteristics and classification. Thallus organization and nutrition in fungi. Reproduction in fungi (asexual and sexual). Heterothallism and parasexuality. Type study of <i>Phytophthora</i>, <i>Rhizopus</i>, <i>Neurospora</i>, <i>Puccinia</i>, <i>Penicillium</i> and <i>Trichoderma</i>.</p>	6	
Unit V	<p>Structure and reproduction. VAM Fungi and their significance. Fungal diseases-Late Blight of Potato, Black stem rust of wheat; Downy Mildew of Bajra, Grain smut of Sorghum, Sandal Spike, Citrus Canker, Root Knot Disease of Mulberry. Economic importance of Fungi.</p>	6	

Suggested Readings:

1. Ananthnarayan R and Panikar JCK. 1986. Text book of Microbiology. Orient Longman Ltd. New Delhi.
2. Arora DR. 2004. Textbook of Microbiology, CBS, New Delhi.
3. William CG. 1989. Understanding microbes. A laboratory text book for Microbiology. W.H. Freeman and Company. New York.
4. Dubey RC and Maheshwari DK. 2007. A textbook of Microbiology, S. Chand and Company, New Delhi.
5. Dubey RC and Maheshwari DK. 2002. A Text book of Microbiology, 6. S.C. Chand and Company, Ltd. Ramnagar, New Delhi.
7. Sharma R. 2006. Text book of Microbiology. Mittal Publications. New Delhi. 305pp.
8. Sharma PD. 1999. Microbiology and Plant Pathology. Rastogi publications. Meerut, India.
9. Vasanthkumari R. 2007. A textbook of Microbiology, BI Publications Pvt. Ltd., New Delhi.

Course prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous internal Evaluation shall be based on allotted assignments and class text.

The marks shall be as follows:

Internal examination : 10

Assignment/Practical/Project : 5

Attendance/Behaviour : 5

Programme: B..Sc. (Honours/Honours with Research) in Botany	Year: B.Sc. Ist Year	Semester: II
Pedagogy:		
Course Code: BOT-23101L	Course Title: Lab work on Microbial Diversity and Technology	
Course Outcome: After completing this course, the students will be able to -		
CO1. Practical understanding through virtual dissection CO2. Prepare permanent slides and museum conservations. CO3. Know about Taxonomic identification and characteristic features. CO4: Know about permanent slide preparation		
Credit: 2	Paper: Core Compulsory	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+2		
Unit:	Topics	Practicals (Hrs.)
Practical 1: Safety measures in microbiology laboratory and study of equipment/appliances used for microbiological studies (Microscopes, Hot air oven, Autoclave/Pressure Cooker, Inoculation needles/loop, Petri plates, Incubator, Laminar flow hood, Colony counter, Haemocytometer, Micrometer etc.). Practical 2: Enumeration of soil/food /seed as microorganisms by serial dilution technique. Practical 3: Preparation of culture media (NA/PDA) sterilization, inoculation, incubation of <i>E coli</i> / <i>B. subtilis</i> / Fungi and study of cultural characteristics. Practical 4: Determination of cell count by using Haemocytometer and determination of microbial cell dimension by using Micrometer. Practical 6: Simple staining of bacteria (Crystal violet /Nigrosine blue) / Gram's staining of bacteria. Practical 7: Isolation and study of morphology of <i>Rhizobium</i> from root nodules of legumes Practical 8: Preparation of spawn and cultivation of paddy straw (Oyster) mushroom. Practical 9: Study of vegetative structures and reproductive structures - <i>Albugo</i> , <i>Phytophthora/Pythium</i> , <i>Rhizopus/Mucor</i> , <i>Saccharomyces</i> , <i>Neurospora/Sordaria</i> , <i>Puccinia</i> , <i>Agaricus</i> , <i>Lycoperdon</i> , <i>Aspergillus/Penicillium</i> , <i>Trichoderma</i> . (Depending on local availability) Practical 10: Preparation of agar slants, inoculation, incubation, pure culturing and preservation of microbes by oil overlaying. Practical 11: Study of late blight of Potato, Downy mildew of Bajra, Citrus canker, Tobaccomosaic disease, Sandal spike disease. Practical 12: Study of well-known microbiologists and their contributions		60

through charts and photographs. Practical-13: Visit to water purification units/Composting/ microbiology labs/dairy and farms to understand role of microbes in day today life. (Note: Botanical study tour to a floristic rich area for 1-2 days and submission of study report is compulsory)	
Practical Botany as suggested in Theory paper	
Suggested continuous Evaluation methods-	
Continuous internal Evaluation shall be based on allotted assignments and class text.	
The marks shall be as follows:	
Internal examination	:10
Assignment/Practical/Project	: 5
Attendance/Behaviour	: 5

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. 1st Year	Semester: Ist
Pedagogy:			
Course Code: BOTIKS-2301	Course/Paper Title:	Introduction to Indian Knowledge System	
Course Outcomes: After completing this course, the students will be able to -			
CO 1: explain the the foundational Concepts & Principles of IKS.			
CO 2: explain the historical development and evolution of Indian Intellectual traditions.			
CO 3: explain the knowledge key texts, thinkers, and schools of thought within the IKS.			
CO 4: analyze the interdisciplinary nature of Indian knowledge, integrating philosophy, spirituality, science, arts, and literature through the study of IKS.			
CO 5: explain the holistic and multidimensional nature of Indian Thought.			
Credit: 03		Paper (Core Compulsory / Elective): Core Compulsory	
Max. Marks : 20 + 80			
Total Number of Lectures (Lecture – Tutorials – Practical): 3 + 0 + 0			
Units:	Topics		No. of Lectures
I	Introduction to Indian Knowledge System <ul style="list-style-type: none"> • Definition, Concepts and Scope of IKS • IKS based approach on Indian Knowledge System & Role of Guru (teacher) • Understanding the concepts of dharma, karma, and the four purusharthas (goals of life) 		09
II	Vedic Knowledge and Philosophy <ul style="list-style-type: none"> • Study of the Vedas, including the Rigveda, Yajurveda, Samaveda, and Atharvaveda • Introduction to Upanishads and their metaphysical and philosophical teachings • Analysis of the six orthodox (astika) schools of Indian philosophy (e.g., Nyaya, Vaisheshika, Yoga, Samkhya, Mimamsa, and Vedanta) 		09
III	Unit 3: Spiritual and Mystical Traditions <ul style="list-style-type: none"> • Exploration of Hindu spiritual traditions, including Bhakti, Karma, Jnana, and Raja Yoga • Study of Advaita Vedanta and its nondualistic philosophy • Introduction to other spiritual paths like Tantra and Sufism in the Indian context 		09
IV	Scientific and Technological Advancements		09

V	<ul style="list-style-type: none"> • Examination of ancient Indian contributions to mathematics, astronomy, and medicine • Study of scientific treatises such as Aryabhatiya, Sushruta Samhita, and Charaka Samhita • Exploration of the Indian concept of time, measurement, and cosmology <p>Indian Arts, Literature, and Aesthetics</p> <ul style="list-style-type: none"> • Analysis of Indian classical music, dance, and theater traditions • Study of classical Sanskrit literature, including the works of Kalidasa and Valmiki • Understanding the concept of rasa (aesthetic experience) and its manifestations in Indian arts • Modern Interpretation and Contemporary Relevance 	09
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Suggested Readings:

<ul style="list-style-type: none"> • "Indian Philosophy: A Very Short Introduction" by Sue Hamilton • "A History of Indian Philosophy" by Surendranath Dasgupta • "Indian Philosophy: A Critical Survey" by Chandradhar Sharma • "India: A History" by John Keay • "The Wonder That Was India" by A.L. Basham • "Ancient India" by R.S. Sharma • "The Oxford History of India" edited by Percival Spear • "A History of Indian Literature" (multiple volumes) by Sisir Kumar Das • "Indian English Literature" by M. K. Naik • "The Norton Anthology of World Literature: India, Pakistan, and Bangladesh" edited by Sarah Lawall • "Indian Art" by Partha Mitter • "The Art and Architecture of the Indian Subcontinent" by J.C. Harle • "Indian Architecture: Buddhist and Hindu Period" by Percy Brown • "The Crest of the Peacock: Non-European Roots of Mathematics" by George Gheverghese Joseph • "Indian Science and Technology in the Eighteenth Century" by Dharampal • "Raga Mala: The Autobiography of Ravi Shankar" by Ravi Shankar • "The Ragas of North India" by Walter Kaufmann • "The Complete Book of Ayurvedic Home Remedies" by Vasant Lad • "Ayurveda: The Science of Self-Healing" by Vasant Lad • "The Heart of Yoga: Developing a Personal Practice" by T.K.V. Desikachar • "The Yoga Sutras of Patanjali" translated by Swami Satchidananda
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Suggested continuous E-Valuation Methods –

<p>Continuous Internal Evaluation (CIL)</p> <p>Total marks for each course shall be based on internal assessment (20%) and semester end examination (80%). The internal assessment of 20% shall be distributed as under:</p> <p>(i) Internal Class Test – 10%.</p> <p>(ii) Assignment/Project/Practical – 5%</p> <p>(iii) Attendance/Behavior – 5%.</p>
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Other Courses:

Minor : To be Chosed from POOL B

Skill Enhancement Course (SEC) : To be Chosed from POOL C

Value Added Course : To be Chosed from POOL D

SEMESTER-II

Programme: B..Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. Ist Year	Semester: II
Pedagogy:			
Course Code: BOT-23102		Course Title: Diversity of Non-Flowering Plants	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Know the systematic, morphology and structure of Algae CO.2 Understand the morphological diversity of Bryophytes CO.3 Understand the morphological diversity of Pteridophytes CO. 4 Understand Gymnosperms with respect to distinguishing characters, comparison with Angiosperms, economic importance and classification CO.5 Understand the features of Lichens			
Credit: 5		Paper: Core Compulsory	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials +Practical): 3+0+2			
Unit:	Topics	No. of Lectures	
Unit I.	Introduction and historical development in phycology. General characteristics and classification of algae, Diversity- habitat, thallus organization, pigments, reserve food, flagella types, life-cycle and alternation of generation in Algae. Distribution of Algae. Morphology and reproduction and life-cycles of <i>Nostoc</i> , <i>Oedogonium</i> , <i>Chara</i> , <i>Sargassum</i> and <i>Batrachospermum</i> . Diatoms and their importance. Blue-green algae-A general account. Algalblooms and toxins. Algal cultivation-Cultivation of microalgae- <i>Spirulina</i> and <i>Dunaliella</i> ; Algal cultivation methods in India. Algal products- Food and Nutraceuticals, Feed stocks, food colorants; fertilizers, aquaculture feed; therapeutics and cosmetics; medicines; dietary fibres from algae and uses.	10	
Unit II	General characteristics and classification of Bryophytes,Diversity-habitat, thallus structure, Gametophytes and sporophytes. Distribution, morphology, anatomy, reproduction and life-cycles of <i>Riccia</i> , <i>Anthoceros</i> , and <i>Funaria</i> . Ecological and economic importance of Bryophytes.Fossil Bryophytes. General characteristics and classification; Structure of sporophytes and life-cycles. Distribution, morphology, anatomy, reproduction and life-cycles in <i>Selaginella</i> , <i>Equisetum</i> , <i>Pteris</i> , <i>Salvinia</i> and <i>Azolla</i>	10	
Unit III	A brief account of heterospory and seed habit. Stellar evolution in Pterodophytes. Affinities and evolutionary significance of Pteridophytes. Ecological significance of Pteridophytes	5	
Unit IV	General characteristics. Distribution and classification of Gymnosperms. Study of the habitat, distribution, habit, anatomy, reproduction and life-cycles in <i>Cycas</i> , <i>Pinus</i> and <i>Gnetum</i> . Affinities and evolutionary significance of Gymnosperms. Economic importance of Gymnosperms - food, timber, industrial uses and medicines. Origin and evolution of plants through Geological Time scale.	10	
Unit V	Paleobotanical records, plant fossils, Preservation of plant fossils - impressions, compressions, petrification's, moulds and casts, pith casts. Radiocarbon dating. Fossil taxa- <i>Rhynia</i> , <i>Lepidodendron</i> , <i>Lepidocarpon</i> , <i>Lyginopteris</i> and <i>Cycadeoidea</i> . Exploration of fossil fuels. Birbal Sahni Institute of Paleosciences.	10	
Suggested Readings: <ol style="list-style-type: none"> 1. Chopra, G.L. A text book of Algae. Rastogi & Co., Meerut, Co., New Delhi, Depot.Allahabad. 2. Thomas N. Taylor, Edith L.Taylor and Michael Krings. Paleobotany; The biology and evolution of fossil plants, 2009. ISBN-10: 0123739721, Academic Press 3. Johri, Lata anf Tyagi, 2012, A Text Book of, Vedam e Books, New Delhi. 4. Sharma, O.P. 1990. Text Book of Pteridophyta. McMillan India Ltd. New Delhi. 5. Sharma, O.P. 1992. Text Book of Thallophytes. McGraw Hill Publishing Co. New Delhi. 6. Sharma, O.P., 2017, Algae Singh-Pande-Jain 2004-05. A Text Book of Botany.Rastogi Publication, Meerut. 7. S.P. Bhatnagar, Moitra and Pant; An Introduction to Gymnosperm, 1966 			
Course prerequisite: To study this course, the students must have had subject biology in class 12 th			
Suggested continuous Evaluation methods-			

Continuous internal Evaluation shall be based on allotted assignments and class text.

The marks shall be as follows:

Internal examination :10

Assignment/Practical/Project : 5

Attendance/Behaviour : 5

Programme: B.Sc. (Honours/Honours with Research) in Botany	Year: B.Sc. Ist Year	Semester: II
Pedagogy:		
Course Code: BOT-23102L	Course Title: Lab work on Diversity of Non- Flowering Plants	
Course Outcome: After completing this course, the students will be able to -		
CO1. Practical understanding through virtual dissection CO2. Prepare permanent slides and museum conservations. CO3. Know about Taxonomic identification and characteristic features. CO4: Know about permanent slide preparation		
Credit: 2	Paper: Core Compulsory	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+2		
Unit:	Topics	Practical s (Hrs.)
Practical-1: Study of morphology, classification, reproduction and lifecycle of <i>Nostoc/Oscillatoria</i> . Practical-2: Study of morphology, classification, reproduction and life-cycle of <i>Oedogonium& Chara, Sargassum, Batrachospermum/ Polysiphonia</i> . Practical-3: Study of morphology, classification, reproduction and life-cycle of <i>Riccia & Anthoceros</i> . Practical-4: Study of morphology, classification, anatomy, reproduction and life-cycle of <i>Selaginella and Equisetum</i> . Practical -5: Study of morphology, classification, anatomy, reproduction and life-cycle of <i>Pteris, Azolla, Salvinia</i> Practical -6: Study of morphology, classification, anatomy and reproduction in <i>Cycas</i> . Practical -7: Study of morphology, classification & anatomy, reproduction in <i>Pinus</i> . Practical -8: Study of morphology, classification & anatomy, reproduction in <i>Gnetum</i> . Practical -9: Study of important blue green algae causing water blooms in the lakes. Practical -10: Study of different methods of cultivation of ferns in a nursery. Practical -11: Preparation of natural media and cultivation of <i>Azolla</i> in artificial ponds. Practical -12: Media preparation and cultivation of <i>Spirulina</i> . Practical -13: Study different algal products and fossils impressions and slides. Practical-14: Visit to algal cultivation units/lakes with algal blooms/Fernhouse/ Nurseries/Geology museum/lab to study plant fossils. (Note: Botanical study tour to a floristic rich area for 1-2 days and submission of study report is compulsory)		60
Suggested Readings: Practical Botany described in theory paper		
Suggested continuous Evaluation methods-		
Continuous internal Evaluation shall be based on allotted assignments and class text.		
The marks shall be as follows:		
Internal examination :10		
Assignment/Practical/Project : 5		
Attendance/Behaviour : 5		

Other Courses:

Minor : To be Chosed from POOL B

Skill Enhancement Course (SEC) : To be Chosed from POOL C

Value Added Course : To be Chosed from POOL D

EXIT OPTION: **Undergraduate Certificate (in the field of learning/discipline)** for those who exit after the first year (two semesters) of the undergraduate programme. (Programme duration: first year or two semesters of the undergraduate programme) [NSQF Level 5]

SEMESTER-III

Programme: B..Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. IInd Year	Semester: III
Pedagogy:			
Course Code: BOT-23103		Course Title: Plant Anatomy and Developmental Botany	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Understand the scope & importance of Anatomy CO.2 Know various tissue systems CO.3 Understand the normal and anomalous secondary growth in plants and their causes. CO.4. Understand structure and development in microsporangium and megasporangium CO.5 Know pollination, fertilization, endosperm and embryogeny			
Credit: 04		Paper: Core Compulsory	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials +Practical): 2+0+2			
Unit:	Topics	No. of Lecture	
Unit I.	Introduction, objectives and scope of Plant Anatomy; General structure of plant cells - structure of plant cell wall. Tissue and tissue systems - Definitions, structure and functions of Meristematic tissues and permanent tissues (Simple and Complex). A brief account of plant secretory tissues/cells. Concept of tissue systems - Ground tissues, Dermal tissues and Vascular tissues. Classification of meristems: Based on location (apical, intercalary and lateral), Origin (promeristem, primary and secondary meristem) and function (protoderm, procambium and ground meristem). Apical meristems: Generalised structure of shoot apex, theories on organization of Shoot Apical Meristem (SAM) - Apical cell theory, Tunica-Corpus theory and Histogen theory. Generalised structure of root apex, theories on organisation of Root Apical Meristem (RAM) – Apical Cell Theory, Histogen theory, Quiescent centre theory and Korper – Kappe theory.	6	
Unit II	Primary anatomy of root: Dicot (Tridax/Sunflower), monocot (Maize). Primary anatomy of stem: Dicot (Tridax/Sunflower), Monocot (Maize), Nodal anatomy. Anatomy of leaf: Dicot (Tridax/Sunflower), Monocot (Maize). Types of trichomes and stomata. Secondary Growth: Normal Secondary growth in stem and root(Tridax/Sunflower).Anomalous secondary growth in <i>Aristolochia</i> and <i>Boerhaavia</i> (dicot stem), <i>Dracaena</i> (monocot stem). Applications of anatomy in Plant systematics, forensics and Pharmacognosy.	6	
Unit III	Introduction to the concepts of differentiation and morphogenesis (definitions and significance in plant growth and development process). Concept of totipotency and de-differentiation. Differentiation and cell polarity in acellular (Dictyostelium), Unicellular (<i>Acetabularia</i>) and multicellular plant system (Arabidiopsis). Shoot Apical meristem (SAM): Origin, structure and function, Cytohistological zonation and Ultrastructure of meristems. Organogenesis: Differentiation of root, stem, leaf and axillary buds; bud dormancy Leaf development: Mechanism of leaf primordium initiation, development and Phyllotaxis, Diversity in size, shape and arrangement of leaves Structure and function of root apical meristem (RAM): Root cap, quiescent centre and origin of lateral roots. Flower development: Overview of flower initiation and	6	

	development, Genetic control of flower development - ABC model of flower development. Senescence in plants – a general account.	
Unit IV	Introduction, Scope and contributions of Indian embryologists: P. Maheshwari, B G L Swamy Microsporangium: Development and structure of mature anther; Anther wall layers; Tapetum -types, structure and functions; sporogenous tissue. Microsporogenesis - Microspore mother cells, microspore tetrads and its types; Pollinia. Microgametogenesis – Formation of vegetative and generative cells, structure of male gametophyte. Pollen embryosac (Nemec phenomenon).	5
Unit V	Megasporangium – Structure of typical Angiosperm ovule. Types of ovules- Anatropous, Orthotropous, Amphitropous, Campylotropous, Circinotropous. Megagametogenesis –Female gametophyte embryosac- monosporic - Polygonum type, bisporic – Allium type, tetrasporic - Fritillaria type. Structure of mature embryosac. Pollination and fertilization: Structural and functional aspects of pollen, stigma and style. Post pollination events; Current aspects of fertilization; Significance of double fertilization, Post fertilization changes. Endosperm – Types and its biological importance. Free nuclear (Cocos nucifera), cellular (Cucumis), helobial types. Ruminant endosperm. Embryogenesis: Structure Dicot and Monocot seed, Dicot (Capsella bursa-pastoris) and Monocot (Najas) embryo development.	7

Suggested Readings:

1. Bhojwani and Bhatnagar, Introduction to Embryology of Angiosperms –Oxford & IBH, Delhi
2. Bhojwani Sant Saran, 2014. Current Trends in the Embryology of Angiosperms, Woong-Young Soh, Springer Netherlands,
3. Coutler E. G. , 1969. Plant Anatomy – Part I Cells and Tissues – Edward Arnold, London.
4. Dickison, W.C. (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA
5. Eames A. J. - Morphology of Angiosperms - Mc Graw Hill, New York.
6. Esau, K. 1990. Plant Anatomy, Wiley Eastern Pvt Ltd New Delhi
7. Evert, R.F. (2006) Esau's Plant Anatomy: Meristem, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc
8. Fahh, A. 1992. Plant Anatomy, Pergamon Press, USA
9. Johri, B.M. I., 1984. Embryology of Angiosperms, Springer-Verlag, Netherlands.
10. Karp G., 1985. Cell Biology; Mc.Graw Hill Company
11. Maheshwari, P 1950. An introduction to the embryology of angiosperms. New York: McGraw-Hill
12. Mauseth, J.D. (1988). Plant Anatomy, the Benjamin/Cummings Publisher, USA.
13. Nair P .K .K - Pollen Morphology of Angiosperms - Scholar Publishing House, Lucknow
14. Pandey S.N. 1997, Plant Anatomy and Embryology .A. Chadha, Vikas Publication House Pvt Ltd;
15. Pandey, B. P., 1997. Plant Anatomy, S.Chand and Co. New Delhi
16. Raghavan, V., 2000. Developmental Biology of Flowering plants, Springer, Netherlands.
17. Saxena M. R. – Palynology – A treatise - Oxford & I. B .H., New Delhi
18. Yash Mangla, Priyanka Khanduri and Charu Gupta (2022) Reproduction Biology of Angiosperm, Chamberlain University Publication

Course prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous internal Evaluation shall be based on allotted assignments and class text.

The marks shall be as follows:

Internal examination	:10
Assignment/Practical/Project	: 5
Attendance/Behaviour	: 5

Programme: B.Sc. (Honours/Honours with Research) in Botany	Year: Second Year	Semester: III
Pedagogy:		
Course Code: BOT-23103L	Course Title: Lab work based on theory	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Student will practically understand about plant morphology, and anatomical section		
CO. 2 Student will understand the sectioning by practical		
CO. 3 To know Embryological development by practical method.		
CO. 4 To know dissection techniques.		
CO. Diagrammatic study of Morphology, Embryology and Anatomy		

Credit: 2	Paper: Core Compulsory	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials +Practical): 0+0+2		
Unit:	Topics	Practical (Hrs.)
Practical No.1 i) Study of meristem (Permanent slides/ Photographs). ii) Study of Simple Tissues: Parenchyma, Collenchyma and Sclerenchyma Practical No.2 Complex Tissues - xylem and phloem; Maceration technique to study elements of xylem and phloem Practical No.3 Study of primary structure of dicot and monocot stem Practical No.4 Study of primary structure of dicot and monocot root and leaf Practical No. 5 Study of Normal secondary growth structure in dicot stem and root (Sunflower) and Anomalous secondary growth: <i>Aristolochia</i> , <i>Boerhaavia</i> (dicot stem) <i>Dracaena</i> (monocot stem) Practical No. 6 Study of trichomes (any three types) and stomata (any three types) with the help of locally available plant materials Practical No. 7 Permanent slides of Microsporogenesis and male gametophyte Mounting of Pollen grains of Grass and <i>Hibiscus</i> and Pollinia of <i>Calotropis</i> Practical No. 8 Pollen germination (hanging drop method) and Effect of Boron and Calcium on pollen germination Practical No. 9 Permanent slides of types of ovules, Megasporogenesis and embryosac development. Practical No. 10 Types of placentation: Axile, Marginal and Parietal types. Sectioning of ovary, for the studied types of placentation Practical No. 11 Mounting of embryo: Any locally available seeds. <i>Tridax</i> and <i>Cyamopsis</i> , Mounting of endosperm: <i>Cucumis</i> Practical No. 12 Histochemical localization of proteins/ carbohydrates Practical No. 13 and 14 Mini project work in groups of 3-5 students, from the following list. This is to be recorded in the practical record book. a) Study of pollen morphology of different flowers with respect to shape, colour, aperture etc. b) Pollen germination of different pollen grains and calculating percentage of germination. c) Calculating percentage of germination of one particular type of pollen grain collected from different localities/ under different conditions. d) Study of placentation of different flowers. e) Any other relevant study related to Anatomy / Embryology.		60
Suggested Readings: 1Practical book as based on theory		
Course prerequisite: To study this course, the students must have had subject biology in class 12 th		
Suggested continuous Evaluation methods-		
Continuous internal Evaluation shall be based on allotted assignments and class text. The marks shall be as follows: Internal examination :10 Assignment/Practical/Project : 5 Attendance/Behaviour : 5		

Programme: B..Sc. (Honours/Honours with Research) in Botany	Year: Second Year	Semester: III
Pedagogy:		
Course Code: BOTIKS-2302	Course Title: Applied IKS-1 : Botany	
Course Outcome: After completing this course, the students will be able to -		
CO.1 : CO. 2 : CO. 3 : CO. 4 : CO. 5.:		
Credit: 3	Paper: Core Compulsory	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials +Practical): 3+0+0		
Unit:	Topics	Lectures (Hrs.)
Unit 1: Introduction to Indian Knowledge Systems		09
<ul style="list-style-type: none"> • Overview of Indian philosophies and knowledge systems • Importance of integrating traditional wisdom into modern science • Relevance of Indian knowledge in botany and plant sciences 		
Unit 2: Ayurveda and Plant-Based Healing		09
<ul style="list-style-type: none"> • Principles of Ayurveda and its approach to plant-based medicine • Study of medicinal plants in Ayurvedic texts and their modern applications • Ayurvedic concepts of plant energies, tastes, and qualities 		
Unit 3: Yoga and Plant Connection		09
<ul style="list-style-type: none"> • Exploration of Yoga's connection with nature and plants • Yoga practices to enhance plant awareness and mindfulness • Ecological implications of Yogic principles on plant life 		
Unit 4: Ethical and Sustainable Plant Use		09
<ul style="list-style-type: none"> • Ancient Indian perspectives on sustainable plant use • Ethics of plant harvesting, conservation, and biodiversity • Integrating traditional practices into modern sustainable resource management 		
Unit 5: Indigenous Botanical Knowledge		09
<ul style="list-style-type: none"> • Ethnobotanical studies of indigenous communities in India • Learning from indigenous practices of plant use and conservation • Case studies on the preservation of indigenous botanical knowledge 		
Suggested Readings:		
<ul style="list-style-type: none"> • "Traditional Herbal Medicine in India" by P. Pushpangadan and L. Geethakumari • "Indian Medicinal Plants: An Illustrated Dictionary" by C.P. Khare • "Ethnobotany and Medicinal Plants of India and Nepal" by K. L. Mehra and A. K. Joshi • "Indian Systems of Medicine: A Brief Profile" by M. S. Valiathan • "Ayurvedic Pharmacopoeia of India" 		
Course prerequisite: To study this course, the students must have had subject biology in class 12 th		

Suggested continuous Evaluation methods-**Continuous internal Evaluation shall be based on allotted assignments and class text.**

The marks shall be as follows:

Internal examination :10

Assignment/Practical/Project : 5

Attendance/Behaviour : 5

MINOR PAPER for Other Discipline

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. IInd Year	Semester: III
Pedagogy:			
Course Code: POOL B		Course Title: Plants and Human Welfare-I	
Course Outcome: After completing this course, the students will be able to -			
<ul style="list-style-type: none"> • CO.1 Identification of exotic plant species, • CO.2 To understand the importance of the Plant biodiversity • CO.3 identification of forest trees based on the characteristics of bark, flowers and fruits, • CO.4 understanding the methods of safe disposal of biodegradable and non-biodegradable wastes. • CO. 5. understanding the preservation methods of fresh and dry fruits 			
Credit: 2		Paper: Elective (Miner)	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 2+0+0			
Unit	Topics	No. of Lecture	
Unit I	Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agro biodiversity and cultivated plant taxa, wild taxa. Values and uses of biodiversity: Ethical and aesthetic values, Methodologies for valuation, Uses of plants.	6	
Unit II	Loss of genetic diversity, loss of species diversity, loss of ecosystem diversity, Loss of agro biodiversity, projected scenario for biodiversity loss. Management of plant biodiversity: Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.	8	
Unit III	Environmental Impact Assessment (EIA), Geographical Information System GIS, Participatory resource appraisal, Ecological footprint with emphasis on carbon footprint, Resource accounting; Solid and liquid waste management	6	
Unit IV	Forestry, their utilization, agro-forestry, social forestry, urban forestry, Rural forestry and commercial aspects. (a) Avenue trees, (b) ornamental plants of India. (c) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood, fiber and their uses.	10	
Suggested Readings:			
1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.			
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.			
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.			
Course. prerequisite: To study this course, the students must have had subject biology in class 12 th			
Suggested continuous Evaluation methods-			
Continuous internal Evaluation shall be based on allotted assignments and class text.			
The marks shall be as follows:			
Internal examination :10			
Assignment/Practical/Project : 5			
Attendance/Behaviour : 5			

Other Courses:**Minor : To be Chosed from POOL B****Skill Enhancement Course (SEC) : To be Chosed from POOL C****Value Added Course : To be Chosed from POOL D**

SEMESTER-IV

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. IInd Year	Semester: IV
Pedagogy:			
Course Code: BOT-23104		Course Title: Ecology and Conservation Biology	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Understand plant communities and ecological adaptations in plants CO.2 Learn about conservation of biodiversity, Nonconventional Energy and Pollution CO.3 Discover botanical regions of India and vegetation types CO. 4 Concept forming regards various types of forests in India CO.5 To study role played by green & playhouses in horticulture			
Credit: 5		Paper: Core Compulsory	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 3+0+2			
Unit	Topics	No. of Lecture	
Unit I	Introduction to Ecology and Conservation Biology: Definitions, Principles of Ecology, Brief History, Major Indian Contributions, Scope and importance. Ecological levels of organisation. Ecological factors: Climatic factors: light, temperature, precipitation and humidity. Edaphic factors: Soil and its types, soil texture, soil profile, soil formation; physico-chemical properties of soil - mineral particle, soil pH, soil aeration, organic matter, soil humus and soil microorganisms. Topographic Factors: Altitude Ecological groups of plants and their adaptations: Morphological and anatomical adaptations of hydrophytes, xerophytes, epiphytes and halophytes.	10	
Unit II	Ecosystem Ecology: Introduction, types of ecosystems with examples –terrestrial and aquatic, natural and artificial. Structure of ecosystem: Biotic and Abiotic components, detailed structure of a pond ecosystem. Ecosystem functions and processes: Food chain-grazing and detritus; Food web. Ecological pyramids -Pyramids of energy, biomass and number. Principles of Energy flow in ecosystem. Bio-geo chemical cycles: Gaseous cycles - carbon and nitrogen, Sedimentary cycle- Phosphorus. Ecological succession: Definition, primary and secondary succession. General stages of succession. Hydrosere and xerosere. Community Ecology: Community and its characteristics – frequency, density, abundance, cover and basal area, phenology, stratifications, life-forms. Concept of ecotone and ecotypes. Intra-specific and Inter-specific interactions with examples. Ecological methods and techniques: Methods of sampling plant communities – transects and quadrates. Remote sensing as a tool for vegetation analysis, land use-land cover mapping. Population Ecology: Population and its characteristics – Population density, natality, mortality, age distribution, population growth curves and dispersion.	10	
Unit III	Phytogeography and Environmental issues: Theory of land bridge, theory of continental drift, polar oscillations and glaciations. Centre of origin of plant – Vavilov’s concept, types. Phytogeographical regions – concept, phytogeographical regions of India. Vegetation types of Western Ghats – Composition and distribution of evergreen, semi- evergreen, deciduous, scrub, mangroves, shoal forests and grasslands. An account of the vegetation of the Western Ghats. Pollution: Water pollution: Causes, effect, types; water quality indicators, water quality standards in India, control of water pollution (Waste water treatment). Water pollution disasters – National mission on clean Ganga ,Minimata, Pacificgyre garbage patch, Exxon valdez oil spill. Air pollution: Causes, effect, air quality standards, acid rain, control. Soil pollution: Causes, effect, solid waste management, control measures of soil pollution.	10	
Unit IV	Biodiversity and its conservation: Biodiversity: Definition, types of biodiversity - habitat diversity, species diversity and genetic diversity, Global and Indian species diversity. Sustainable Development Goals (SDG’s) in biodiversity conservation. Values of Biodiversity – Economic and aesthetic value, Medicinal and timber yielding plants. NTFP. Threats to biodiversity. Concept of Biodiversity Hotspots,	10	

	Biodiversity hot spots of India. Concept of endemism and endemic species. ICUN plant categories with special reference to Karnataka/ Western Ghats, Speciation.	
Unit V	Biodiversity Conservation-Indian Forest conservation act, Biodiversity bill (2002). Conservation methods – <i>In-situ</i> and <i>ex-situ</i> methods <i>In-situ</i> methods –Biosphere reserves, National parks, Sanctuaries, Sacred grooves. <i>Ex-situ</i> methods-Botanical gardens, Seed bank, Gene banks, Pollen banks, Culture collections, Cryopreservation.	5
Suggested Readings:		
<ol style="list-style-type: none"> 1. Sharma, P.D. 2018. Fundamentals of Ecology. Rastogi Publications. 2. Odum E.P. (1975): Ecology By Holt, Rinert& Winston. 3. Oosting, H.G. (1978): Plants and Ecosystem Wadworth Belmont. 4. Kochhar, P.L. (1975): Plant Ecology. (9th Edn.,) New Delhi, Bombay, Calcutta-226pp., 5. Kumar, H.D. (1992): Modern Concepts of Ecology (7th Edn.,) Vikas Publishing Co., New Delhi. 6. Kumar H.D. (2000): Biodiversity & Sustainable Conservation. Oxford & IBH Publishing Co Ltd. New Delhi. 7. Newman, E.I. (2000): Applied Ecology, Blackwell Scientific Publisher, U.K. 8. Chapman, J.L&M.J. Reiss (1992): Ecology (Principles & Applications). Cambridge University Press, U.K. 9. Malcolm L. Hunter Jr., James P. Gibbs, Viorel D. Popescu, 2020. Fundamentals of Conservation Biology, 4th Edition. Wiley-Blackwel. 10. Saha T. K., 2017. Ecology and Environmental Biology. Books and Allied Publishers. 		
Course prerequisite: To study this course, the students must have had subject biology in class 12 th		
Suggested continuous Evaluation methods-		
Continuous internal Evaluation shall be based on allotted assignments and class text.		
The marks shall be as follows:		
Internal examination :10		
Assignment/Practical/Project : 5		
Attendance/Behaviour : 5		

Programme: B.Sc. (Honours/Honours with Research) in Botany	Year: B.Sc. IInd Year	Semester: IV
Pedagogy:		
Course Code: BOT-23104L	Course Title: Lab work based on theory	
Course Outcome: After completing this course, the students will be able to -		
CO.1 To study on morphology, taxonomy of thallus organization, reproduction, life cycle, phylogeny and interrelationships		
CO. 2 To understand the synthetic ecology		
CO.3 To monitor the environment biology		
CO. 4 To perform the physic-chemical parameters		
CO.5 To Conceptualize the impact of anthropogenic on environment		
Credit: 2	Paper: Core Compulsory	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+2		
Unit:	Topics	Practical (Hrs.)
Practical No. Experiments 1 Determination of pH of different types of soils, estimation of salinity of soil/water samples. 2 Study of Ecological instruments – Wet and Dry thermometer, altimeter, hygrometer, soil thermometer, rain gauge, barometer, etc 3 Determination of water holding capacity of soil samples 4 Determination of Biological oxygen demand (BOD) 5 Determination of Chemical oxygen demand (COD) 6 Determination of soil texture of different soil samples. 7 Hydrophytes: Morphological adaptations in <i>Pistia</i> , <i>Eichhornia</i> , <i>Hydrilla</i> , <i>Nymphaea</i> .		60

<p>Anatomical adaptations in <i>Hydrilla</i> (stem) and <i>Nymphaea</i> (petiole). 8 Xerophytes: Morphological adaptations in <i>Asparagus</i>, <i>Casuarina</i>, <i>Acacia</i>, <i>Aloe vera</i>, Euphorbia tirucalli. Anatomical adaptations in phylloclade of <i>Muhlenbackia</i>. 9 Epiphytes: Morphological adaptations in <i>Acampe</i>, <i>Bulbophyllum</i>, <i>Drynaria</i>. Anatomical adaptations in epiphytic root of <i>Acampe/ Vanda</i>. Halophytes: study of vivipary in mangroves; Morphology and anatomy of Pneumatophores. 10 Study of a pond/forest ecosystem and recording the different biotic and abiotic components 11 Demonstration of different types of vegetation sampling methods – transects and quadrats. Determination of density and frequency. 12 Application of remote sensing to vegetation analysis using satellite imageries 13 and 14 Field visits to study different types of local vegetations/ecosystems and the report to be written in practical record book.</p>	
Suggested Readings: Botany practical book based on theory	
Course prerequisite: To study this course, the students must have had subject biology in class 12 th	
Suggested continuous Evaluation methods-	
Continuous internal Evaluation shall be based on allotted assignments and class text. The marks shall be as follows: Internal examination :10 Assignment/practical/project : 5 Attendance/behaviour : 5	

Minor Paper for other Discipline

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. IInd Year	Semester: IV
Pedagogy:			
Course Code: POOL B		Course Title: Plants and Human Welfare-II	
Course Outcome: After completing this course, the students will be able to -			
<ul style="list-style-type: none"> • CO.1 Develop conceptual understanding of gardening from historical perspective • CO.2 Analyze various nursery management practices with routine garden operations. • CO.3 Distinguish among the various Ornamental Plants and their cultivation • CO.4 Evaluate garden designs of different countries • CO.5 Appraise the landscaping of public and commercial places for floriculture 			
Credit: 2		Paper (Code compulsory/Elective): Core	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 2+0+0			
Unit	Topics	No. of Lecture	
Unit I	Introduction: Importance and scope of floriculture and landscape gardening. Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.	8	
Unit II	Ornamental Plants: Flowering annuals; perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and fern allies; Cultivation of plants in pots; Indoor gardening; Bonsai.	10	
Unit III	Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden, Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flowerbeds, Shrubbery, Borders, Water-garden. Some Famous gardens of India. Floriculture and green house technology. Commercial aspects and exporting of flowers and ornamental plants. Quarantine and testing requirements.	8	
Unit IV	Landscaping places of public importance: Landscaping highways And Educational institutions. Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (<i>Carnation</i> ,	4	

	<i>Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolus, Marigold, Rose, Liliun, Orchids</i>). Diseases and Pests of Ornamental Plants.	
Suggested Readings:		
1. Randhawa, G.S. and Mukhopadhyay, A. (1986).Floriculture in India. Allied Publishers.		
2. Adams, C., M. Early and J. Brrok (2011). Principles of Horticulture. Routledge, U.K.		
Course. prerequisite: To study this course, the students must have had subject biology in class 12 th		
Suggested continuous Evaluation methods-		
Continuous internal Evaluation shall be based on allotted assignments and class text.		
The marks shall be as follows:		
Internal examination	:	10
Assignment/practical/project	:	5
Attendance/behaviour	:	5

Other Courses:

Minor : To be Chosed from POOL B

Skill Enhancement Course (SEC) : To be Chosed from POOL C

Value Added Course : To be Chosed from POOL D

Exit Option: Undergraduate Diploma (in the field of learning/discipline)for those who exit after two years (four semesters) of the undergraduate programme (Programme duration: First twoyears or four semesters of the undergraduate programme) [NSQF Level 6]

SEMESTER-V

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. IIIrd Year	Semester: V
Pedagogy:			
Course Code: BOT-23105		Course Title: Plant Taxonomy and Resource Botany	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Understand the status of angiosperms in plant kingdom			
CO.2 Realize the origin of Angiosperms with respect to time, place, origin and probable ancestors			
CO.3 Understand various angiosperm families emphasizing their morphology, distinctive features and biology			
CO.4 Know the role of cytology and Phytochemistry in Taxonomy			
CO.5 Study of Phenology of fruits, vegetables or flowering crops			
Credit: 4		Paper : Core Compulsory	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 2+0+2			
Unit			No. of Lecture
Unit I	Fundamental components of taxonomy (identification, nomenclature, classification) Taxonomic resources: Herbarium- functions and important herbaria, Botanical gardens, Flora, Keys- single access and multi-access. Botanical Nomenclature-Principles and rules of ICBN.		8
Unit II	Types of classification- artificial, natural and phylogenetic. Bentham & Hooker's system of classification- merits and demerits. Engler & Prantle's system of classification- merits and demerits Phylogeny – origin and evolution of Angiosperms, APG		7
Unit III	Systematic study and economic importance of the following families: Annonaceae, Brassicaceae, Rutaceae, Curcubitaceae, and Apiaceae.		5
Unit IV	Systematic study and economic importance of plants belonging to the following families: Asteraceae, Asclepiadaceae, Lamiaceae, Ephorbiaceae,Arecaceae,and Poaceae.		5

Unit V	Anther structure, microsporogenesis and development of male gametophyte. Ovule structure and types; Megasporogenesis, development of Monosporic, Bisporic and Tetrasporic types (<i>Peperomia</i> , <i>Drusa</i> , <i>Adoxa</i>) of embryo sacs. Pollination and Fertilization (out lines) Endosperm development and types. Development of Dicot and Monocot embryos, Polyembryony.	5
Suggested Readings:		
1. Porter, C.L. (): Taxonomy of flowering Plants, Eurasia Publishing House, New Delhi. 2. Lawrence, G.H.M. (1953): Taxonomy of Vascular Plants, Oxford & IBH Publishers, New Delhi, Calcutta. 3. Jefferey, C.(1968) : An Introduction to Plant Taxonomy J.A. Churchill, London. 4. Mathur, R.C.(1970) : Systematic Botany (Angiosperms) Agra Book Stores- Lucknow, Ajmer, Allahabad, Delhi. 5. Maheswari, P(1963) :Recent Advances in the Embryology of Angiosperms(Ed.,) International Society of Plant Morphologists- University of Delhi. 6. Swamy. B.G.L. & Krishnamoorthy. K.V.(1980):From flower to fruit Tata McGraw Hill Publishing Co., Ltd., New Delhi. 6. Maheswari, P.(1985):An Introduction to the Embryology of Angiosperms Tata McGraw Hill Publishing Co.,Ltd., New Delhi. 8. Bhojwani, S.S. & Bhatnagar, S.P. (2000) : The Embryology of Angiosperms (4th Edition) Vikas Publishing House(P)Ltd., UBS Publisher's Distributors, New Delhi. 9. Gurucharan Singh; Plant Systematics; An Integrated Appraoach, 2004; Taylor and Francis, CRC Press, Infield: Science Publishers		
Course prerequisite: To study this course, the students must have had subject biology in class 12 th		
Suggested continuous Evaluation methods-		
Continuous internal Evaluation shall be based on allotted assignments and class text.		
The marks shall be as follows:		
Internal examination :10		
Assignment/Practical/Project : 5		
Attendance/Behaviour : 5		

Programme: B.Sc. (Honours/Honours with Research) in Botany	Year: B.Sc. IIIrd Year	Semester: V
Pedagogy:		
Course Code: BOT-23105L	Course Title: Lab work based on theory	
Course Outcome: After completing this course, the students will be able to -		
CO.1 student will learn about practical knowledge on various plant families. CO.2 Student will study about the distribution of plant, natures, habits CO.3 Student will know about the stored grain and their loss CO.4 Student will know about the economic importance of the various cash crops. CO.5 Student will lean by field visit to various industry and centre.		
Credit: 2	Paper: Core Compulsory	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture+Tutorials+Practical): 0+0+2		
Unit:	Topics	Practical (Hrs.)
Suggested Laboratory Exercises: 1. Systematic study of locally available plants belonging to the families prescribed in theory syllabus. 2. Demonstration of herbarium techniques. 3. Structure of pollen grains using whole mounts (<i>Catharanthus</i> , <i>Hibiscus</i> , <i>Acacia</i> , grass). 4. Demonstration of Pollen viability test using <i>in- vitro</i> germination (<i>Catharanthus</i>), Pollinium <i>Calotropis</i> . 5. Study of ovule types and developmental stages of embryo sac using permanent slides /Photographs. 6. Structure of endosperm (nuclear and cellular); Developmental stages of dicot and monocot Embryos using permanent slides / Photographs 7. Isolation and mounting of embryo (using <i>Sympsis</i> / <i>Senna</i> / <i>Crotalaria</i>)		60

8. Field visits . 9. Study of local flora and submission of field note book	
Suggested Readings: Botany practical book based on theory	
Course prerequisite: To study this course, the students must have had subject biology in class 12 th	
Suggested continuous Evaluation methods-	
Continuous internal Evaluation shall be based on allotted assignments and class text. The marks shall be as follows: Internal examination :10 Assignment/Practical/Project : 5 Attendance/Behaviour : 5	

Programme: B.Sc. (Honours/Honours with Research) in Botany	Year: Third Year	Semester: V
Pedagogy:		
Course Code: BOTIKS-2303	Course Title: Applied IKS-2 : Botany	
Course Outcome: After completing this course, the students will be able to -		
CO.1 CO. 2 CO. 3 CO. 4 CO. 5.		
Credit: 3	Paper: Core Compulsory	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials +Practical): 1+0+2		
Unit:	Topics	Lectures (Hrs.)
Unit-1: Plant Ecology and Vedic Sciences		03
<ul style="list-style-type: none"> • Vedic insights into plant ecology, life cycles, and interdependence • Ecological wisdom from ancient texts and its alignment with modern ecology • Harmonizing traditional and scientific approaches to studying ecosystems 		
Unit-2: Ayurvedic Plant Identification		03
<ul style="list-style-type: none"> • Practical techniques for identifying plants based on Ayurvedic characteristics • Field trips for plant identification and collection • Creating a bridge between Ayurvedic and botanical plant classification 		
Unit-3: Integration of Indian Knowledge in Modern Botany		03
<ul style="list-style-type: none"> • Collaborative research between traditional healers and modern scientists • Case studies of successful integration of Indian knowledge in botanical research, Flower Diversity in Ancient Literature used in Worship of God/Godess and its relevance. • Challenges and benefits of combining ancient wisdom with modern methods 		
Unit-4: Presentations and Projects		03
<ul style="list-style-type: none"> • Student presentations on selected topics related to integrating Indian knowledge in botany • Group projects on developing innovative applications combining traditional and modern approaches 		

Unit-5: Practical Workshops and Field Trips <ul style="list-style-type: none"> Workshops on herbal medicine preparation, Ayurvedic remedies, and Yoga practices Field trips to botanical gardens, Ayurvedic centers, and indigenous communities 	03
Suggested Readings: <ul style="list-style-type: none"> "Traditional Herbal Medicine in India" by P. Pushpangadan and L. Geethakumari "Indian Medicinal Plants: An Illustrated Dictionary" by C.P. Khare "Ethnobotany and Medicinal Plants of India and Nepal" by K. L. Mehra and A. K. Joshi "Indian Systems of Medicine: A Brief Profile" by M. S. Valiathan "Ayurvedic Pharmacopoeia of India" 	
Course prerequisite: To study this course, the students must have had subject biology in class 12 th	
Suggested continuous Evaluation methods-	
Continuous internal Evaluation shall be based on allotted assignments and class text. The marks shall be as follows: Internal examination :10 Assignment/Practical/Project : 5 Attendance/Behaviour : 5	

Major (Elective): Choose Any One Course

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: Third Year	Semester: V-VI
Subject: Botany			
Course Code: BOT-23106A		Course Title: Medicinal Plants in Health Care	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Recognize the basic medicinal plants CO.2 Apply techniques of conservation and propagation of medicinal plants. CO.3 Setup process of harvesting, drying and storage of medicinal herbs CO.4 Propose new strategies to enhance growth of medicinal herbs considering the practical issues pertinent to India CO.5 Know the value of medicinal plants of tribal people			
Credit: 3		Paper: Elective (Major)	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 01+0+02			
Unit	Topics	No. of Lecture	
Unit I	History, Scope and Importance of Medicinal Plants; Traditional systems of medicine; Definition and Scope. Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e-tabiya, tumors treatments / therapy, polyherbal formulations.	3	
Unit II	Conservation of endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Seed bank pollenbank cryopreservation.	3	
Unit III	Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of greenhouse for nursery production, propagation through cuttings, layering, grafting and budding. Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: Folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India.	3	
Unit IV	Brief description of selected plants and derived drugs, namely Guggul (<i>Commiphora</i>) for hypercholesterolemia, <i>Boswellia</i> for inflammatory disorders, Arjuna (<i>Terminalia</i>)	3	

	<i>arjuna</i>) for cardioprotection, turmeric (<i>Curcuma longa</i>) for wound healing, <i>Taxol</i> , <i>Ephedrine</i>	
Unit V	antioxidant and anticancer properties, Kutaki (<i>Picrorhiza kurroa</i>) for hepatoprotection, Opium Poppy for analgesic and antitussive, <i>Cinchona</i> and <i>Artemisia</i> for Malaria, <i>Rauwolfia</i> as tranquilizer, <i>Podophyllum</i> as antitumor. <i>Vinea rosea</i> as anticancerous, <i>Morinda citrifolia</i> , <i>Acorus calamus</i> , <i>ocinunsanchem</i> . <i>Tinospora cordifolia</i> , <i>Coleus amboinicu</i> , <i>Piper nigrum</i>	3
Suggested Readings:		
1. Akerele, O., Heywood, V. and Synge, H. (1991). The Conservation of Medicinal Plants. Cambridge University Press.		
2. AYUSH (www.indianmedicine.nic.in). About the systems—An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.		
3. CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow (2016). <i>Aush Gyanya</i> : Handbook of Medicinal and Aromatic Plant Cultivation.		
4. Dev, S. (1997). Ethno-therapeutics and modern drug development: The potential of Ayurveda. <i>Current Science</i> 73:909–928.		
5. Evans, W.C. (2009). Trease and Evans Pharmacognosy, 16th edn. Philadelphia, PA: Elsevier Saunders Ltd.		
6. Jain, S.K. and Jain, Vartika. (eds.) (2017). Methods and Approaches in Ethnobotany: Concepts, Practices and Prospects. Deep Publications, Delhi		
7. Kapoor, L.D. (2001). Handbook of Ayurvedic medicinal plants. Boca Raton, FL: CRC Press.		
8. Saroya, A.S. (2017). Ethnobotany. ICAR publication.		
9. Sharma, R.(2003). Medicinal Plants of India-An Encyclopaedia. Delhi: Daya Publishing House.		
10. Sharma, R. (2013) Agro Techniques of Medicinal Plants. Daya Publishing House, Delhi.		
11. Thakur, R.S., H.S. Puri, and Husain, A.(1989). Major medicinal plants of India. Central Institute of Medicinal and Aromatic Plants, Lucknow, India.		
Course. prerequisite: To study this course, the students must have had subject biology in class 12 th		
Suggested continuous Evaluation methods-		
Continuous internal Evaluation shall be based on allotted assignments and class text.		
The marks shall be as follows:		
Internal examination :10		
Assignment/Practical/Project : 5		
Attendance/Behaviour : 5		

Programme: B..Sc. (Honours/Honours with Research) in Botany		Year: Third Year	Semester: V
Subject: Botany			
Course Code: BOT-23106B		Course Title: Plant Propagation and Tissue Culture	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Gain knowledge of the basic techniques involved in plant tissue culture			
CO2. Understand the concept of cellular totipotency and differentiation as well as the role of plant growth regulators in plant tissue culture.			
CO3. Gain proficiency in techniques of plant regeneration.			
CO4. Have an insight of the applications of plant tissue culture in crop improvement			
CO5. Understand the various methods of plants propagations			
Credit: 3		Paper: Elective (Major)	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 1+0+2			
Unit	Topics	No. of Lecture	
Unit I	Concept and history of plant tissue culture; pioneering work and significant achievements of Indian scientists. Plant tissue culture laboratory design; basic requirements and sterilization practices.	3	
Unit II	Washing, packing and sterilization of glasswares; composition, types, preparation and sterilization of culture media; selection, isolation, surface sterilization and inoculation of explants; establishment of invitro cultures, ideal conditions for incubation of cultures, maintenance of cultures and subculture; regeneration of plantlets; acclimatization of tissue cultured plantlets in greenhouse/polyhouse	3	

Unit III	Concept of cellular totipotency and differentiation (dedifferentiation and redifferentiation); role of plant growth regulators in tissue culture; role of meristems in tissue culture; characteristics of callus tissue; somaclonal variation; organogenesis and somatic embryogenesis. Preparation of synthetic seeds.	3
Unit IV	Principle, protocol and applications of the following types of culture: callus culture, meristem culture, embryo culture, root culture, anther and pollen culture; micro-propagation. Cell suspension culture - methods for isolation of single cells, testing viability of cells, protocol for cell suspension culture, types of suspension cultures (batch and continuous), growth pattern of cells in batch culture, methods for measurement of growth of cells in suspension and applications of cell suspension cultures.	3
Unit V	Introduction to somatic hybridization; role of enzymes in protoplast isolation, mechanical and enzymatic isolation of plant protoplasts, testing viability of isolated protoplasts, spontaneous and induced fusion of protoplasts, selection of hybrid protoplasts, culture of hybrid protoplasts and applications of somatic hybridization. Cybrids and their applications.	3

Suggested Readings:

1. Collins, H.A. and Edwards, S. 1998. Plant Cell Culture. Bios Scientific Publishers, Oxford.
2. Misra, S.P. 2009. Plant Tissue Culture. Ane Books Pvt. Ltd., New Delhi.
3. Singh, S.K. and Srivastava, S. 2006. Plant Tissue Culture. Campus Books International, New Delhi.
4. Bhojwani, S.S. 1990. Plant Tissue Culture: Applications and Limitations. Elsevier Science Publishers, New York, NY.
5. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.
6. Bhojwani, S.S. and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science, Amsterdam.
7. Razdan, M.K. 2003. An Introduction to Plant Tissue Culture. Oxford & IBH Publishing Co., New Delhi.
8. Chawla, H.S. 2000. Introduction to Plant Biotechnology. Oxford and IBH Publishers, New Delhi.
9. De, K.K. 1992. Plant Tissue Culture. New Central Book Agency (P) Ltd., Calcutta.
10. Jha, T.B. and Ghosh, B. 2005. Plant Tissue Culture. Universities Press Pvt. Ltd., Hyderabad.
11. Ramawat, K.G. 2004. Plant Biotechnology. S. Chand & Company Ltd., New Delhi.
12. Prakash, M. and Arora, C.K. 2005. Cell and Tissue Culture. Anmol Publications Pvt. Ltd., New Delhi.
13. Chawla, H.S. 2002. Introduction to Plant Biotechnology. Science Publishers Inc., USA.
14. Narayanswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
15. Joshi, R. 2006. Agricultural Biotechnology. Gyan Books, New Delhi.
16. Kumar, H.D. 2005. Agricultural Biotechnology. Daya Publishing House, New Delhi.
17. Gautam, H. 2006. Agricultural and Industrial Applications of Bio-technology. Rajat Publications, New Delhi.
18. Harikumar, V.S. 2006. Advances in Agricultural Biotechnology. Regency Publishers, New Delhi.
19. Raghavan, V. 1986. Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, New York.
20. Chawla, H.S. 2003. Plant Biotechnology: A Practical Approach. Oxford & IBH Publishers, New Delhi.
21. Kumar, U. 2011. Methods in Plant Tissue Culture. Agro-Bios.
22. Nair, L.N. 2010. Methods in Microbial and Plant Biotechnology. New Central Book Agency (P.) Ltd., Kolkata

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous internal Evaluation shall be based on allotted assignments and class text.

The marks shall be as follows:

Internal examination	:10
Assignment/Practical/Project	: 5
Attendance/Behaviour	: 5

Other Courses:

Minor : To be Chosed from POOL B

Value Added Course : To be Chosed from POOL D

SEMESTER-VI

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. IIIrd Year	Semester: VI
Pedagogy:			
Course Code: BOT-23107		Course Title: Plant Physiology and Biochemistry	
Course Outcome: After completing this course, the students will be able to -			
CO.1 To understand the plants and plant cells in relation to water CO.2 Understand the process of photosynthesis in higher plants with particular emphasis on light and dark reactions, C3 and C4 pathways CO.3 Understand the respiration in higher plants with particular emphasis on aerobic and anaerobic respiration CO.4 Learn about the movement of sap and absorption of water in plant body CO.5 Recognize the impact of Biochemistry on socioeconomic aspects of life			
Credit: 5		Paper: Core Compulsory	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 3+0+2			
Unit	Topics	No. of Lecture	
Unit I	Physical properties of water, Importance of water to plant life. Diffusion, imbibition and osmosis; Water potential; concept and components. Absorption and transport of water and ascent of sap. Transpiration –Definition, types of transpiration, structure and opening and closing mechanism of stomata.	10	
Unit II	Mineral Nutrition: Essential elements (macro and micronutrients) and their role in plant metabolism, deficiency symptoms.Mineral ion uptake (active and passive transport). Nitrogen metabolism- nitrogen fixation in <i>Rhizobium</i> , outlines of protein synthesis (transcription and translation).Enzymes: General characteristics, mechanism of enzyme action and factors regulating enzyme action.	10	
Unit III	Photosynthesis: Photosynthetic pigments, photosynthetic light reactions, photo-phosphorylation, carbon assimilation pathways: C3, C4, and CAM , Photorespiration and its significance. Translocation of organic solutes: mechanism of phloem transport, source-sink relationships.	10	
Unit IV	Growth and development: definition, phases and kinetics of growth.Physiological effects of phytohormones - auxins, gibberellins, cytokinins, ABA, ethylene and brassinosteroids. Physiology of flowering -photoperiodism, role of phytochrome in flowering; vernalization. Physiology of senescence and ageing	8	
Unit V	Respiration: glycolysis, anaerobic respiration, TCA cycle, electron transport system. Mechanism of oxidative phosphorylation. Lipid Metabolism: Types of lipids, Beta-oxidation, glyoxylate pathway.	7	
Suggested Readings:			
.1. Steward. F.C (1964): Plants at Work (A summary of Plant Physiology) Addison-Wesley Publishing Co., Inc. Reading, Massachusetts, Palo alto, London. 2. Devlin, R.M. (1969) : Plant Physiology, Holt, Rinehart & Winston & Affiliated East West Press (P) Ltd., New Delhi . 3. Noggle, R.& Fritz (1989):Introductory Plant Physiology Prentice Hall of India. 4. Lawlor.D.W. (1989): Photosynthesis, metabolism, Control & Physiology ELBS/Longmans-London. 5. Mayer, Anderson & Bonning(1965): Introduction to Plant Physiology D.Van Nostrand . Publishing Co., N.Y. 6. Mukherjee, S. A.K. Ghosh(1998) Plant Physiology ,Tata McGraw Hill Publishers(P) Ltd., New Delhi. 7. Salisbury, F.B & C.W. Ross (1999): Plant Physiology CBS Publishers and Printers, New Delhi. 7. Plummer, D.(1989) Biochemistry–the Chemistry of life ,McGraw Hill Book Co., London, N.Y. New Delhi, Paris, Singapore, Tokyo. 9. Day, P.M.& Harborne, J.B. (Eds.,) (2000): Plant Biochemistry. . Harcourt Asia (P) Ltd., India & Academic Press, Singapore.			
Course prerequisite: To study this course, the students must have had subject biology in class 12 th			
Suggested continuous Evaluation methods-			
Continuous internal Evaluation shall be based on allotted assignments and class text.			

The marks shall be as follows:
 Internal examination :10
 Assignment/Practical/Project : 5
 Attendance/Behaviour : 5

Programme: B..Sc. (Honours/Honours with Research) in Botany	Year: B.Sc. IIIrd Year	Semester: VI
Pedagogy:		
Course Code: BOT-23107L	Course Title: Lab work based on theory	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Preparation of cytological fixative and stains CO.2 To study the activity of enzyme lipase in germinating seeds CO.3 To study on morphology, taxonomy of thallus organization, reproduction, life cycle, phylogeny and interrelationships CO. 4 Extraction and separation of free amino acid of germinating seed by circular paper chromatography CO.5 Extraction and Detection of secondary plant metabolites from suitable plant material		
Credit: 2	Paper: Core Compulsory	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture+Tutorials+Practical): 0+0+2		
Unit:	Topics	Practical (Hrs.)
Suggested laboratory exercises: 1. Osmosis – by potato osmoscope experiment 2. Determination of osmotic potential of plant cell sap by plasmolytic method using leaves of <i>Rhoeo</i> / <i>Tradescantia</i> . 3. Structure of stomata (dicot & monocot) 4. Determination of rate of transpiration using cobalt chloride method. 5. Demonstration of transpiration by Ganongs' photometer 6. Demonstration of ascent of sap/Transpiration pull. 6. Effect of Temperature on membrane permeability by colorimetric method. 7. Study of mineral deficiency symptoms using plant material/photographs. 8. Separation of chloroplast pigments using paper chromatography technique. 9. Rate of photosynthesis under varying Co ₂ concentrations. 10. Effect of light intensity on oxygen evolution in photosynthesis using Wilmott' bubbler.		60
Suggested Readings: 1. Bentley P.J.: Comparative Vertebrate Endocrinology S. Chand & Company Ltd, Ram Nagar New Delhi, 2. Chester-Jones: Fundamentals of Comparative Vertebrate Endocrinology Plenum Press, New York & 3. Gardner, David G. & Dolores M. Shobac: Greenspan's Basic and Clinical Endocrinology, 10th edition (A&L 4. Goldsworthy G J et al: Endocrinology, Blackie, 1981 5. Goodenough et al.: Perspectives on Animal Behaviour. Wiley & Sons, New York. 1993. 6. Grier, JW: Biology of Animal Behaviour, Mosby, 1984 7. Halliday, T.R.: Animal Behaviour Vol. 1 & 2 Communication, 1983 8. Krebs, NB & JR Davies: An Introduction to Behavioural Ecology (3rd ed.), Blackwell, 1993		
Course prerequisite: To study this course, the students must have had subject biology in class 12 th		
Suggested continuous Evaluation methods-		
Continuous internal Evaluation shall be based on allotted assignments and class text. The marks shall be as follows: Internal examination :10 Assignment/Practical/Project : 5 Attendance/Behaviour : 5		

Major (Elective): Choose Any One Course

Programme: B..Sc. (Honours/Honours with Research) in Botany	Year: Third Year	Semester: V-VI
Pedagogy:		
Course Code: BOT-23108A	Course Title: Bioinformatics and Computational Biology	

Course Outcome: After completing this course, the students will be able to -		
CO.1 Understand the basic tenets of research, laboratory safety measures, importance of maintaining records and writing of research ideas		
CO.2 Use bioinformatics tools (BLAST and PIR) for research		
CO3. Acquire skills in microphotography and field photography.		
CO.4 Apply basic statistical techniques to research data for a valid scientific conclusion.		
CO.5 To understanding of Computational biology		
Credit: 3	Paper: Elective (Major)	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 1+0+2		
Unit	Topics	No. of Lecture
Unit I	Research – definition and types of research (library, field and laboratory). Research methods; Literature - review and its consolidation. Access to laboratory; laboratory practices and cleanliness; laboratory hazards (chemical, fire, electrical, noise, radiation), safety measures.	3
Unit II	Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissue specimens and application of scale bars, Importance of photography.	3
Unit III	Numbers, units, abbreviations and nomenclature used in scientific writing. Reference writing. Scientific presentation, writing and ethics; introduction to copyright - academic misconduct/plagiarism.	3
Unit IV	Introduction, aim, scope and research areas of bioinformatics; Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System. National Center for Biotechnology Information (NCBI): Tools and Databases, Database Sequence Submission to NCBI, Basic Local Alignment Search Tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database. Protein Information Resource (PIR): Introduction of PIR, Resources, Swiss Prot: Introduction and salient features	3
Unit V	Structural bioinformatics in drug discovery, Quantitative structure-activity relationship (QSAR) techniques in drug design, Microbial genome applications, Crop improvement.	3
Suggested Readings:		
1. Danniel, W.W. 1987. Biostatistics. John Wiley Sons, New York, NY.		
2. Campbell, A.M. and Heyer, L.J. 2006. Discovering Genomics, Proteomics and Bioinformatics. 2nd edition. Cold Spring Harbor Laboratory Press and Benjamin Cummings.		
3. Campbell, R.C. 1974. Statistics for Biologists. Cambridge University Press.		
4. Dawson, C. 2002. Practical Research Methods. UBS Publishers, New Delhi.		
5. Freedman, P. 1949. The Principles of Scientific Research. Macdonald and Company Limited, Washington DC. B.Sc. Botany Degree Program Goa University, Taleigao Plateau, Goa. Page 46		
6. Ghosh, Z. and Bibekanand, M. 2008. Bioinformatics: Principles and Applications. Oxford University Press.		
7. Gurumani, N. 2006. Research Methodology for Biological Sciences. MJP Publishers, Chennai, TN.		
8. Pevsner, J. 2009. Bioinformatics and Functional Genomics. 2nd edition. Wiley Blackwell.		
9. Ruzin, S.E. 1999. Plant Micro Technique and Microscopy. Oxford University Press, New York, NY.		
Course. prerequisite: To study this course, the students must have had subject biology in class 12 th		
Suggested continuous Evaluation methods-		
Continuous internal Evaluation shall be based on allotted assignments and class text.		
The marks shall be as follows:		
Internal examination :10		
Assignment/Practical/Project : 5		
Attendance/Behaviour : 5		

Programme: B.Sc. (Honours/Honours with Research) in Botany	Year: Third Year	Semester: VI
Subject: Botany		
Course Code: BOT-23108B	Course Title: Landscaping, Gardening, and Greenhouse Technology	

Course Outcome: After completing this course, the students will be able to -		
CO.1 Understand biological data collection and analysis		
CO.2 Know about data presentation in various method like charts, graphs,		
CO.3 Know about determining the level of data significance and various methods for data testing		
CO.4 Student will know about computer use in biostatistics		
CO 5. Student will know about statistical software in biostatistics		
Credit: 3	Paper: Elective (Major)	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 3+0+0		
Unit	Topics	No. of Lecture
Unit I	Introduction to Landscaping and Gardening <ul style="list-style-type: none"> • Basics of landscaping: principles, elements, and design concepts • Importance of gardening and landscaping in urban environments • Historical overview of landscape design and gardening practices 	8
Unit II	Plant Selection and Maintenance <ul style="list-style-type: none"> • Understanding plant characteristics: growth habits, color, texture, form • Soil requirements for different plant types • Planting techniques and transplanting guidelines • Pruning, trimming, and shaping plants for optimal growth and aesthetics • Integrated pest management and disease control in landscaping and gardening 	9
Unit III	Landscape Design Principles <ul style="list-style-type: none"> • Principles of landscape design: balance, unity, rhythm, focal points, scale • Site analysis and assessment for landscape planning • Design styles and themes in landscaping • Hardscape elements: pathways, patios, decks, water features • Incorporating sustainable practices in landscape design 	9
Unit IV	Garden Design and Maintenance <ul style="list-style-type: none"> • Types of gardens: formal, informal, cottage, rock, water, etc. • Planting schemes and color palettes for different garden styles • Designing with seasonal interest and biodiversity in mind • Water-efficient gardening techniques: xeriscaping, rain gardens • Maintaining garden health and aesthetics throughout the year 	8
Unit V	Introduction to Greenhouse Technology <ul style="list-style-type: none"> • Importance of greenhouse technology in modern agriculture 	11

- Components of a greenhouse: structure, ventilation, heating, cooling, shading
- Different types of greenhouse structures and materials

Suggested Readings:

1. "The Well-Tempered Garden" by Christopher Lloyd

This classic book provides insights into garden design principles, plant selection, and maintenance, making it a great resource for both aspiring landscapers and gardeners.

2. "Planting: A New Perspective" by Piet Oudolf and Noel Kingsbury

This book delves into innovative approaches to planting design, emphasizing the use of perennials, grasses, and other plants to create dynamic and naturalistic landscapes.

3. "The Essential Garden Design Workbook" by Rosemary Alexander

A practical guide to landscape design, this workbook covers various design principles, exercises, and case studies to help students develop their design skills.

4. "The Greenhouse and Hoophouse Grower's Handbook" by Andrew Mefferd

Focusing on greenhouse technology, this book covers essential topics such as greenhouse construction, environmental control, crop production techniques, and sustainable practices.

5. "Greenhouse Operation and Management" by Paul V. Nelson and Robert A. Aldrich

This comprehensive textbook provides in-depth coverage of greenhouse operation, management practices, and techniques for successful crop production in controlled environments.

6. "Introduction to Horticultural Science" by Richard N. Arteca

This book offers a broad overview of horticultural science, including concepts related to plant growth, development, physiology, and cultivation practices relevant to landscaping, gardening, and greenhouse technology.

7. "The Well-Designed Mixed Garden: Building Beds and Borders with Trees, Shrubs, Perennials, Annuals, and Bulbs" by Tracy DiSabato-Aust

Focusing on mixed garden design, this book discusses creating harmonious plant combinations and designing landscapes that evolve through the seasons.

8. "The Greenhouse Gardener's Manual" by Roger Marshall

A practical guide to greenhouse gardening, this book covers topics such as choosing greenhouse structures, managing climate conditions, and cultivating a wide range of crops.

9. "Fundamentals of Plant Physiology" by Lincoln Taiz and Eduardo Zeiger

This textbook provides a strong foundation in plant physiology, helping students understand the physiological processes underlying plant growth, development, and responses to environmental factors.

10. "Sustainable Horticulture: Today and for the Future" by Raymond P. Poincelot

- A book focusing on sustainable horticulture practices, discussing environmentally friendly approaches to landscaping, gardening, and greenhouse crop production

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous internal Evaluation shall be based on allotted assignments and class text.

The marks shall be as follows:

Internal examination :10
 Assignment/Practical/Project : 5
 Attendance/Behaviour : 5

Other Courses:**Internship/Apprenticeship (Compulsory)****Minor : To be Chosed from POOL B****Value Added Course : To be Chosed from POOL D**

Exit Option: Bachelor' Degree (Programme duration: Three years or six semesters) .

SEMESTER-VII

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. IVth Year	Semester: VII
Pedagogy:			
Course Code: BOT-23110		Course Title: Molecular Biology	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Student will understand biotechnological knowledge and genetic engineering. CO.2 Students will understand applications of biotechnology CO.3 Students will understand environmental biotechnology CO.4 Student will learn about the cloning and industrial use of biotechnology CO.5 Understand the process of synthesis of proteins and role of genetic code in polypeptide formation, concept of gene and genome.			
Credit: 6		Paper (Code compulsory/Elective): Core	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 4+0+2			
Unit	Topics	No. of Lecture	
Unit I	Historical perspective; DNA/RNA as genetic material (Griffith's; Hershey and Chase; Avery, McLeod & McCarty; Fraenkel-Conrat's experiment). Enzymes in translation; Basic features of translation - initiation, elongation and termination, Post-translational processing and modification.	5	
Unit II	DNA Structure: Salient features of double helix (Watson and Crick), Types of DNA, Types of RNA, denaturation and renaturation, cot curves; Organization of DNA - prokaryotes, viruses, eukaryotes. Structure of nuclear DNA v/s organelle DNA.	10	
Unit III	Genetic code; Central and revised dogma of molecular biology; General principles - Modes of replication, bidirectional replication. Models of DNA replication (Rolling circle, Theta replication and semi-discontinuous replication). Replication of linear dsDNA, enzymes involved in DNA replication Enzymes in transcription; Basic features of transcription - initiation, elongation and termination, promoters and enhancers.	10	
Unit IV	Gene organization in prokaryotes and eukaryotes; gene regulation in prokaryotes and eukaryotes. Split genes - concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, alternative splicing; Eukaryotic mRNA processing and stability (5' cap, 3' poly A tail); Ribozymes; RNA silencing.	10	
Unit V	Definition of gene and recombinant DNA, steps in genetic engineering. Enzymes used in recombinant DNA technology (Restriction enzymes, DNA ligases, DNA modifying enzymes); Cloning Vectors: pBR322, Ti plasmid, YAC; λ phage, M13 phage, Cosmid; DNA isolation and sequencing (Sanger & Coulson, Maxam & Gilbert)	10	

<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. 2007. Molecular Biology of the Gene. 6th edition. CSHL Press, New York, NY. 2. Snustad, D.P. and Simmons, M.J. 2010. Principles of Genetics. 5th edition. John Wiley and Sons Inc., U.S.A. 3. Klug, W.S., Cummings, M.R. and Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A. 4. Russell, P.J. 2010. i-Genetics - A Molecular Approach. 3rd edition. Benjamin Cummings, U.S.A. 5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B. and Doebley, J. 2010. Introduction to Genetic Analysis. 10th edition. W. H. Freeman and Co., U.S.A. 6. Glick, B.R. and Pasternak, J.J. 2003. Molecular Biotechnology - Principles and Applications of Recombinant DNA. ASM Press, Washington D.C. 7. Stewart, C.N. Jr. 2008. Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc., U.S.A. 8. Dubey, R.C. 1993. A Textbook of Biotechnology. S. Chand & Company Pvt. Ltd., New Delhi.
<p>Course. prerequisite: To study this course, the students must have had subject biology in class 12th</p>
<p>Suggested continuous Evaluation methods-</p>
<p>Continuous internal Evaluation shall be based on allotted assignments and class text. The marks shall be as follows: Internal examination :10 Assignment/Practical/Project : 5 Attendance/Behaviour : 5</p>

Programme: B.Sc. (Honours/Honours with Research) in Botany	Year: B.Sc. IVth Year	Semester: VII
Pedagogy:		
Course Code: BOT-23110L	Course Title: Lab work based on theory	
Course Outcome: After completing this course, the students will be able to -		
CO 1. Student will gain the practical knowledge of biotechnology. CO.2 Students will learn separation techniques of the DNA CO.3 Student will learn separation technique of protein. CO.4 Student will learn separation technique of RNA CO.5 Student will learn immunological practical.		
Credit: 2	Paper: Core Compulsory	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+2		
Unit:	Topics	Practical (Hrs.)
<ol style="list-style-type: none"> 1. General laboratory methods and safety procedures. (2P) 2. Extraction of DNA from cauliflower. (2P) 3. Estimation of DNA by diphenylamine method. (1P) 4. Demonstration of separation of DNA by gel electrophoresis. (2P) 5. Extraction of RNA from plant material. (2P) 6. Estimation of RNA by Orcinol reagent. (1P) 7. Study of DNA replication mechanisms through models/photographs (Rolling circle, Theta replication and semi-discontinuous replication). (2P) 8. Study of structures of pBR322, Ti plasmid, YAC, λ phage through models/photographs. (2P) 		60
Suggested Readings:		
<ol style="list-style-type: none"> 1. Das H.K.: Textbook of Biotechnology, Wiley India Pvt. Limited, ISBN 8126505567, 2004 2. Thieman, William, Michael A. Palladino: Introduction to Biotechnology, Pearson Education India; 3rd ed 3. B.D. Singh: Basic of Biotechnology 4. Kuby : Immunology 5. W.W. Daniel : Biostatistics, Wiley India, Publication 6. Prasad S.G. : Biostatistics 		
<p>Virtual dissection: https://www.vlab.co.in, www/onlinelab.in, https://vlab.amrita.edu</p>		
Course prerequisite: To study this course, the students must have had subject biology in class 12 th		
Suggested continuous Evaluation methods-		

Continuous internal Evaluation shall be based on allotted assignments and class text.

The marks shall be as follows:

Internal examination :10
 Assignment/Practical/Project : 5
 Attendance/Behaviour : 5

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. IVth Year	Semester: VII
Pedagogy:			
Course Code: BOT-23111A		Course Title: Research Methodology	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Understand and ensure uniformity, consistency, reliability and reproducibility of experience CO2. To understand experimental data and interpretation. CO3. To understand the principles and applications of basic laboratory methods and instruments CO4. To know about imply appropriate tools and techniques to solve the problems CO5.To know about ethic in research field			
Credit: 4		Paper: Core Compulsory	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 4+0+0			
Unit	Topics	No. of Lecture	
Unit I	Foundations of Research: Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied	10	
Unit II	Research Design: Need for research design— Features of good design, Important concepts related to good design; Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs	12	
Unit III	Data Collection, Analysis and Report Writing, Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis writing, Preparation of Tables and Bibliography. Data Presentation using digital technology	16	
Unit IV	Biostatistics: Designing of experiments, Null hypothesis, probability, Correlation, regression, Distribution and measurement of central tendency, Chi Square test, Student t test F- test (one way ANOVA, two way ANOVA)	12	
Unit V	Ethical Issues, Intellectual Property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement	10	
Suggested Readings:			
1. Seiler, J.P. (2005). Good Laboratory Practice: the Why and the How. Springer 2. Webster, J. G. (2004). Bioinstrumentation. John Wiley & Sons Incorporated 3. Reilly, M.J. (2016) Bioinstrumentation. CBS Publishers & Distributor 4. Ross, M.H. and Reith, E.J. (1995). Histology A Text and Atlas. Harper International Edition 5. Kiernan j.A. (2015) Histological and Histochemical Methods: Theory and Practice. Pergamon Press 6. Sundar Rao P.S.S. and Richard J. (2012). Introduction to Biostatistics and Research Methods. PHI Private Ltd 7. Sokal R.R. and Rohlf F.J. (2009). Introduction to Biostatistics. Dover Publications.			
Course. prerequisite: To study this course, the students must have had subject biology in class 12 th			
Suggested continuous Evaluation methods-			
Continuous internal Evaluation shall be based on allotted assignments and class text.			
The marks shall be as follows:			
Internal examination :10 Assignment/Practical/Project : 5 Attendance/Behaviour : 5			

Or

Food Processing BOT-23111B]

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. IVth Year	Semester: VII
Pedagogy:			
Course Code: BOT-23111B		Course Title: Food Processing	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Concept of food and nutrients and energy value of food. CO2. Understand the problems of Food adulteration CO3. Learn about Therapeutic diets & Diet planning CO4. Govern the methods in food processing – thermal processing, refrigeration, freezing etc CO5. Learn about food Quality & food standards			
Credit: 4		Paper: Core Compulsory	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 4+0+0			
Unit	Topics	No. of Lecture	
Unit I	Food items; Fermented food, wine, bakery products, cereals, and milk products.	10	
Unit II	Spoilage of food products including cereals, fruits, vegetables, meat, fish, and dairy products	12	
Unit III	Milk and milk products, source of their contamination and control.	16	
Unit IV	Starter cultures. Microbiological legal standards of selected food and milk products. Food poisoning and microbial toxins produced in food items and dairy products.	12	
Unit V	Food preservatives and their uses. Mushroom cultivation technology and single cell protein	10	
Suggested Readings:			
<ol style="list-style-type: none"> 1. Alfa-Laval. <i>Dairy Handbook</i>. Alfa-Laval, Food Engineering AB. P.O. Box 65, S-221 00 Lund, Sweden. [Well illustrated text. Excellent introduction to dairy technology]. American Public Health Association, <i>Standard Methods for the examination of dairy products</i>. 1015 Eighteenth St. NW, Washington, D.C. 2. Battistotti, B., Bottazzi, V., Piccinardi, A. and Volpato, G. 1983. <i>Cheese: A guide to the world of cheese and Cheese making</i>. Facts on File Publications, New York, NY. 3. Berger, W., Klostermeyer, H., Merkenich, K. and Uhlmann, G. 1989. <i>Processed Cheese Manufacture</i>, A JOHA guide. BK Ladenburg, Ladenburg. 4. Chandan, R. 1997. <i>Dairy Based Ingredients</i>. Amer. Assoc. Cereal Chemists, St. Paul, Minnesota. 5. Davis, J.G. 1965. <i>Cheese</i>. American Elsevier Publ. Co., New York. 6. Eck, A. and Gillis, J.-C., 2000. <i>Cheesemaking from Science to Quality Assurance</i>, Lavoisier Publishing, Paris.. 7. Emmons, D.B., Ernstrom, C.A., Lacroix, C. and Verret, P. 1990. Predictive formulas for yield of cheese from composition of milk: a review. <i>J. Dairy Sci.</i> 73: 1365-1394. 8. Fox, P.F., Guinee, T.P., Cogan, T.M., McSweeney, P.L.H. 2000. <i>Fundamentals of Cheese Science</i>. Aspen Publishers, Inc. Gaithersburg, Maryland. 9. Hill, A.R. 1995. Chemical species in cheese and their origin in milk components. In <i>Chemistry of Structure Function Relationships in Cheese</i>, E.L. Malin and M.H. Tunick, Editors. Plenum Press, NY. 10. Masui, K. and Yamada, T. 1966. French Cheeses: <i>The Visual Guide to More than 350 Cheeses From Every Region of France</i>. 11. DK Publishing, New York. Official Methods of Analysis of the Association of Official Agricultural Chemists, P.O. Box 540, Benjamin Franklin Station, Washington, D.C 			
Course. prerequisite: To study this course, the students must have had subject biology in class 12 th			
Suggested continuous Evaluation methods-			
Continuous internal Evaluation shall be based on allotted assignments and class text.			
The marks shall be as follows:			
Internal examination :10			
Assignment/Practical/Project : 5			
Attendance/Behaviour : 5			

Major (Elective) : Choose Any Two Course

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. IVth Year	Semester: VII
Pedagogy:			
Course Code: BOT-23112A		Course Title: Medicinal Plants and Phytochemistry	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Student will understand the concept of herbal medicine and its type a CO.2 Student will know about various natural benefits of plants according to ayurveda CO.3 Student will know about the Phytochemical estimation and extraction CO.4. To understand the conservations about endangered flora CO.5 To know about the pneuraceutical scope of herbs			
Credit: 4		Paper: Core Compulsory	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 2+0+2			
Unit	Topics	No. of Lecture	
Unit I	Importance of medicinal plants; use of medicinal plants in indigenous / traditional systems of medicine - Siddha, Unani, Ayurveda and Homeopathy. Herbal remedies for holistic health. Collection and processing i. e. harvesting, drying, garbling, packing, storage of crude drugs and their marketing.	6	
Unit II	Plant morphology and organoleptic characters, biological source, chemical constituents and medicinal uses of the following herbs: Aloe (<i>Aloe vera</i>), Jungli pyaz (<i>Urginea indica</i>), Kirayat (<i>Andrographis paniculata</i>), lemon grass (<i>Cymbopogon citratus</i>), mint (<i>Mentha piperita</i>), coriander (<i>Coriandrum sativum</i>), garlic (<i>Allium sativum</i>), tulsi (<i>Ocimum sanctum</i>), ginger (<i>Zingiber officinale</i>), turmeric (<i>Curcuma longa</i>), sarpagandha (<i>Rauwolfia serpentina</i>) and periwinkle (<i>Catharanthus roseus</i>).	6	
Unit III	General methods of preparation of crude herbal extracts – decoction, maceration, infusion, hot continuous extraction, distillation and supercritical fluid extraction. Histochemical tests for screening of phytoconstituents in natural drugs – alkaloids, flavonoids, steroids, terpenoids, tannins, glycosides and volatile oils. Drug adulteration – deliberate and indeliberate adulteration; types of adulterants. Need for quality control of herbal drugs; microscopic evaluation for quality control.	6	
Unit IV	Herbal plants used in cosmetic formulations for skin care (cream, lotion and sunscreen), hair care (oil, shampoo, conditioner and dye) and oral care (toothpaste and mouthwash). Advantages of herbal formulations over synthetic cosmetics. Study of various oils used in aromatherapy with special reference to its applications in inhalation, local application and bath. Herbal nutraceuticals and their health benefits; culinary uses of herbs.	6	
Unit V	Conservation and sustainable use of medicinal plants; in-situ and ex-situ conservation methods. Centres for conservation of medicinal plants – CIMAP and FRLHT; TKDL. Plant tissue culture as a source of phytopharmaceuticals	6	
Suggested Readings:			
1. Kokate, C.K., Purohit, A.P. and Gokhale, S.B. 2010. Pharmacognosy. 45th edition. Nirali Prakashan, Pune.			
2. Anonymous. 1999. The Ayurvedic Pharmacopoeia of India. Vol. I & II. Ministry of Health and Family Welfare, Govt. of India, New Delhi.			
3. Jackson, B.P. and Snowdon, D.W. 1992. Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices. CBS Publishers, New Delhi.			
4. Sivarajan, V.V. and Balachandran, I. 1994. Ayurvedic Drugs and Their Plant Sources. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.			
5. Rosaline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.			
6. Trease and Evans. 2009. Pharmacognosy. 16th edition. W.B. Saunders Co. Ltd., London.			
7. Kar, A. 2003. Pharmacognosy & Pharmacobiotechnology. New Age International (P.) Ltd.			
8. Fuller, K.W. and Gallon, J.A. 1998. Plant Products and New Technology. Clarendon Press, New York.			
9. Sachs, M. 2014. Ayurvedic Beauty Care: Ageless Techniques to Invoke Natural Beauty. ISBN: 9788120818804.			

10. Miller, L. and Miller, B. 1998. Ayurveda and Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. Lotus Press, United States.
11. Akerele, O.O., Heywood, V. and Singe, H. 1991. Conservation of Medicinal Plants. Cambridge University Press, U.K.
12. Harborne, J.B. 1984. Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. 2nd edition. Chapman and Hall, New York.
13. Khandelwal, K.R. 2002. Practical Pharmacognosy: Techniques and Experiments. 9th edition. Nirali Prakashan, Pune.
14. Bakhru, H.K. 2010. Foods That Heal: The Natural Way to Good Health. Orient Paperbacks, New Delhi.
15. Mendonsa, G. 2010. The Best of Goan Cooking. UBS Publishers & Distributors Pvt. Ltd.
16. Kapoor, S. 2000. Khana Khazana. Popular Prakashan Pvt. Ltd., Mumbai
Course. prerequisite: To study this course, the students must have had subject biology in class 12 th
Suggested continuous Evaluation methods-
Continuous internal Evaluation shall be based on allotted assignments and class text. The marks shall be as follows: Internal examination :10 Assignment/Practical/Project : 5 Attendance/Behaviour : 5

Programme: B..Sc. (Honours/Honours with Research) in Botany	Year: B.Sc. IVth Year	Semester: VII
Subject: Botany		
Course Code: BOT-23112AL	Course Title: Lab work based on theory	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Practical knowledge on herbal plant extraction, isolation CO.2 Chemical analysis of bioactive compounds CO.3 Practical knowledge of optimization technique in herbal drugs CO.4 To know about phytochemicals practical based on biochemistry CO.5 Practical knowledge by filed visit.		
Credit: 2	Paper: Core Compulsory	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+2		
Unit:	Topics	Practical (Hrs.)
1. Study of biological source, organoleptic characters, chemical constituents and medicinal uses of the following herbs: <i>Andrographis paniculata</i> , <i>Mentha piperita</i> , <i>Allium sativum</i> , <i>Ocimum sanctum</i> , <i>Rauwolfia serpentina</i> and <i>Catharanthus roseus</i> . (2P) 2. Study of organoleptic and microscopic characters, chemical constituents and medicinal uses of the following herbs: <i>Aloe vera</i> (leaf), <i>Zingiber officinale</i> (rhizome), <i>Curcuma longa</i> (rhizome), <i>Urginea indica</i> (bulb scale), <i>Cymbopogon citratus</i> (leaf) and <i>Coriandrum sativum</i> (fruit). (3P) 3. Detection of alkaloids (Datura / Sadafuli / Tirphal), flavonoids (Green Tea / Onion) and saponins (Karando / Godekashtha) or from other suitable plant materials. (1P) 4. Microscopic evaluation and chemical tests (Metanil yellow test and chalk powder test) to detect adulteration of turmeric powder. (1P) 5. Preparation of herbal mouthwash (demonstration). (1P) 6. Preparation of herbal soap (demonstration). (1P) 7. Preparation of herbal formulation for common cold (demonstration). (1P) 8. Preparation of lemon grass medicinal tea (demonstration). (1P) 9. Preparation of coriander chutney or any other herbal dish (demonstration). (1P) 10. Oral presentation and submission of one herbal plant grown by the student (to be evaluated during regular practical - 3 marks). (3P)		60
Suggested Readings: Botany Practical book based on theory		
Course prerequisite: To study this course, the students must have had subject biology in class 12 th		
Suggested continuous Evaluation methods-		

Continuous internal Evaluation shall be based on allotted assignments and class text.

The marks shall be as follows:

Internal examination :10

Assignment/Practical/Project : 5

Attendance/Behaviour : 5

Other Courses:

Minor : To be Chosed from POOL B

SEMESTER-VIII

Programme: B..Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. IVth Year	Semester: VIII
Pedagogy:			
Course Code: BOT-23113		Course Title: Cell Biology, Genetics and Plant breeding	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Student will understand the concept of Cell and its organelle			
CO.2 Student will know about Mendelian genetics			
CO.3 Student will know about the Plant breeding			
CO4. To understand the Crop Improvement and New Crop Development			
CO.5 To know about the Cytogenetics			
Credit: 6		Paper: Core Compulsory	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 4+0+2			
Unit	Topics	No. of Lecture	
Unit I	Cell, the unit of life- Cell theory, prokaryotic and eukaryotic cells; Eukaryotic cell components. Ultra structure and functions of cell wall and cell membranes. Chromosomes: morphology, organization of DNA in a chromosome (nucleosome model), euchromatin and heterochromatin.	10	
Unit II	DNA as the genetic material: Griffith's and Avery's transformation experiment, Hershey – Chase bacteriophage experiment. DNA structure (Watson and Crick model) and replication of DNA (semi-conservative). Types of RNA (mRNA, tRNA, rRNA), their structure and function.	12	
Unit III	Mendel's laws of Inheritance (Mono- and Di- hybrid crosses); backcross and test cross. Chromosome theory of Inheritance. Linkage: concept, complete and incomplete linkage, coupling and repulsion; linkage maps based on two and three factor crosses. Crossing Over: concept & significance.	14	
Unit IV	Introduction and objectives of plant breeding. Methods of crop improvement: Procedure, advantages and limitations of introduction, selection, and hybridization.	10	
Unit V	Role of mutations in crop improvement. Role of somaclonal variations in crop improvement. Molecular breeding – use of DNA markers in plant breeding and crop improvement (RAPD, RFLP).	12	
Suggested Readings:			
1.Old, R.W. and Primrose S.B. 1994, Principles of Gene Manipulation Blackwell Science, London			
2. Grierson, D. and Convey S.N. 1989, Plant Molecular Biology, Blackie Publishers, NewYork.			
3. Lea, P.J. and Leegood R.C. 1999, Plant Biochemistry and Molecular Biology, John Wiley and Sons, London.			
4. Power C.B., 1984, Cell Biology, Himalaya Publishing Co. Mumbai			
5. De. Robertis and De Robertis, 1998, Cell and Moleceular Biology, K.M. Verghese and Company .			
6. Sinnott, E.W., L.C. Dunn & J. Dobshansky (1958) : Principles of Genetics (5th Edition) McGraw Hill Publishing Co., N.Y. Toronto, London.			
7. Winchester, A.M. (1958) : Genetics(3rd Edition) Oxford & IBH Publishing House, Calcutta, Bombay, New Delhi.			

7. Singleton, R.(1963) : Elementary Genetics, D. Van Nostrand Co., Ltd., Inc., N.Y. & Affiliated East West Press (P) Ltd., New Delhi.
8. Strickberger, M.W. (1976): Genetics(2nd Edition) MacMillan Publishing Co., Inc., N.Y., London
9. Watson, J.D. (1977): Molecular Biology of the Gene, W.A. Benjamin, Inc., Menlo Park- California, Reading Massachusetts, London, Amsterdam, Don Mills, Ontario, Sydney.
10. Gardner,E.J & Snusted, D.P.(1984): Principles of Genetics (7thedition) John Wiley & Sons, N.Y. Chichester, Brisbane, Toronto, Singapore.
11. Lewin, B. (1985) Genes VII Wiley Eastern Ltd., New Delhi, Bombay, Calcutta, Madras, Hyderabad.
12. Allard R.W(1999): The Principles of Plant Breeding, John & Wiley and Sons.
13. Poelman J.M: Breeding Field Crops, Springer.
14. George Acquaaah(2012):Principles of Plant Genetics & Breeding: Wiley-Blackwell.

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous internal Evaluation shall be based on allotted assignments and class text.

The marks shall be as follows:

Internal examination	:10
Assignment/Practical/Project	: 5
Attendance/Behaviour	: 5

Programme: B..Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. IVth Year	Semester: VIII
Pedagogy:			
Course Code: BOT-23113L		Course Title: Lab work based on theory	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Practical knowledge on herbal plant extraction, isolation CO.2 Chemical analysis of bioactive compounds CO.3 Practical knowledge of optimization technique in herbal drugs CO.4 To know about phytochemicals practical based on biochemistry CO.5 Practical knowledge by filed visit.			
Credit: 2		Paper: Core Compulsory	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+2			
Unit:	Topics	Practical (Hrs.)	
<ol style="list-style-type: none"> 1. Study of biological source, organoleptic characters, chemical constituents and medicinal uses of the following herbs: <i>Andrographis paniculata</i>, <i>Mentha piperita</i>, <i>Allium sativum</i>, <i>Ocimum sanctum</i>, <i>Rauwolfia serpentina</i> and <i>Catharanthus roseus</i>. (2P) 2. Study of organoleptic and microscopic characters, chemical constituents and medicinal uses of the following herbs: <i>Aloe vera</i> (leaf), <i>Zingiber officinale</i> (rhizome), <i>Curcuma longa</i> (rhizome), <i>Urginea indica</i> (bulb scale), <i>Cymbopogon citratus</i> (leaf) and <i>Coriandrum sativum</i> (fruit). (3P) 3. Detection of alkaloids (<i>Datura / Sadafuli / Tirphal</i>), flavonoids (green tea / Onion) and saponins (Karando / Godekashtha) or from other suitable plant materials. (1P) 4. Microscopic evaluation and chemical tests (Metanil yellow test and chalk powder test) to detect adulteration of turmeric powder. (1P) 5. Preparation of herbal mouthwash (demonstration). (1P) 6. Preparation of herbal soap (demonstration). (1P) 7. Preparation of herbal formulation for common cold (demonstration). (1P) 8. Preparation of lemon grass medicinal tea (demonstration). (1P) 9. Preparation of coriander chutney or any other herbal dish (demonstration). (1P) 10. Oral presentation and submission of one herbal plant grown by the student (to be evaluated during regular practical - 3 marks). (3P) 		60	
Suggested Readings: Botany practical book based on theory			
Course prerequisite: To study this course, the students must have had subject biology in class 12 th			
Suggested continuous Evaluation methods-			
Continuous internal Evaluation shall be based on allotted assignments and class text.			
The marks shall be as follows:			
Internal examination		:10	

Assignment/Practical/Project : 5
Attendance/Behaviour : 5

MAJOR (ELECTIVE): CHOOSE ANY TWO COURSE

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: Fourth Year	Semester: VII-VIII
Pedagogy:			
Course Code: BOT23114A		Course Title: Seed Biology and Seed Technology	
Course Outcome: After completing this course, the students will be able to -			
CO.1 Understanding the seed structure and related functions, seed health and productivity. CO2. Technology for assessing the seed pathology, purity, and preservation. CO3. Learning the field and laboratory protocols of seed production, certification and quality. CO4. To describe the basic biology, life history, physiology of seed CO5. To know about ecology of seed plants.			
Credit: 4		Paper (Code compulsory/Elective): Core	
Max. Marks: 20+80		Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 4+0+0			
Unit	Topics	No. of Lecture	
Unit I	Introduction : Seed as basic input in agriculture; seed development in cultivated plants; seed quality concept and importance of genetic purity in seed production; types of cultivars, their maintenance and factors responsible for deterioration, seed production in self and cross pollinated crops.	14	
Unit II	Mode of pollination and reproduction in crop plants and their modification in relation to hybrid seed production. Principles of hybrid seed production, isolation distance, synchronization of flowering, rouging etc. male sterility and incompatibility system in hybrid seed production, role of pollinators and their management.	12	
Unit III	Seed multiplication ratios, seed replacement rate, demand and supply; suitable areas of seed production and storage, agronomy of seed production – agro climatic requirements and their influence on quality seed production; seed – criteria involved; life span of a variety and causes for its deterioration; certification standards for self and cross pollinated and vegetatively propagated crops.	12	
Unit IV	Hybrid Seed – Methods of development of hybrids; use of male sterility and self-incompatibility and CHA in hybrid seed production; one, two and three line system; maintenance of parental lines of hybrids; planning and management of hybrid seed production technology of major field crops and vegetables.	12	
Unit V	Planning of seed production for different classes of seeds for self and cross pollinated crops, seed quality control system and organization, seed village concept; seed production agencies, seed industry and custom seed production in India, Seed banks.	10	
Suggested Readings:			
<ol style="list-style-type: none"> 1. Agarwal RL. 1997. Seed Technology. 2nd Ed. Oxford & IBH. 2. Chhabra AK. 2006. Practical Manual of Floral Biology of Crop Plants. Dept. of Plant Breeding CCS HAU, Hisar. 3. Desai BB. 2004. Seeds Handbook. Marcel Dekker. Kelly AF. 1988. Seed Production of Agricultural Crops. Longman. 4. McDonald MB Jr & Copeland LO. 1997. Seed Production: Principles and Practices. Chapman & Hall. 5. Musil AF. 1967. Identification of Crop and Weed Seeds. Handbook No. 219, USDA, Washington, DC, USA. 6. Poehlman JM & Sleper DA. 2006. Breeding Field Crops. Blackwell. 7. Singh BD. 2005. Plant Breeding: Principles and Methods. Kalyani. 8. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani. 9. Thompson JR. 1979. An Introduction to Seed Technology. Leonard Hill. 10. Tunwar NS & Singh SV. 1985. Handbook of Cultivars. CSCB, GOI 			
Course. prerequisite: To study this course, the students must have had subject biology in class 12 th			

Suggested continuous Evaluation methods-**Continuous internal Evaluation shall be based on allotted assignments and class text.**

The marks shall be as follows:

Internal examination :10

Assignment/Practical/Project : 5

Attendance/Behaviour : 5

Programme: B..Sc. (Honours/Honours with Research) in Botany	Year: Fourth Year	Semester: VIII
Pedagogy:		
Course Code: BOT23114B	Course Title: Organic Farming	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Understanding the Soil analysis, soil enrichment methods. CO2. Technology for assessing the composting procedure, recycling of wastes CO3. Learning the field and laboratory protocols of use of waste materials in mushroom cultivation CO4. To describe the nutrient requirement of various crops CO5.To know about identifying various methods of keeping soil health		
Credit: 4	Paper (Code compulsory/Elective): Core Elective	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 2+0+2		
Unit	Topics	No. of Lecture
Unit I	Introduction: Farming, organic farming, concept and development of organic farming, Principles of organic farming, types of organic farming, biodynamic farming, Benefits of organic farming, need for organic farming, conventional farming v/sorganic farming,Scope of organic farming; Andhra Pradesh, National and International status, Agencies and institutions related to organic agriculture, Requirements for organic farming, farm components for an organic farm	14
Unit II	Organic farming systems, soil tillage, land preparation and mulching, Choice of varieties, Propagation-seed, planting materials and seed treatments, water management, Green manuring, composting- principles, stages, types and factors, composting methods, Vermi composting, Bulky organic manures, concentrated organic manures, organic preparations, organic amendments and sludges., Bio-fertilizers- types, methods of application, advantages and disadvantages, standards for organic inputs- fertilizers	12
Unit III	Plant protection- cultural, mechanical, botanical pesticides, control agents, Weed management, Standards for organic inputs- plant protection	12
Unit IV	Organic crop production methods- rice, coconut, Organic crop production methods-vegetables- okra, amaranthus, cucurbits, Livestock component in organic farming., Sustainable Agriculture-Apiculture, Mushroom cultivation.	12
Unit V	Farm economy: Basic concept of economics- demand &supply, economic viability of a farm, Basic production principles, reducing expenses, ways to increase returns, cost of production system. Benefit/ cost ratio, marketing, imports and exports, Policies and incentives of organic production, Farm inspection and certification, Terrace farming.	10
Suggested Readings:		
1. Palaniappan SP &Anandurai K. 1999. Organic Farming–Theory and Practice. Scientific Publishers, Jodhpur 2. Joshi, M. 2014. New Vistas of Organic Farming 2nd Ed. Scientific Publishers, Jodhpur. 3. Farming system : Theory and Practice - S.A.Solaimalai 4. Organic Farming: Theory and Practice- S.P.Palaniappan and K.A. Annadurai 5. A hand book of Organic Farming by A.K.Sharma		
Course. prerequisite: To study this course, the students must have had subject biology in class 12 th		
Suggested Activities: Preparation of Vermicompost in small scale, observing sewage sludge disposal mechanisms in urban/semi urban areas, studying the usage, of green manures, neem oil, neem cake, pongamia oil in organic farming, livestock component in various farming methods, visiting an Apiculture center, drawing various terrace farming models		
Continuous internal Evaluation shall be based on allotted assignments and class text.		
The marks shall be as follows:		

Internal examination	:10
Assignment/Practical/Project	: 5
Attendance/Behaviour	: 5

Programme: B..Sc. (Honours/Honours with Research) in Botany	Year: Fourth Year	Semester: VIII
Pedagogy:		
Course Code: BOT23114C	Course Title: Natural Resource Management	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Understanding the horticulture, silviculture and socio-culture CO2. Management practices for recycling of wastes CO3. Learning the field and laboratory protocols of use of waste materials in sustainable management CO4. To describe the Ethical concept CO5.To know about identifying agricultural waste		
Credit: 4	Paper (Code compulsory/Elective): Core Elective	
Max. Marks: 20+80	Min Passing Marks: 7+29	
Total Number of Lectures (Lecture +Tutorials + Practical): 2+0+2		
Unit	Topics	No. of Lecture
Unit I	Natural resources: Definition and types. Sustainable utilization :Concept, approaches (economic, ecological and socio-cultural). Land: Utilization (agricultural, horticultural, silvicultural); Soil degradation and management. Water: Fresh water (rivers, lakes, groundwater, water harvesting technology, rain water storage and utilization.	14
Unit II	Biological Resources: Biodiversity-definition and types; Significance; Threats; Management strategies; Bioprospecting; IPR; CBD; National Biodiversity Action Plan). Forests: Definition, Cover and its significance (with special reference to India); Major and minor forest products; Depletion; Management.	12
Unit III	Energy: Renewable and non-renewable sources of energy-solar, wind, tidal, geothermal and bioenergy resources. Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint.	12
Unit IV	Resource Accounting; Waste management. National and international efforts in resource management and conservation	12
Unit V	Estimation of solid waste generated by a domestic system (biodegradable and non-biodegradable) and its impact on land degradation. Measurement of dominance of woody species by DBH (diameter at breast height) method.	10
Suggested Readings:		
<ol style="list-style-type: none"> 1. B. W. Pandey. 2005. Natural Resource Management. Mittal Publication, New Delhi 2. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi. 3. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi. 4. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi. 		
Course. prerequisite: To study this course, the students must have had subject biology in class 12 th		
Suggested Activities: Calculation and analysis of ecological footprint, Ecological modelling, Collections of data on forest cover of specific area.		
Continuous internal Evaluation shall be based on allotted assignments and class text.		
The marks shall be as follows:		
Internal examination	:10	
Assignment/practical/project	: 5	
Attendance/behaviour	: 5	

Programme: B.Sc. (Honours/Honours with Research) in Botany		Year: B.Sc. 4th Year	Semester: VIIIth
Pedagogy:			
Course Code: BOT23115A		Course/Paper Title:	Dissertation/Research Project & Viva voce [For Hons. with Research Students]
Course Outcomes: After completing this course, the students will be able to -			
CO 1: acquire Research Skills and awareness about Methodology			
CO 2: develop critical thinking skills for evaluating existing literature and research gaps.			
CO 3: develop Communication Skills, Analytical and Problem-Solving abilities.			
CO 4: develop Project Management and will be able to contribute to existing knowledge			
CO 5: Collaborate in Interdisciplinary Skills.			
Credit: 08			Paper (Core Compulsory / Elective): Elective
Max. Marks : 20 + 80			
Total Number of Lectures (Lecture – Tutorials – Practical): 0+0+8			
Units:	Topics:		No. of Lectures
I	Dissertation/ Research Project & Viva Voce		240
Suggested Readings:			
<u>Suggested continuous E-Valuation Methods –</u>			
Continuous Internal Evaluation (CIL)			
Total marks for each course shall be based on internal assessment (20%) and semester end examination (80%). The internal assessment of 20% shall be distributed as under:			
(iv)	Internal Class Test – 10%.		
(v)	Assignment/Project/Practical – 5%		
(vi)	Attendance/Behavior – 5%.		

Or

Field Visit/ Educational Tour Visit based Viva Voce [Course Code : BOT23115B] for (Hons. Students)

Completion of the Programme: Bachelor Degree with Honours/Honours with Research in Major Discipline at the Successful Completion of the Fourth Year (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme.

POOL-B**Minor Discipline Courses (For I & IInd Semester) : Can be Chosed by All Discipline Students**

Year	Semester	Nomenclature/Title of the Course	VAC Code	Credit
1st Year	I	Modern Indian language – Hindi P-I	MIN-001	2
		Modern Indian language – Sanskrit P-I	MIN-002	2
		Modern Indian language – English language P-I	MIN-003	2
1st Year	II	Modern Indian language – Hindi P-II	MIN-004	2
		Modern Indian language – Sanskrit P-II	MIN-005	2
		Modern Indian language – English language P-II	MIN-006	2

POOL- C**Skill Enhancement Courses**

S.N.	SEC Code	Title of SEC / Vocational Courses	Level	COM./ELE	Credits (L/T+P)
1	SEC-001	Digital Marketing	NSQF 5	ELE.	1+2
2	SEC-002	Culinary Arts	NSQF 5	ELE.	1+2
3	SEC-003	Tourism & Travel Management	NSQF 5	ELE.	1+2
4	SEC-004	Early Childhood Education	NSQF 5	ELE.	1+2
5	SEC-005	Sports Coaching	NSQF 5	ELE.	1+2
6	SEC-006	Financial accounting & Taxation	NSQF 5	ELE.	1+2
7	SEC-007	Retail Management	NSQF 5	ELE.	1+2
8	SEC-008	Supply Chain Management	NSQF 5	ELE.	1+2
9	SEC-009	Digital Photography & Videography	NSQF 5	ELE.	1+2
10	SEC-010	Yoga and Nutrition Expert	NSQF 5	ELE.	1+2
11	SEC-011	Disaster Management	NSQF 5	ELE.	1+2
12	SEC-012	Digital Library Establishment	NSQF 5	ELE.	1+2
13	SEC-013	Computerized Accounting (Tally)ERP-9/Prime)	NSQF 5	ELE.	1+2
14	SEC-014	Apiculture	NSQF 5	ELE.	1+2
15	SEC-015	Aquaculture	NSQF 5	ELE.	1+2
16	SEC-016	Vermiculture	NSQF 5	ELE.	1+2
17	SEC-017	Sericulture	NSQF 5	ELE.	1+2
18	SEC-018	Horticulture	NSQF 5	ELE.	1+2
19	SEC-019	Mushroom Cultivation	NSQF 5	ELE.	1+2
20	SEC-020	Herbal Technology	NSQF 5	ELE.	1+2
21	SEC-021	Basic Instrumentation Skills	NSQF 5	ELE.	1+2
22	SEC-022	Digital Electronics	NSQF 5	ELE.	1+2
23	SEC-023	Organic Farming	NSQF 5	ELE.	1+2
24	SEC-024	Water Management (Ganges)	NSQF 5	ELE.	1+2
25	SEC-025	Computational Chemistry	NSQF 5	ELE.	1+2
26	SEC-026	Industrial Chemistry	NSQF 5	ELE.	1+2
27	SEC-027	Jyotish Shashtra and Karmakand	NSQF 5	ELE.	1+2
28	SEC-028	Vastushastra	NSQF 5	ELE.	1+2
29	SEC-029	Radio Jockey CCRJ	NSQF 5	ELE.	1+2

POOL-D
Value Added Courses

Year	Semester	Nomenclature/Title of the Course	VAC Code	Credit
1st Year	I	Understanding India	VAC-001	2
1st Year	II	Communication Skills and Personality development	VAC-002	2
2nd Year	III	Indian Heritage and Culture	VAC-003	2
2nd Year	IV	Food, Nutrition and Hygiene	VAC-004	2
3rd Year	V	Gram Pravas and Talking Hands	VAC-005	2
3rd Year	VI	Physical Education and Yoga	VAC-006	2