ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYAL SCHOOL OF LIFE SCIENCES (RSLSC)

DEPARTMENT OF BOTANY

COURSE STRUCTURE & SYLLABUS
(BASED ON NATIONAL EDUCATION POLICY 2020)
FOR

B.Sc. IN BOTANY (4 YEARS SINGLE MAJOR)

W.E.F

AY - 2023 – 24

Preamble

The National Education Policy (NEP) 2020 conceives a new vision for India's higher education system. It recognizes that higher education plays an extremely important role in promoting equity, human as well as societal well-being and in developing India as envisioned in its Constitution. It is desired that higher education will significantly contribute towards sustainable livelihoods and economic development of the nation as India moves towards becoming a knowledge economy and society.

Over the past decades the higher education system of our country has undergone substantial structural and functional changes resulting in both quantitative and qualitative development of the beneficiaries. The upgradation of undergraduate programmes will play an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution - a democratic, just, socially conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all. A holistic and multidisciplinary education would aim to develop all capacities of human beings -intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. As part of this holistic education, students will also be provided with opportunities for internships with local industries, businesses, artists, crafts persons, and so on, as well as research internships with faculty and researchers at the University, so that students may actively engage with the practical aspects of their learning and thereby improve their employability. The learning outcome based curriculum in general and in **Botany** in particular will definitely help the teachers of the discipline to visualize the curriculum more specifically in terms of the learning outcomes expected from the students at the end of the instructional process. It is pertinent to mention here that the purpose of education is to develop an integrated personality of the individual and the educational system provides all knowledge and skills to the learner for this.

As per the recommendations from the UGC, introduction of courses related to Indian Knowledge System (IKS) is being incorporated in the curriculum structure which encompasses all of the systematized disciplines of Knowledge which were developed to a high degree of sophistication in India from ancient times and all of the traditions and practises that the various communities of India—including the tribal communities—have evolved, refined and preserved over generations, like for example Plant Sciences in Ancient time, Vedic Mathematics, Vedangas, Metallurgy, etc.

At RGU, we are committed that at the societal level, higher education will enable each student to develop themselves to be an enlightened, socially conscious, knowledgeable, and skilled citizen who can find and implement robust solutions to its own problems. The programme structure developed has the provision of ensuring the integrated personality of the students in terms of providing opportunity for exposure to the students towards core courses, discipline specific courses, generic elective courses, ability enhancement courses and skill enhancement courses with special focus on technical, communication and subject specific skills through practical and other innovative transactional modes to develop their employability skills. This learning outcome based framework has categorically mentioned very well defined expected outcomes for the programme like core competency, communication skills, critical thinking, affective skills, problem-solving, analytical, reasoning, research-skills, teamwork, digital literacy, moral and ethical awareness, leadership readiness and so on along with very specific learning course outcomes at the starting of each course. Therefore, this template on Learning Outcomes based NEP-NCrF Framework for B.Sc. with Botany/ Botany Honours will be more flexible, multi-disciplinary, holistic and will definitely be a landmark in the field of outcome based curriculum construction.

1. Introduction

The National Education Policy (NEP) 2020 clearly indicates that higher education plays an extremely important role in promoting human as well as societal well-being in India. It highlights that the following fundamental principles that have a direct bearing on the curricula would guide the education system at large, viz.

i. Recognizing, identifying, and fostering the unique capabilities of each student to promote her/his holistic development.

ii. Flexibility, so that learners can select their learning trajectories and programmes, and thereby choose their own paths in life according to their talents and interests.

iii. Multidisciplinary and holistic education across the sciences, social sciences, arts, humanities, and sports for a multidisciplinary world.

iv. Emphasis on conceptual understanding rather than rote learning, critical thinking to encourage logical decision-making and innovation; ethics and human & constitutional values, and life skills such as communication, teamwork, leadership, and resilience.

v. Extensive use of technology in teaching and learning, removing language barriers, increasing access for Divyang students, and educational planning and management.

vi. Respect for diversity and respect for the local context in all curricula, pedagogy, and policy.

To house the objectives of NEP – 2020, the new course structure of **BSc in Botany** aims at a new and forward-looking Vision for India's Higher Education System. This curriculum framework for the bachelor-level program in Botany is developed keeping in view of the student centric learning pedagogy, which is entirely multidisciplinary outcome-oriented and curiosity-driven. To avoid rote -learning approach and foster imagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum framework focuses on pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field works. The platform aims at equipping the graduates with necessary skills for botany-related careers, careers with general graduate-level aptitude and for higher education in Botany and allied subjects. Augmented in this framework are graduate attributes including critical thinking, basic psychology, scientific reasoning, moral ethical reasoning and so on, qualification descriptors that are specific outcomes pertinent to the discipline of botany, learning outcomes for the two programmes these frameworks have been developed, learning outcomes for individual courses, pedagogical methods and assessment methods. Looking at all these new concepts and progress, the detailed syllabus of BSc (H) – Botany has been designed and decided to be implemented from the academic session 2023-24.

2. Approach to Curriculum Planning

While designing these frameworks, emphasis is given on the objectively measurable teaching-learning outcomes to ensure employability of the graduates. In line with recent trends in education section, these frameworks foster implementation of modern pedagogical tools and concepts such as flip-class, hybrid learning, MOOCs and other e-learning platforms. In addition, the framework pragmatic to the core; it is designed such a way to enable the

learners implementing the concepts to address the real world problems. A major emphasis of these frameworks is that the curriculum focuses on issues pertinent to India and also of the west; for example, biodiversity and conservation of endemic and threatened species that are found in India, Indian climatological variables, Indian biodiversity and so on. Above all, these frameworks are holistic and aim to mould responsible Indian citizen who have adequate skills in reflective thinking, rational skepticism, scientific temper, digital literacy and so on such that they are equipped to fight immediate social issues apropos to Indian milieu, including corruption and inequity.

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications such as a Bachelor's Degree (Hons) programmes are earned and awarded on the basis of (a) demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and (b) academic standards expected of graduates of a programme of study.

Learning outcomes-based frameworks in any subject must specify what graduates completing a particular programme of study are (a) expected to know, (b) understand and (c) be able to do at the end of their programme of study. To this extent, NEP in Botany is committed to allowing for flexibility and innovation in (i) programme design and syllabi development by higher education institutions (HEIs), (ii) teaching-learning process, (iii) assessment of student learning levels, and (iv) periodic programme review within institutional parameters as well as NEP guidelines, (v) generating framework(s) of agreed expected graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes. HEIs, on their turn, shall address to the situations of their students by identifying relevant and common outcomes and by developing such outcomes that not only match the specific needs of the students but also expands their outlook and values.

3. Award of Bachelor's Degree Programme in Botany (Honours)

The structure and duration of undergraduate programmes of study offered by the University as per NEP 2020 include:

3.1 Undergraduate programmes of either 3 or 4-year duration with Single Major, with multiple entry and exit options, with appropriate certifications:

A. **UG Certificate**: Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate if, in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

B. **UG Diploma**: Students who opt to exit after completion of the second year and have secured 80 credits will be awarded the UG diploma if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

C. **3-year UG Degree**: Students who will undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 120 credits and satisfying the minimum credit requirement.

D. **4-year UG Degree (Honours**): A four-year UG Honours degree in the major discipline will be awarded to those who complete a four-year degree programme with 160 credits and have satisfied the credit requirements as given in Table 6 in Section 5.

E. **4-year UG Degree (Honours with Research):** Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a Faculty Member of the University. The research project/dissertation will be in the major discipline. The students who secure 160 credits, including 12 credits from a research project/dissertation, will be awarded UG Degree (Honours with Research).

(Note: UG Degree Programmes with Single Major: A student must secure a minimum of 50% credits from the major discipline for the 3-year/4-year UG degree to be awarded a single major. For example, in a 3-year UG programme, if the total number of credits to be earned is 120, a student of Botany with a minimum of 60 credits will be awarded a B.Sc. in Botany with a single major. Similarly, in a 4-year UG programme, if the total number of credits to be earned is 160, a student of Botany with a minimum of 80 credits will be awarded a B.Sc. (Hons./Hon. With Research) in Botany in a 4-year UG programme with single major. Also the 4-year Bachelor's degree programme with Single Major is considered as the preferred option since it would allow the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student.)

A student pursuing 4 years undergraduate programme with research in a specific discipline shall be awarded an appropriate Degree in that discipline on completion of 8th Semester if he/she secures 160 Credits. An illustration of credits requirements in relation to the type of award is illustrated below:

Table: 1: Award of Degree and Credit Structure with ME-ME

Award	Year	Credits to earn	Additional Credits	Re-entry allowed within (yrs)	Years to Complete
UG Certificate	1	40	4	3	7
UG Diploma	2	80	4	3	7
3-year UG Degree (Major)	3	120	x	x	x
4-year UG Degree (Honours)	4	160	x	x	x
4-year UG Degree (Honors with Research):	4	160	Students who secure cumulative 75% marks and above in the first six semesters		

Table 3: Credit Distribution for 3-year Course Semester

Course Credits								
Semester	**Major**	**Minor**	**ID**	**AEC**	**SEC**	**VAC**	**SI**	**Total**
I	6	3	3	2	3	3	0	**20**
II	6	3	3	2	3	3	0	**20**
III	8	4	3	2	3	0	0	**20**
IV	12	6	0	2	0	0	0	**20**
V	12	4	0	0	0	0	4	**20**
VI	16	4	0	0	0	0	0	**20**
TOTAL	**60**	**24**	**9**	**8**	**9**	**6**	**4**	**120**

Table 4: Credit Distribution for 4-year Course Semester

Course Credits									
Semester	**Major**	**Minor**	**ID**	**AEC**	**SEC**	**VAC**	**SI**	**RP**	**Total**
I	6	3	3	2	3	3	0	0	**20**
II	6	3	3	2	3	3	0	0	**20**
III	8	4	3	2	3	0	0	0	**20**
IV	12	6	0	2	0	0	0	0	**20**
V	12	4	0	0	0	0	4	0	**20**
VI	16	4	0	0	0	0	0	0	**20**
VII	16	4	0	0	0	0	0	0	**20**
VIII	4	4	0	0	0	0	0	12	**20**
TOTAL	**80**	**32**	**9**	**8**	**9**	**6**	**4**	**12**	**160**

Bachelor's Degree (Honours) is a well-recognized, structured, and specialized graduate level qualification in tertiary, collegiate education. The contents of this degree are determined in terms of knowledge, understanding, qualification, skills, and values that a student intends to acquire to look for professional avenues or move to higher education at the postgraduate level.

Bachelor's Degree (Honours) programmes attract entrants from the secondary level or equivalent, often with subject knowledge that may or may not be directly relevant to the field of study/profession. Thus, BSc (Honours) Course in Botany aims to equip the students to qualify for joining a profession or to provide development opportunities in particular employment settings. Graduates are enabled to enter a variety of jobs or to continue academic study at a higher level.

3.2 Aims of Bachelor's Degree (Honours) Programme in Botany:

The overall objectives of the NEP Framework for B.Sc.- Honours degree in Botany are-

1. To impart the basic knowledge of Plant Sciences with theories, principles, processes, and studies of traditional and modern botany.
2. To impart more multi-disciplinary and holistic course curriculum.
3. To develop the learners providing research-based knowledge
4. To equip the students in solving the practical problems pertinent to India
5. To adopt recent pedagogical trends in education including e-learning, flipped class, hybrid learning and MOOCs
6. To mould responsible citizen for nation-building and transforming the country towards the future
7. To provide an environment that ensures cognitive development of students in a holistic manner. A dialogue about plants and its significance is fostered in this framework, rather than didactic monologues on mere theoretical aspects
8. 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.
9. To mould a responsible citizen who is aware of most basic domain-independent knowledge, including critical thinking and communication.
10. To enable the graduate prepare for national as well as international competitive examinations, especially UGC-CSIR NET and UPSC Civil Services Examination

4. Graduate Attributes & Learning Outcomes

Introduction:

As per the NHEQF, each student on completion of a programme of study must possess and demonstrate the expected Graduate Attributes acquired through one or more modes of learning, including direct in-person or face-to-face instruction, online learning, and hybrid/blended modes. The graduate attributes indicate the quality and features or characteristics of the graduate of a programme of study, including learning outcomes relating to the disciplinary area(s) relating to the chosen field(s) of learning and generic learning outcomes that are expected to be acquired by a graduate on completion of the programme(s) of study.

The graduate profile/attributes must include,

• capabilities that help widen the current knowledge base and skills,

• gain and apply new knowledge and skills,

• undertake future studies independently, perform well in a chosen career, and

• play a constructive role as a responsible citizen in society.

The graduate profile/attributes are acquired incrementally through development of cognitive levels and describe a set of competencies that are transferable beyond the study of a particular subject/disciplinary area and programme contexts in which they have been developed.

Graduate attributes include,

• learning outcomes that are specific to disciplinary areas relating to the chosen field(s) of learning within broad multidisciplinary/interdisciplinary/ transdisciplinary contexts.

• generic learning outcomes that graduate of all programmes of study should acquire and demonstrate.

Sl. No.	**Graduate Attribute**	**The Learning Outcomes Descriptors** ***(The graduates will be able to demonstrate the capability to:***
GA1	**Disciplinary Knowledge**	acquire knowledge and coherent understanding of the broad discipline encompassing various subjects involved with the study of plants in both disciplinary and interdisciplinary areas of study.
GA 2	**Complex problem solving**	solve different kinds of problems in familiar and non-familiar contexts and apply the learning to real-life situations.
GA 3	**Analytical & Critical thinking**	apply analytical thought including the analysis and evaluation of policies, and practices. Able to identify relevant assumptions or implications. Identify logical flaws and holes in the arguments of others. Analyse and synthesize data from a variety of sources and draw valid conclusions and support them with evidence and examples.
GA 4	**Creativity**	create, perform, or think in different and diverse ways about the same objects or scenarios and deal with problems and situations that do not have simple solutions. Think 'out of the box' and generate solutions to complex problems in unfamiliar contexts by adopting innovative, imaginative, lateral thinking, interpersonal skills, and emotional intelligence.
GA 5	**Communication Skills**	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.
GA 6	**Research-related skills**	develop a keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions. Should acquire the ability to problematize, synthesize and articulate issues and design research proposals, 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. Should develop the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work.
GA 7	**Collaboration**	work effectively and respectfully with diverse teams in the interests of a common cause and work efficiently as a member of a team.
GA 8	**Leadership readiness/qualities**	plan the tasks of a team or an organization and setting direction by formulating an inspiring vision and building a team that can help achieve the vision.
GA 9	**Digital and technological skills**	use ICT in a variety of learning and work situations. Access, evaluate, and use a variety of relevant information sources and use appropriate software for analysis of data.
GA 10	**Environmental awareness and action**	mitigate the effects of environmental degradation, climate change, and pollution. Should develop the technique of effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living.

5 Program Learning Outcomes relating to BSc Botany (Honours) degree Programme in Botany:

The student graduating with the Degree B.Sc. (Honours) Botany should be able to acquire

Sl.no.	**Graduate Attribute**	**The Programme Learning Outcomes Descriptors** ***The graduates will acquire the following:***
PLO1:	**Knowledge of Botany**	Students will acquire core competency in the subject Botany, and in allied subject areas. • The student will be able to identify major groups of plants and compare the characteristics of lower (e.g. algae and fungi) and higher (angiosperms and gymnosperms) plants. • Students will be able to use the evidence based comparative botany approach to explain the evolution of organism and understand the genetic diversity on the earth. • The students will be able to explain various plant processes and functions, metabolism, concepts of gene, genome and how organism's function is influenced at the cell, tissue and organ level. • Students will be able to understand adaptation, development and behaviour of different forms of life.

		• The understanding of networked life on earth and tracing the energy pyramids through nutrient flow is expected from the students. • Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Botany.
PLO2:	**Problem solving ability:**	An increased understanding of fundamental concepts and their applications of scientific principles is expected at the end of this course. Students will acquire problem solving capabilities.
PLO3:	**Critical Thinking and Analytical ability:**	The students will be able to Analyse and synthesize data from a variety of sources and draw valid conclusions and support them with evidence and examples. They will be able to identify relevant assumptions or implications, identify logical flaws and holes in the arguments of others.
PLO4	**Creativity:**	The students will be able to think 'out of the box' and generate solutions to complex problems in unfamiliar contexts by adopting innovative, imaginative, lateral thinking, interpersonal skills, and emotional intelligence.
PLO5:	**Communication Skills:**	The students will be express their thoughts and ideas effectively in writing as well as orally and communicate with others using appropriate media.
PLO6:	**Research ability:**	Students will develop the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work.
PLO7:	**Collaborative ability:**	Students will learn team workmanship in order to serve efficiently institutions, industry and society. Will be able to develop collaborative ability.
PLO8:	**Leadership ability:**	The students will be able to build a team to achieve the vision, plan a task and execute it.
PLO9:	**Digitally equipped:**	Students will acquire digital skills and integrate the fundamental concepts with modern tools.
PLO10:	**Environmental awareness:**	Will be able to develop the technique of effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living.

6. Programme specific Learning Outcomes

Programme Specific Outcomes (PSOs):

PSO1. A student completing the course is able to understand different specializations of Botany such as systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics and molecular biology of various life-forms.

PSO2. The student completing the course is trained in various analytical techniques of plant biology, use of plants as industrial resources or as human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants.

PSO3. The student completing the course is able to identify various life forms of plants, design and execute experiments related to basic studies on evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, proteomics and transgenic technology. Students are also familiarized with the use of bioinformatics tools and databases and in the application of statistics to biological data.

PSO4. The student completing the course is capable of executing short research projects incorporating various tools and techniques in any of the basic specializations of Plant Sciences under supervision.

7. Teaching Learning Process

Teaching and learning in this programme involve classroom lectures, tutorials, Practicums and experiential learnings:

It allows-

• The tutorials allow a closer interaction between the students and the teacher as each student gets individual attention.

• Written assignments and projects submitted by students

• the project-based learning

• Group discussion

• Home assignments

• Quizzes and class tests

• PPT presentations, Seminars, interactive sessions

• Diversity survey

• Co-curricular activity etc.

• Industrial Tour or Field visit

8. Assessment Methods

Sl. No.	Components of evaluation	Marks	Frequency	Code	Weightage (%)
A.	Continuous Evaluation				
i.	Analysis/ Class Test	Combination of any 3 from I to	1 – 3	C	25%

ii	Home assignments	V with 5 marks each	1 – 3	H	
iii	Project		1	P	
iv	Seminar		1 – 2	S	
v	Viva-Voce/ Presentations		1 – 2	V	
vi	Mid semester Examinations	MSE shall be of 10 marks	1	Q/CT	
vii	Attendance	5 marks	100%	A	5%
B.	Semester End examination		1	SEE	70%
Total					100%

B.SC. BOTANY PROGRAMME STRUCTURE				
1ST SEMESTER				
MAJOR SUBJECTS				
Sl.No.	**Subject Code**	**Names of subjects**	**C**	**Course level**
1	BOT142C101	Cryptogamic botany (Algae, Bryophytes & Pteridophytes)	3	100
2	BOT142C102	Cryptogamic botany practical	3	100
MINOR SUBJECTS				
3	BOT42M101	Diversity of Plants	3	100
INTERDISCIPINARY SUBJECTS				
4	IDC 1	IKS 1	3	100
SKILL ENHANCEMENT COURSE (SEC)				
5	BOT142S121	Plant disease identification and control	3	100
ABILITY ENHANCEMENT COURSES (AEC)				
6	AEC982A101	Communicative English and Behavioral Science-I	3	100
VALUE ADDED COURSE (VAC)				
7	VAC 1	One course from a basket of available courses to be selected	3	100
TOTAL CREDITS FOR THE SEMESTER			**20**	

2ND SEMESTER				
MAJOR SUBJECTS				
Sl.No.	**Subject Code**	**Names of subjects**	**C**	**Course level**
1	BOT142C103	Phanerogams - Gymnosperms & Angiosperms	3	100
2	BOT142C104	Phanerogams Practical	3	100
MINOR SUBJECT				
3	BOT142M102	Economic Botany	3	100
INTERDISCIPINARY SUBJECT				
4	IDC - 2	IKS - 2	3	100
SKILL ENHANCEMENT COURSE (SEC)				
5	BOT142S221	Plant identification and Herbarium Techniques	3	100
ABILITY ENHANCEMENT COURSE (AEC)				
6	AEC982A201	Communicative English and Behavioral Science-II	2	100
VALUE ADDED COURSE (VAC)				
7	VAC 2	One course from a basket of available courses to be selected	3	100
TOTAL CREDITS FOR THE SEMESTER			**20**	

3RD SEMESTER				
Sl.No.	**Subject Code**	**Names of subjects**	**C**	**Course level**
MAJOR SUBJECTS				
1	BOT142C201	Plant morphology, Anatomy & Taxonomy	4	200
2	BOT142C202	Plant morphology, Anatomy & Taxonomy - practical	4	200
MINOR SUBJECT				
3	BOT42M201	Ethnobotany	4	200
INTERDISCIPLINARY SUBJECT				
4	IDC 3	Basket course	3	200
SKILL ENHANCEMENT COURSE (SEC)				
5	BOT142S321	Floriculture	3	200
ABILITY ENHANCEMENT COURSE (AEC)				
6	AEC982A301	Communicative English and Behavioral Science-III	2	200
TOTAL CREDITS FOR THE SEMESTER			**20**	
4TH SEMESTER				
Sl.No.	**Subject Code**	**Names of subjects**	**C**	**Course level**
MAJOR SUBJECTS				
1	BOT142C203	Microbiology & Mycology	3	200
2	BOT142C204	Genetics & Plant breeding	3	200
3	BOT142C205	Traditional medicinal plants of India	3	
4	BOT142C206	Microbiology, Mycology, Genetics & Plant breeding - Practical	3	200
MINOR SUBJECTS				
4	BOT142M202	Ecology, Environment and Biodiversity conservation	3	200
5	BOT142M203	Bioresource Management	3	200
ABILITY ENHANCEMENT COURSE (AEC)				
6	AEC982A401	Communicative English and Behavioral Science-IV	2	200
TOTAL CREDITS FOR THE SEMESTER			**20**	

5th SEMESTER				
Sl.No.	**Subject Code**	**Names of subjects**	**C**	**Course level**
MAJOR SUBJECTS				
1	BOT142C301	Plant physiology & biochemistry	4	300
2	BOT142C302	Cell & Molecular biology	4	300
3	BOT142C303	Plant physiology, biochemistry, Cell & Molecular biology - Practical	4	300
MINOR SUBJECT				
4	BOT42M301	Environmental & Industrial Microbiology	4	300
INTERNSHIP/ RESEARCH PROJECT				
5	AEC982A301	Internship/ Research Project	2	300
TOTAL CREDITS FOR THE SEMESTER			**20**	
6th SEMESTER				
Sl.No.	**Subject Code**	**Names of subjects**	**C**	**Course level**
MAJOR SUBJECTS				
1	BOT142C304	Reproductive Biology of Angiosperms	**4**	300
2	BOT142C305	Plant ecology & Ecosystem Analysis	**4**	300
3	BOT142C306	Sustainable development of Crop cultivation	**4**	300
4	BOT142C307	Reproductive biology, Ecology & Agronomy - Practical	**4**	**300**
MINOR SUBJECTS				
5	BOT142M302	Agronomy & Sustainable development	**4**	**300**
TOTAL CREDITS FOR THE SEMESTER			**20**	

7TH SEMESTER				
Sl.No.	**Subject Code**	**Names of subjects**	**C**	**Course level**
MAJOR SUBJECTS				
1	BOT142C401	Biostatistics & Bioinformatics	4	400
2	BOT142C402	Applied Microbiology	4	400
3	BOT142C403	Plant Biotechnology	4	400
4	BOT142C404	Biostatistics, Bioinformatics, Plant Biotechnology & Applied Microbiology - Practical Biotechnology	4	400
MINOR SUBJECTS				
5	BOT42M401	Plant Biotechnology	4	400
TOTAL CREDITS FOR THE SEMESTER			**20**	
8TH SEMESTER				
Sl.No.	**Subject Code**	**Names of subjects**	**C**	**Course level**
MAJOR SUBJECTS				
1	BOT142C405	Genetic Engineering in Plants	4	400
MINOR SUBJECTS				
2	BOT142M402	Research Methodology	4	400
DISSERTATION/ RESEARCH PROJECT				
3	BOT142C406	DISSERTATION	12	400
IN LIU OF DISSERTATION				
4	BOT142C407	Advanced plant systematics	4	400
5	BOT142C408	Advanced plant physiology and biochemistry	4	400
6	BOT142C409	Environmental Pollution and conservation	4	400
TOTAL CREDITS FOR THE SEMESTER			**20**	

DETAILED SYLLABUS OF 1ST SEMESTER

MAJOR SUBJECT: CRYPTOGAMIC BOTANY (ALGAE, BRYOPHYTES & PTERIDOPHYTES)
Subject Code: BOT142C101, COURSE LEVEL: 100
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology and chemistry up to class 12

Course objective: To introduce the students to the diversity and type study of Cryptogams, their economic importance, and their evolution to present times.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	The course shall **infer** the students with the understanding of the wide diversity of cryptogams, their economical, ecological & evolutionary variations and roles.	**BT -2**
CO2	The learners shall **develop** an understanding of the transition of early land plants from aquatic to terrestrial habitats.	**BT-5**
CO3	The students shall be able to **outline** the applications of phycology, bryology & pteridology.	**BT -5**

Detailed Syllabus

Module	Course content	Lecture hours
I	**Major Groups of Algae I: Cyanophyta, Chlorophyta and Charophyta**: General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Type study of *Nostoc, Volvox and Chara* **Major Groups of Algae II: Xanthophyta, Pheophyta and Rhodophyta**: General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Type study of *Vaucheria, Ectocarpus* and *Polysiphonia*	**15**
II	**Introduction to Archegoniates**: Unifying features of archegoniates. Transition to land habit and its evolutionary significance. Alternation of generations. **Bryophytes:** Type Studies: Classification (up to family), morphology, anatomy and reproduction, evolutionary trends of *Riccia, Marchantia, Anthoceros, Sphagnum and Funaria (development stages not included).* Ecological and economic importance of bryophytes	**15**
III	**Pteridophytes:** General characteristics; Classification; Early land plants (*Cooksonia*and *Rhynia*). Type Studies: Classification (up to family), morphology, anatomy and reproduction of *Psilotum*, *Selaginella*, *Equisetum, Marsilea* and *Pteris*.	**15**
IV	Apogamy, and apospory, heterospory and seed habit, telome theory, stelar evolution. Ecological and economic importance of pteridophytes. Recent studies and development in Cryptogamic Botany	**15**

Total	**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

Text Books:

1. Bhattacharya K., Ghosh A. K., & Hait G. (2017). A Textbook of Botany. Vol I & II. NCBA Kolkatta.
2. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
3. Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.

Reference books:

1. Lee, R.E. Phycology. 2018. Cambridge University Press, Cambridge
2. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
3. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
4. R.S. Chopra. Taxonomy of Indian mosses: an introduction. 2009. Publications & Information Directorate, CSIR, New Delhi.
5. A Manual Of Cryptogamic Botany: Adapted To The Requirements Of The Science And Art Department (Classic Reprint). 2018. Charlotte M. W. Ross. Forgotten Books Publisher.

MAJOR SUBJECT: CRYPTOGAMIC BOTANY - PRACTICAL

Subject Code: BOT142C102, COURSE LEVEL: 100

L-T-P-C = 0-0-6-3, Credit Units: 03

SCHEME OF EVALUATION: Practical (P)

Prerequisite: Basic knowledge of biology and chemistry up to class 12

Course objective: To introduce the students to the world of algae, mosses and ferns by showing them live specimens and photographs and enable the students to have a hands-on experience of observing of the first land plants and their diversity

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Employ** practical knowledge of lower plants	**BT - 3**
CO2	**Discover** early land plants and their diversity	**BT - 3**

CO3	**Examine** the morphology, anatomy and reproductive structures of the lower plants	**BT - 4**

Detailed Syllabus

Module	Course content	Lecture hours
I	**Algae:** 1. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas*, Volvox, *Oedogonium, Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia,* 2. Temporary preparations and permanent slides (subject to availability, a minimum of 5 genera to be studied).	**20**
II	**Bryophytes:** 3. Study of Riccia & Marchantia- Morphology of thallus, vertical section of thallus through Gemma cup. 4. Anthoceros, Sphagnum, Funaria (as per availability) - Morphology of thallus, dissection of sporophyte (temporary slide), vertical section of thallus (permanent slide). temporary slides showing antheridial and archegonial heads, longitudinal section of capsule and protonema.	**20**
III	**Pteridophytes:** 5. Selaginella- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide). 6. Equisetum- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide). 7. Pteris- Morphology, transverse section of rachis, vertical section of sporophyll, wholemount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).	**20**
IV	8. Feld study, sample collection and diversity study of cryptogams	**30**
Total		**90**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • FIELD VISITS • SAMPLE COLLECTION • SUBMISSION

Text books:

1. Santra S. Practical Botany Vol.1 and 2. 2015. NCBA Publisher.
2. Bendre and Kumar. Practical Botany Vol.1 and 2. 2018. Rastogi Publications.

Reference Books:

1. Internet : https://www.biodiversitylibrary.org/item/90703#page/3/mode/1up.
2. Pandey.B.P. Modern Practical Botany Vol. 1, 2, 3. 2011. S.Chand Publication.

MINOR SUBJECT: DIVERSITY IN PLANTS
COURSE LEVEL: 100, SUBJECT CODE: BOT142M101,
CREDIT UNITS: 3, L-T-P-C: 2-0-1-3
SCHEME OF EVALUATION: Combined Theory & Practical (TP):

Course objective: Develop an understanding of the various groups of Plant kingdom and Acquire knowledge about the evolution from lower plants to higher plants in the Plant kingdom.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recognize** various plant groups of plants from primitive to highly evolved	**BT 1**
CO2	**Infer** foundation for further studies in Botany	**BT 2**

Module	Topic and Course content	Lecture hours
	Theory	
I	**Microbes:** Discovery, general characteristics and economic importance of viruses and bacteria. **Fungi:** General characteristics, range of thallus organization, reproduction, ecological and economic importance of fungi. General account and significance of symbiotic associations: Lichens and Mycorrhiza.	**11**
II	**Algae:** General characteristics, range of thallus organization, reproduction, ecological and economic importance of algae.	**11**
III	**Archegoniates:** Unifying features, **Bryohytes:** General characteristics, range of thallus organization, reproduction, ecological and economic importance, adaptation to land habit. **Pteridophytes:** General characteristics, ecological and economic importance.	**11**

IV	**Gymnosperms:** General characteristics, ecological and economic importance. **Angiosperms:** General characteristics, ecological and economic importance	**11**
Total		**44**
Practical		
1	Study of preservation of botanical specimens, different instruments used in a laboratory and Microscopy and different sections of plant material and preparation of microscope slides.	**1**
2	Study of different staining procedures (single, double and Gram staining), Preparation of Gram stain and other important stains used in laboratory studies	**1**
3	Study of different types of bacteria through photographs and permanent slides	**1**
4	Study of various structures of *Nostoc* and *Fucus* through temporary preparations and permanent slides	**2**
5	Study of various structures of *Rhizopus* and *Agaricus* through temporary preparations and permanent slides	**2**
6	Study of various growth forms of lichen and different types of mycorrhiza through photographs	**1**
7	Study of various structures of *Marchantia* through temporary preparations and permanent slides	**2**
8	Study of various structures of *Selaginella* and *Equisetum* through temporary preparations and permanent slides	**2**
9	Study of various structures of *Cycas* and *Pinus* through temporary preparations and permanent slides	**2**
10	Study of floral structures of *Hibiscus* sp. and *Tagetes* sp. (Marigold).	**1**
Total		**15**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
44	30	16 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

Text Books:

1. Bhattacharya K., Ghosh A. K., & Hait G. (2017). A Textbook of Botany. Vol I & II. NCBA Kolkata.
2. B. P. Pandey . Botany for Degree students – Biodiversity. 2010. S. Chand Publishers.

Reference Books:

1. Gangopadhyay A. Plant Biodiversity.2007. Gene-Tech Books.

2. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
3. Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.
4. Santra S. Practical Botany Vol.1 and 2. 2015. NCBA Publisher.
5. Bendre and Kumar. Practical Botany Vol.1 and 2. 2018. Rastogi Publications.

SEC 1: PLANT DISEASE IDENTIFICATION AND CONTROL
Subject Code: BOT142S121, L-T-P-C: 0-0-3-3, Credit Units: 03
SCHEME OF EVALUATION: Practical (P)

Pre-requisite: Basic knowledge of biology and chemistry up to class 12

Course objective: To introduce and develop basic concepts to the world of plant disease focusing on the management and control of pathogens and epidemics.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	To **describe and identify** the physical dimensions, forms, functions and habitats of pathogens	**BT 2 and BT 3**
CO2	To **experiment with different** plant diseases in different crops	**BT 3**
CO3	To **examine and infer** from the studied specimen the type and its management of the disease in the plant kingdom	**BT 4**

Detailed Syllabus

Module	Course content	Lecture hours
I	**Introduction:** Terms and concepts; Symptomology and identification of fungal, viral and bacterial plant diseases. Host-Pathogen relationships; Disease cycle and role of environment in disease development; prevention and control of plant diseases. Quarantine and its significance in control of plant diseases.	**15**
II	Major epidemics and their social impacts. Legislative, cultural, and biological protection measures of plant diseases. Koch's postulates. Factors influencing infection, colonization, and development of symptoms.	**15**
III	**Laboratory and Analytical Techniques** Preparation and sterilization of common media. Methods of isolation of pathogens and their identification. Preservation of microorganisms in pure culture. Methods of inoculation. Measurement of plant disease. Detection and Diagnosis of pathogens in seeds and other planting materials.	**15**

IV	Collection and study of Fungal, Bacterial and Viral Diseases of Crop Plants Project on Management and control of Plant diseases	**15**
Total		**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • FIELD VISITS • SAMPLE COLLECTION • SUBMISSION

TEXT BOOKS:

1. Paul Khurana, S. M. 2009: Pathological Problems of Economic crop plants and their management.
2. Dubey, R.C. and Maheshwari, D.K. (1999). A text book of Microbiology, S. Chand & Company Ltd., New Delhi, India

REFERENCE BOOKS:

1. Pelczar, M.J. Microbiology. 2005.Tata McGraw-Hill Co, New Delhi
2. Planke, J. E. Vander. (2013) Plant Diseases Epidemics and control.
3. Sinclair W.A. and H.H. Lyon. Diseases of Trees and Shrubs. 2005. Cornell University Press.
4. Webster J and Weber R.W.S. Introduction to Fungi. 2007. Cambridge University Press.
5. Lucas J.A. Plant Pathology and Plant Pathogens. 2011. John Wiley and Sons Ltd.
6. Williamson VM, Kumar A (2006) Nematode resistance in plants: the battle underground. Trends in Genetics 22: 396–403.

DETAILED SYLLABUS OF 2ND SEMESTER

MAJOR SUBJECT: PHANEROGAMS: GYMNOSPERMS & ANGIOSPERMS
Subject Code: BOT142C201, COURSE LEVEL: 100
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To introduce the students to the world of phanerogams and their evolutionary significance, their detailed taxonomy, and their life cycles.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Identify** the phanerogams, their vegetative and reproductive structures and their importance.	**BT 1**
CO2	**Explain** evolutionary lines in each group of gymnosperms and angiosperms	**BT 2**
CO3	**Relate** the differences and the affinities between the Gymnosperms & Angiosperms.	**BT 3**

CO1:

Detailed Syllabus

Modules	Course content	Lecture hours
I	**Gymnosperms I:** History and recent systems of classification of gymnosperms; origin and evolution of gymnosperms; affinities of gymnosperms with pteridophytes and angiosperms; distribution of gymnosperms in India; Ecological and economic importance of gymnosperms; **Gymnosperms II:** Gymnosperms: General characteristics. Classification (up to family). Morphology, anatomy and reproduction ofaffinities of living gymnosperms: Cycas, Pinus and Gnetum (Developmental details not to be included).	**15**
II	**Angiosperms**: General characteristics; Basal angiosperms and Magnoliids; Basal monocots; Petaloid monocots; Commelinids; Basal eudicots and Caryophyllids; Rosids; Asterids. Evolutionary trend in angiosperms plants. Ideas on the origin and evolution of roots, stem, leaf, stamen, and carpel. Range of vegetative and reproductive structures and their modification in angiosperms.	**15**

III	**Angiosperms Morphology** (stems, roots, leaves & flowers, inflorescence): modifications and morphology of stems, roots, leaves and buds. Types of inflorescence, flowers, flower parts, fruits and type of placentations, definition and types of seeds. **Palynology:** pollen structure, pollen morphology; basic concepts of applied palynology. Role in taxonomic studies	**15**
IV	**Origin and evolution of Plants**: Origin and evolution of plants through Geological Time scale. **Paleobotany**- Paleobotanical records, plant fossils, Preservation of plant fossils - impressions, compressions, petrification's, moulds and casts, pith casts. Radiocarbon dating. **Fossil taxa**- Rhynia, Lepidodendron, Lepidocarpon, Lyginopteris and Cycadeoidea. Exploration of fossil fuels.	**15**
Total		**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

Text Books:

1. C.J.Chamberlain. Gymnosperms: Structure And Evolution. 2009. Andesite Press.
2. Bhattacharya K., Ghosh A. K., & Hait G. (2017). A Textbook of Botany. Vol I & II. NCBA Kolkatt

Reference Books:

1. A.V.S.S.Sambamurty. A Textbook Of Bryophytes, Pteridophytes, Gymnosperms And Paleobotany. 2006. I.K. International Publishing House Pvt.Ltd.
2. J. M. Coulter, C.J.Chamberlain. Morphology Of Gymnosperms. 2016. Wentworth Publishers.
3. W.N. Stewart and G.W. Rothwell. Paleobotany and the evolution of plants. 2010. Cambridge University Press
4. Charlotte M. W. Ross (2018) A Manual Of Cryptogamic Botany: Adapted To The Requirements Of The Science And Art Department (Classic Reprint).. Forgotten Books Publisher.

MAJOR SUBJECT: PHANEROGAMS - PRACTICAL
COURSE LEVEL: 100, Subject Code: BOT142C104,
L-T-P-C: 0-0-6-3, Credit Units: 03
SCHEME OF EVALUATION: Practical (P)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To impart practical knowledge on various group of phanerogams, their diversity, morphology, anatomy and their fossil counterparts.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	The course will help the students to **gain** practical knowledge of vascular plants	**BT2**
CO2	They will be equipped to identify various anatomical structures of plant body	
CO3	They will be able to identify economic importance of various plants	

Detailed Syllabus

Module	**Course content**	**Lecture hours**
I	**Gymnosperms:** 1. Detailed study of distribution of Gymnosperms in North East India with the help of available resources. 2. Study of morphological, anatomical and reproductive features of gymnosperms available in the region. 3. Study of types pollination mechanism in gymnosperms.	**20**
II	**Angiosperms:** 4. Study of morphological, anatomical, and reproductive features of angiosperms available in the region. 5. Study of types of inflorescence, flowers, flower parts, and fruits 6. Study of types of placentation and types of seeds found in angiosperms.	**20**
III	**Paleo botany and palynology:** 7. Study of fossil gymnosperms from photographs and museum specimens. 8. Preparation of pollen grain slides by following different techniques. 9. Study of various modified structures of angiosperms from available sources.	**20**
IV	10. Field visit and collection 11. Mounting of a properly dried and pressed specimen of gymnosperms and angiosperms with herbarium label (to be submitted in the record book).	**30**
Total		**90**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • FIELD VISITS • SAMPLE COLLECTION • SUBMISSION

Text books:

3. Santra S. Practical Botany Vol.1 and 2. 2015. NCBA Publisher.
4. Bendre and Kumar. Practical Botany Vol.1 and 2. 2018. Rastogi Publications.

Reference Books:

3. Internet : https://www.biodiversitylibrary.org/item/90703#page/3/mode/1up.
4. Pandey.B.P. Modern Practical Botany Vol. 1, 2, 3. 2011. S.Chand Publication.

MINOR SUBJECT: PLANT IDENTIFICATION AND HERBARIUM TECHNIQUES
Subject Code: BOT142M102, COURSE LEVEL: 100
L-T-P-C: 0-0-6-3, Credit Units: 03
SCHEME OF EVALUATION: Practical (P)

Course objective: To impart practical knowledge on various plant identification systems, their preservation and utilization.

Learning Outcomes: At the end of the course the student will be:

CO1	**Identify, describe,** and practice different methods of plant identification systems	BT 2 & 3
CO2	**Categorise** different techniques used in preservation and utilize its knowledge in various field application	BT 4

Detailed Syllabus:

Module	**Course content**	**Lecture hours**

I	**Plant identification:** Introduction, ways of identification, importance of plant identification. **Tools of identification:** Expert determination, Herbarium, taxonomic literature (Floras, Manuals, Monographs, Icones, Journals, Supporting literature), taxonomic keys, interactive keys, visual keys, Computers in identification, molecular plant identification, How to identify Trees, Shrubs and herb plants; limitations of current identification methods.	**22**
II	**Plant nomenclature:** History of organized nomenclature, International Code of Nomenclature (ICN)- ranks of taxa, publication of names, principle of priority, exceptions of principles of priority, valid publication, changes of names, rejection of names, name of hybrids, name of cultivated plants; Role of morphology in plant identification.	**22**
III	**Herbarium:** Introduction, definition, history, objective, herbarium sheet, types of herbaria, importance, major herbaria in the world and India. **Herbarium techniques:** Preparation for collection, field equipment, kinds of field works, what to collect, how to collect, field notebook, pressing, drying, poisoning, mounting, labelling, identification/determination, incorporation, maintenance.	**22**
IV	**Techniques for special types of plants:** Aquatic plants, cane, bamboo, succulents, rhizomatous plants, resinous plants, algae, wild mushrooms and bryophytes; **Digital/virtual herbarium**: Introduction, aims and objectives, importance and few important digital herbaria of India. **Practicals/ Project based on the syllabus.**	**24**
Total		**90**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • FIELD VISITS • SAMPLE COLLECTION • HERBARIUM PREPARATION & SUBMISSION

Textbooks:

1. Simpson, M. G. 2006. Plant Systematics. Elsevier, Amsterdam
2. Rao and Jain 1976. A Handbook of Field and Herbarium methods
3. Singh, G. 2012. Plant Systematics- Theory and Practice. Oxford and IBH Publishing Co Pvt Ltd, New Delhi
4. Sharma and Sharma 2007. Taxonomy. Pragati Prakashan, Meerut

Reference Books:

1. Anderson, N. O., and J. D. Walker. 2003. Effectiveness of Web-based versus live plant identification tests. Horttechnology 13:199-205.
2. Dirr, M. A. 1998. Manual of Woody Landscape Plants: Their Identification, Ornamental Characteristics, Culture, Propagation and Uses. Stipes Publishing, Champaign, IL
3. Kahtz, A. W. 2000. Can computer assisted instruction be used by students for woody plant identification. Horttechnology 10:381-384.

DETAILED SYLLABUS OF 3RD SEMESTER

MAJOR SUBJECT: PLANT TAXONOMY, MORPHOLOGY, & ANATOMY
Subject Code: BOT142M301, COURSE LEVEL: 200
L-T-P-C=4-0-0-4, Credit Units: 04
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To introduce the students to the different tissue systems in angiosperms and their morphology, how they function and the theories of root and shoot development.

Learning Outcomes: After the successful completion of the course the students will be able to:

Course Outcome	Course Content	Bloom taxonomical hierarchy level
CO1	**Recognize** the various tissue organization of the plant body	BT1
CO2	**Identify** and **describe** various angiospermic families based on their features. **Describe** the development and functions of various tissue systems inside the plant body.	BT2
CO3	**Differentiate** between stem and root based on internal organization	BT3
CO4	**Correlate** between flower morphology and methods of reproduction in angiosperms	BT4

Detailed Syllabus

Modules	**Course content**	**Lecture hours**
I	**Introduction and organization of plant body:** **Morphology of Stem**: Characteristics, and Modifications of stem **Morphology of Roots**: Characteristics and Modifications of roots	**15**
II	**Morphology of Leaf:** Characteristics and Modifications of leaf; Phyllotaxy. **Morphology of Flower:** Flower as a modified shoot, morphology of stamen and carpel.	**15**
III	**Shoot and Root:** Organization of shoot and root apex (Apical cell theory, Histogen theory, Korper-Kappe theory, Tunica Corpus theory); Quiescent centre. Anatomical features of monocot and dicot stem and root. **Secondary growth** in dicot and monocot stem. Anomalous secondary growth**.** **Anatomy of Leaf:** Structure of dicot and monocot leaf anatomy.	**15**
IV	**Angiosperm Taxonomy:** Aims of taxonomy, History of classification- Artificial, Natural (Bentham and Hooker), Phylogenetic (Engler & Prantl, Hutchinson, Takhtajan), APG system- a brief idea; **Distinguishing features of the following families:** Magnoliaceae, Brassicaceae, Fabaceae, Malvaceae, Cucurbitaceae, Euphorbiaceae, Apiaceae, Rubiaceae, Solanaceae, Acanthaceae, Verbenaceae, Lamiaceae, Asteraceae. Arecaceae, Musaceae, Zingiberaceae, Orchidaceae, Poaceae.	**15**
Total		**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

Textbook:

1. B.P. Pandey. Plant Anatomy. 2001. S. Chand Publication.
2. Evert, R.F. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. 2006. John Wiley and Sons, Inc.
3. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rdedition.

Reference Books:

1. Annie Ragland. Fundamentals Of Plant Anatomy and Microtechniques. 2016. Saras Publication.
2. Charles B. Beck. An introduction to plant structure and development (plant anatomy for 21st century). (2nd edition). 2010. Cambridge University Press.
3. James D. Mauseth. Plant Anatomy. 2008. The Blackburn Press.
4. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
5. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. 2002. Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
6. Katherine Esau. Anatomy Of Seed Plants.2006. Wiley Publications.
7. Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper and Row, New York.

MAJOR SUBJECT: PLANT MORPHOLOGY, ANATOMY & TAXONOMY - PRACTICAL
Subject Code: BOT142M312, COURSE LEVEL: 200
L-T-P-C=0-0-8-4, Credit Units: 04
SCHEME OF EVALUATION: Practical only (P)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To impart practical knowledge on various group of angiosperms, have a clear concept on cellular structure of plants by microscopic observation, have a hands-on experience on economically important plant parts used, and do microchemical tests to observe the molecules present there.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	Recognize and recall the various tissue organization of vascular plants.	**BT1**
CO2	Identify and describe various anatomical structures of plant bodies.	**BT2**
CO3	Apply knowledge to explain the economic importance of various plants.	**BT3**
CO4	Analyze and correlate the morphological features, anatomical structures, and economic importance of various plant families through practical lab and field experiences.	**BT4**

Detailed Syllabus

Module	**Course content**	**Lecture hours**

I	1. Morphological features of flowers and special types of inflorescences	**22**
II	2. Preparation of temporary and permanent slides of stained T.S. and L.S. of: • monocot and dicot stem • monocot and dicot root 3. Adaptive anatomy in xerophytes and hydrophytes.	**22**
III	4. Study of floral characters of the following families (Minimum 5 subject to availability of any one specimen from each family): • Brassicaceae –*Brassica/Rorippa* • Apiaceae - *Coriandrum / Foeniculum* • Rubiaceae – *Ixora/Hedyotis* • Asteraceae - *Vernonia/Ageratum/ Eclipta/Mikania* • Solanaceae - *Solanum nigrum/Solanum indicum* • Lamiaceae - *Salvia/Ocimum* • Acanthaceae – *Justicia/Phlogocanthus* • Euphorbiaceae - *Euphorbia hirta/E.milii/E. pulcherrima* • Musaceae - *Musa* • Poaceae - *Triticum/Avena/Oryza*	**24**
IV	5.Field visits (Local) 6. Mounting of a properly dried and pressed specimen of plant specimens with herbarium label (to be submitted in the record book).	**22**
Total		**90**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • FIELD VISITS • SAMPLE COLLECTION • HERBARIUM SUBMISSION

Reference Books:

1. Santra S. Practical Botany Vol.1 and 2. 2015. NCBA Publisher.
2. Bendre and Kumar. Practical Botany Vol.1 and 2. 2018. Rastogi Publications.
3. Pandey B.P. Modern Practical Botany Vol. 1, 2, 3. 2011. S. Chand Publication.
4. Internet : https://www.biodiversitylibrary.org/item/90703#page/3/mode/1up.

MINOR SUBJECT: ETHNOBOTANY
Subject Code: BOT142N301, COURSE LEVEL: 200
L-T-P-C=4-0-0-4, Credit Units: 04
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To introduce the students to the various ways plants are used in a particular culture and region, to present its scope as an interdisciplinary science and its relevance in modern times.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recall** various traditional methods of medical treatments in various communities of India	**BT1**
CO2	**Describe** the traditional knowledge of prominent tribes of Assam.	**BT2**
CO3	**Apply** ethnobotanical knowledge to identify and categorize the use of plants by different communities.	**BT3**
CO4	**Analyze** the applications of ethnomedicine in modern pharmaceutical systems.	**BT4**

Detailed syllabus:

Module/ Experiment	Topic/ Course content	Lecture hours
Theory		
I	Basic concept of society, community and groups, Characteristics and of rural communities, Scope and Importance of botany in Rural Economy and Employment Generation, Importance in food and nutritional security, Ecotourism.	**12**
II	Ethnobotany in North -east India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany.	**12**
III	Ethnomedicine, ethnoecology, ethnic communities of NE India. Application of natural products to certain diseases - Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases	**12**
IV	Herbs used by dominant communities of Assam- Bodo, Tiwa, Karbi, Garo and Rabha in their day-to-day life.	**12**
Total		**48**

CREDIT DISTRIBUTION

LECTURE/TUTORIAL	PRACTICALS	EXPERIENTIAL LEARNING
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

References:

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain (ed.) Glimpses of Indian Ethnobotany, Oxford and I B H, New Delhi – 1981
3. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
4. Internet based latest research papers.

SEC: FLORICULTURE
Subject Code: BOT142S321, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: The student will learn the techniques of floriculture, the economic importance of different plants used in floriculture and the commercial aspect of floriculture.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recognize** field-based application on flower cultivation and marketing.	**BT1**
CO2	**Identify** gardening techniques for different flowers	**BT2**
CO3	**Demonstrate** methods of propagation and maintenance of flowers.	**BT3**
CO4	**Analyze** factors affecting flower production and methods to prolong vase life.	**BT4**

Detailed Syllabus:

Module	**Content**	**Lecture hours**
I	Importance and scope of floriculture and landscape gardening, Types of gardens, garden elements, styles of gardening, famous gardens in India and abroad, principles of gardening.	**9**
II	Ornamental plants, flowering annuals, herbaceous perennials, divine vines, shade and ornamental trees, ornamental bulbous and foliage plants, cacti and succulents, palms and cycads, ferns and selaginellas, cultivation of plants in pots, indoor gardening, bonsai.	**9**
III	Methods of propagation of flowers, sexual and vegetative methods of propagation, soil sterilization, seed sowing, pricking, planting and transplanting, shading, defoliation, wintering, mulching, topiary, role of plant growth regulators, maintenance of cut flowers	**9**
IV	Commercial floriculture, factors affecting flower production, production and packaging of cut flowers, flower arrangements, methods to prolong vase life, cultivation of important cut flowers (Carnations, Asters, Chrysanthemum, Dahlia, Gerbera, Gladiolus, Marigold, Rose, Lilium, Orchids). Mode of transportation and preservation of loose and cut flowers.	**9**
Total		**36**

Projects based on the syllabus such as:

1. Digital album of world-famous gardens.

2. Development of model gardens in RGU campus.

3. Exhibition of floral arrangements of both fresh and dry flowers.

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

DETAILED SYLLABUS OF 4TH SEMESTER

MAJOR SUBJECT: MICROBIOLOGY & MYCOLOGY
Subject Code: BOT142M401, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To introduce and develop basic concepts to the world of microbes focusing on the diversity and fundamental biological processes of bacteria, viruses & Fungi.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recall** the physical dimensions, forms, functions, and habitats of bacteria, plant & animal viruses, the ecological role of fungi, and the biotechnological application of certain species of all three groups.	**BT2**
CO2	**Describe** the differences between micro and macro forms of life and their value-addition to the environment.	**BT2**
CO3	I**llustrate** the differences between the antagonistic and beneficial roles of bacteria, viruses & Fungi in the plant kingdom	**BT3**
CO4	**Analyze** the diversity, applications, and significance of microbial and fungal species in biotechnology, industry, and agriculture.	**BT4**

Detailed Syllabus

Module	Course content	Lecture hours
I	**Introduction to microbial world**: Introduction to microbial world, microbial nutrition, growth and metabolism. **Viruses**: Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus(T-phage), lytic and lysogenic cycle; RNA virus (TMV). Economic importance of viruses	**12**
II	**Bacteria**: Discovery, general characteristics, types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts), cell structure, nutritional types, reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). Economic importance of bacteria.	**12**
III	**Introduction to fungi:** Introduction to true fungi, Affinities with plants and animals; Cell wall composition; Nutrition; Classification. General account of Chytridiomycetes, Zygomycota, Ascomycota Basidiomycota and Oomycota: Heterokaryosis and parasexuality.	**12**
IV	**Allied Fungi:** General characteristics; Status of Slime moulds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies. **Symbiotic associations**: Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization. Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance. **Applied Mycology:** Role of fungi in biotechnology, Application of fungi in industries and Agriculture (Biofertilizers)	**12**
Total		**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

SUGGESTED READINGS:

Textbooks:

1. Dubey, R.C. and Maheshwari, D.K. (1999). A textbook of Microbiology, S. Chand & Company Ltd., New Delhi, India
2. Pelczar, M.J. Microbiology. 2005.Tata McGraw-Hill Co, New Delhi
3. Tortora G.J., Funke B.R., Case C.L., Weber D and Bair W. Microbiology: An Introduction (13th Edition). 2018. Pearson Publisher.

Reference books:

2. Wiley, J.M., Sherwood, L.M. and Woolverton C.J., Prescott. Microbiology. 2017. McGraw Hill International.
3. Madigan M.T., Martinko J.M., Bender K.S., Buckley D.H., Stahl D.A., Brock T. Brock Biology of Microorganisms (14th Edition). 2014. Pearson Publisher.
4. Harvey R.A. and Cornelissen C.N. Lippincott Illustrated Reviews: Microbiology (Lippincott Illustrated Reviews Series) Third, North American Edition. 2012. LWW; Third, North American edition.

MAJOR SUBJECT: GENETICS & PLANT BREEDING
Subject Code: BOT142M402, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To acquaint the students with the basics of plant genetics and heredity.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recall** Mendel's laws and the chromosomal basis of inheritance.	**BT2**
CO2	**Describe** the basis of inheritance and variation caused by mutations and aberrations.	**BT2**
CO3	**Evaluate** the techniques to create new varieties with a set of desired characteristics. **Apply** genetic principles to predict outcomes and evaluate techniques for creating new plant varieties.	**BT3**
CO4	**Analyze** various plant breeding techniques and their roles in crop improvement.	**BT4**

Detailed syllabus:

Modules	**Topics / Course content**	**Periods**

I	History, branches, and applications of genetics. Mendelism: Mendel's laws of inheritance – Law of dominance, law of segregation and law of independent assortment. Monohybrid crosses and Dihybrid crosses. Deviation from Mendel's law: Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy. Penetrance and Expressivity, Polygenic inheritance	**12**
II	Extranuclear inheritance and maternal effect. Chromosomal aberrations: Numerical and structural aberrations. Significance of chromosomal aberration in crop improvement. Mutations: types and causes: Spontaneous and induced mutation.	**14**
III	Fine structure of gene: Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism. Population and evolutionary genetics: Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, genetic drift. Genetic variation and Speciation.	**10**
IV	Principles and objectives of Plant Breeding: Domestication and centers of origin of cultivated plants. Plant introduction and Selection methods: mass, pure line and clonal selection. Hybridization and its types; emasculation. Heterosis, hybrid vigor, role of polyploidy in plant breeding and crop improvement.	**12**
Total		**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

SUGGESTED READINGS:

Textbooks:

1. Sundarraj D and Thulasidas, G. 1972. Introduction to cytogenetics and Plant Breeding (III Edn.) Popular Book Depot. Madras.
2. Karp, G. 1996. Cell and Molecular Biology. John Wiley and Sons Inc. New York, Singapore.
3. Singh, B.D., 2005. Plant Breeding, principles and methods (7th Revised and enlarged edition). Kalyani publishers, New Delhi.

Reference books:

1. Russell, P.J. and Gordey, K., 2002. *IGenetics* (No. QH430 R87). San Francisco: Benjamin Cummings.
2. Chahal, G.S. and Gosal, S.S. 2002. Principles and procedures of plant Breeding. Narosa Publishing House. New Delhi.

3. George M. M., 2005. Freifelder's Essentials of Molecular Biology. 4th edition. Narosa Publishing House, New Delhi.
4. George W. Burns, 1969. The Science of Genetics. An introduction to heredity. The Macmillan company. New York.
5. Gardener, J, Simmons, H.J and Snustad, D.P. 1991. Principles of Genetics (8th edition), John Wiley & Sons, New York.
6. Darbeshwar Roy, 2012. Plant breeding - A biometrical Approach. Narosa Publishing House, New Delhi.

MAJOR SUBJECT: TRADITIONAL MEDICINAL PLANTS OF INDIA
Subject Code: BOT142M403, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To impart knowledge on the traditional methods of using medicinal plants in India and also introducing to the students the basic concept of ethnobotany.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recall** the history, scope, and importance of medicinal plants and their uses in indigenous medical systems.	**BT1**
CO2	**Explain** the conservation strategies for endangered and endemic medicinal plants.	**BT2**
CO3	**Apply** knowledge of ethnobotany and folk medicines to identify and describe the medicinal uses of plants in various ethnic communities.	**BT3**
CO4	**Analyze** the applications of ethnomedicine in modern pharmaceutical systems and the significance of case studies from North East India.	**BT4**

Detailed syllabus:

Modules	Topic/ Course content	Lecture hours
I	**History, Scope and Importance of Medicinal Plants:** Ethnobotanical uses of indigenous medicinal plants, indigenous medical systems- Ayurveda and Siddha.	**10**
II	**Conservation of Endangered and Endemic Medicinal Plants:** Introduction to endemic and endangered medicinal plants, red list criteria; In situ and Ex situ conservation strategies of indigenous medicinal plants. Herbal gardens.	**10**
III	**Ethnobotany and Folk medicines:** Examples of ethnobotanically important plants of North East India. Paleo-ethnobotany. Folk medicines ethnic communities of India. Use of natural products for treatment of - jaundice, cardiac ailments, infertility, diabetes, hypertension and skin diseases.	**09**
IV	**Ethnomedicine in NE India**: Case Studies.	**07**
Total		**36**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**

60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

SUGGESTED READINGS:

Textbooks:

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.
3. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
4. S.K. Jain (ed.) Glimpses of Indian Ethnobotany, Oxford and I B H, New Delhi – 1981
5. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
6. Internet based latest research papers.

MAJOR SUBJECT: MICROBIOLOGY, MYCOLOGY, GENETICS & PLANT BREEDING-PRACTICAL
Subject Code: BOT142M414, COURSE LEVEL: 200
L-T-P-C=0-0-6-3, Credit Units: 03
SCHEME OF EVALUATION: Practical (P)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To impart practical knowledge on various groups of archegoniates, have a clear concept on cellular structure of plants by microscopic observation, have a hands-on experience on economically important plant parts used, and do microchemical tests to observe the molecules present there.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recall** and perform basic microbiological techniques such as sterilization, culture preparation, and Gram staining.	**BT1**
CO2	**Describe** and **explain** cell division processes, including mitosis and meiosis, and prepare related slides.	**BT2**
CO3	**Apply** genetic principles to solve genetic problems and understand gene interactions.	**BT3**
CO4	**Analyze** and **demonstrate** plant breeding techniques, including hybridization and field studies of fungal diversity.	**BT4**

Detailed syllabus:

Module	Course content	Lecture hours
I	1. Sterilization techniques. 2. Preparation of culture media. 3. Preparation of pure culture and slants. 4. Isolation and streaking techniques. 5. Gram staining: Curd and root Nodule **6. Lichens:** Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates.	**24**

II	7. Preparation of temporary slides of certain fungi subjected to availability. 8. *Agaricus*: Specimens of button stage and full-grown mushroom; sectioning of gills of *Agaricus*.	**24**
III	9. Study of cell division – Mitosis in onion root tips, stages of meiosis from permanent slides. 10. Genetic problems based on theory syllabus – monohybrid, dihybrid, test cross and gene interaction, gene interaction *viz.* co-dominance, complementary and supplementary genes, epistasis. 11. Photographs of Inversion bridge, Laggards, Polytene and Lampbrush chromosome.	**22**
IV	12. Field visit to understand fungal diversity and their habitat 13. Hybridization techniques - Emasculation, Bagging and tagging.	**20**
Total		**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • SAMPLE COLLECTION • VIVAVOCE • FIELD VISITS

MINOR SUBJECT: ECOLOGY, ENVIRONMENT AND BIODIVERSITY CONSERVATION
Subject Code: BOT142N401, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course Objectives: The aim of the course is to build up the knowledge among the students about the biodiversity of India and world and different conservation strategies used for preserving the biodiversity.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recall** and **describe** the basic concepts of ecology, environment, and biodiversity.	**BT1**
CO2	**Explain** and **classify** biodiversity, its types, status, hotspots, and conservation status.	**BT2**
CO3	**Apply** knowledge to **identify** and categorize plants under different categories of threat.	**BT3**
CO4	**Analyze** and **evaluate** strategies for biodiversity conservation and the role of various organizations and policies	**BT4**

Detailed Syllabus:

Module	**Course content**	**Lecture hours**
I	**Ecology:** Definition, types and importance of ecology. Characteristics of population, population size and exponential growth, population dynamics, life history pattern, fertility rate and age structure. Competition and coexistence, intra and inter specific interactions, mutualism and commensalism, prey-predator interactions.	**9**

	Food chain, food webs, energy flow through ecosystem.	
II	**Environment:** Introduction to Environmental Science and Sustainability, Environmental laws; Environmental Stresses and their management, climate change and global warming, atmospheric ozone. Environmental pollutants- air, water, and soil pollution, Bioindicator and biomarkers of environmental health. Biodegradation and bioremediation. Environmental issues, policies, and regulations	**9**
III	**Introduction to biodiversity**: Biodiversity – types, levels, threats, value and uses; distribution and gradients of biodiversity. Biodiversity hotspots with special emphasis on Indian hotspots. **Measures of Biodiversity:** Alfa, Beta and Gamma diversities – Indices of diversity and evenness. **Causes and Consequences of Biodiversity Loss**	**9**
IV	**Introduction to Conservation**: Biodiversity – assessment, conservation and management, Types of conservation. Conservation strategies. Red and Blue Data Book. Role of organizations in the conservation of biodiversity – IUCN, WCED, UNEP, NBPGR, CBD. Biodiversity act of India and related international conventions. Status of biodiversity conservation in India. Sustainable development, natural resource management in changing environment.	**9**
Total		**36**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • CASE STUDIES • VIVAVOCE

Textbooks:

1. Krishnamurthy, K.V. 2017. A textbook of Biodiversity, CRC Press.
2. Sharma, P. D. (2009). Ecology and Environment, Rastogi Publications, Meerut, India

Reference Books:

1. Bharucha, F.R. A textbook of plant geography of India, Oxford University Press, 179 pages
2. Cain, S.A. 1944. Foundations of Plant Geography, Harper & Brothers, N.Y.
3. Schulze E. D., et al. 2010. Plant Ecology. Springer.
4. Chapman, J. L. and Reiss, M. J. (1992). Ecology – Principles and Applications, Cambridge University Press, Cambridge, UK

MINOR SUBJECT: BIORESOURCE MANAGEMENT
Subject Code: BOT142N402, COURSE LEVEL: 200
L-T-P-C=2-0-1-3, Credit Units: 03
SCHEME OF EVALUATION: Theory & Practical (TP)

Prerequisite: Basic knowledge of biology of class XII.

Course Objective: Gain knowledge and skills to effectively manage and sustainably utilize biological resources for various purposes, including conservation, economic development, and environmental stewardship.
Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recall** the principles and concepts of bioresource management, including the sustainable use and conservation of biological resources.	**BT1**
CO2	**Explain** the significance, threats, and management strategies related to biodiversity and biological resources.	**BT2**
CO3	**Apply** analytical and problem-solving skills to assess and manage bioresources in various contexts, considering ecological, economic, and social factors.	**BT3**
CO4	**Evaluate** the impacts of human activities on bioresources and develop strategies to mitigate negative effects and promote sustainable resource management	**BT4**

Detailed Syllabus:

Module	Course content	Lecture hours
I	**Biological Resources:** Biodiversity-definition and types; Significance; Threats; Management strategies; Bio-prospecting; IPR; CBD; National Biodiversity Action Plan). Forest types. Forest products – Major and minor. Consequence of deforestation and industrialization. Sustainable use of bioresources.	**12**
II	**Energy, Contemporary practices in resource management:** Renewable and non-renewable sources of energy, EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management. National and international efforts in resource management and conservation.	**12**
III	**Acts and policies:** Forest Conservation Act 1981; Environment (protection) Act 1986; Hazardous waste (Management and Handling) Rules 1989; Bio-Medical Waste (Management and Handling) Rules 1998; Environmental Impact Assessment (EIA); Environmental Management Plan (EMP) and Environmental Clearance for Establishing Industry (ECEI); National Biodiversity Act 2002.	**12**
IV	**Practical:** 1. Estimation of solid waste generated by a domestic system (biodegradable and non-biodegradable) and its impact on land degradation. 2. Collection of data on forest cover of specific area. 3. Ecological modeling.	**12**
Total		**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
24	12	12 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS AND SAMPLING

Suggested Readings:

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, 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.

VAC II: BIODIVERSITY, CONSERVATION & MANAGEMENT
SUBJECT CODE:
CREDIT UNITS: L-T-P-C = 2-1-0-3
SCHEME OF EVALUATION: Theory & Practical (TP)

Course Objectives:

The aim of the course is to build up the knowledge among the students about the biodiversity of India and world and different conservation strategies used for preserving the biodiversity.

Learning Outcomes:

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

CO1	**Recall** the types, levels, and value of biodiversity, and understand the distribution and gradients of biodiversity.	**BT1**
CO2	**Explain** the threats to biodiversity and the causes and consequences of biodiversity loss.	**BT2**
CO3	**Apply** knowledge of biodiversity measures and hotspot conservation to identify and categorize plants under different categories of threat.	**BT3**
CO4	**Analyse** conservation strategies, laws, and the role of organizations in biodiversity conservation, and evaluate case studies on conservation.	**BT4**

Detailed Syllabus:

Module	Course content	Lecture hours
I	**Introduction to biodiversity**: Biodiversity – types, levels, threats, value and uses; distribution and gradients of biodiversity. Biodiversity hotspots with special emphasis on Indian hotspots. Biodiversity and Ecosystem services (BES). Measures of Biodiversity: Alfa, Beta and Gamma diversities	**9**
II	**Causes and Consequences of Biodiversity Loss:** Habitat Loss and Alteration. Loss of Genetic Diversity in Crops.	**9**
III	**Introduction to Conservation**: Types of conservation. Conservation strategies, Role of organizations in the conservation of biodiversity – IUCN, WCED, UNEP, NBPGR, CBD. IUCN - Red data list.	**9**
III	**Conservation Strategies**: Laws and Legal Actions. Status of biodiversity conservation in India. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management). Case Studies on conservation	**9**
Total		**36**

Text Books:

1. Krishnamurthy, K.V. 2017. A textbook of Biodiversity, CRC Press.

2. Sharma, P. D. (2009). Ecology and Environment, Rastogi Publications, Meerut, India

Reference Books:

1. Bharucha, F.R. A textbook of plant geography of India, Oxford University Press, 179 pages
2. Cain, S.A. 1944. Foundations of Plant Geography, Harper & Brothers, N.Y.
3. Schulze E. D., et al. 2010. Plant Ecology. Springer.
4. Chapman, J. L. and Reiss, M. J. (1992). Ecology – Principles and Applications, Cambridge University Press, Cambridge, UK