Programme Bye-laws & Syllabus of B.Sc. (Hons.) in Botany

based on
CHOICE-BASED CREDIT SYSTEM (CBCS) &
CREDIT TRANSFER SYSTEM
w.e.f. Academic Session (2021-22)
Course Code: 338

REVISED IN BOS MEETING HELD ON 24.08.2021 &
APPROVED IN THE 42ND MEETING OF ACADEMIC COUNCIL HELD ON 15TH DECEMBER 2021

Department of Botany
School of Chemical & Life Sciences
JAMIA HAMDARD (Deemed to be University)
NEW DELHI – 110 062

Department of Botany

The Department of Botany, which came into existence in the year 1989, has developed strong research programmes in the fields of stress physiology, structural & developmental botany, environmental botany, plant systematics, medicinal botany, plant biotechnology and plant molecular biology. The first registration for Ph.D. dates back to 1991 while the post-graduate and under-graduate teaching programme started in 1994 and 2017 respectively leading to the award of degrees of M.Sc. & B.Sc. (Hons.). The first Ph.D. from the department was awarded in 1995 and the first batches of students were awarded M.Sc. and B.Sc. (Hons.) in 1996 and 2020 respectively. An Advanced Diploma in Environmental Monitoring and Impact Assessment is also offered by the department through distance mode of learning.

During the last **31** years, as many as **114** students have received Ph.D. degrees. The alumni of the department are noted teachers and scientists occupying important positions in Indian universities, research institutions, colleges and non-governmental organizations. The department has been acknowledged for its excellence and creativity by various funding agencies of National/ International repute.

Twenty-three research projects from various funding agencies including DBT, DST, UGC, AYUSH, IPI, CCRUM, have been successfully completed in the department. The department has received generous funding DST-FIST & UGC-SAP (DRS-I) programmes. At present the department is receiving substantial funding from DST-SERB, UGC & SERB-NPDF.

The students of department have been successfully clearing the national level exams including NET/GATE/ICMR test for JRF and have been selected in reputed institutions such as JMI, Delhi University, AMU (Aligarh), Amity University, IGNOU, Kashmir University, NIOS, DRDO, Integral University (Lucknow) etc. Besides national institutions, students of the Botany department have been enrolled in Ph.D. programmes of international universities. Moreover, students of botany have been qualifying the highest level of civil services exams including IAS, IPS, KAS.

Research at our department ranges from fundamental discovery (through integrated physiological, biochemical and molecular biology approaches) to delivery of research-based information and new technology to end users.

Thrust Areas of Research

- Understanding the physiological and molecular mechanisms of abiotic and biotic stressors
- Identification and characterization of medicinal plants and their active ingredients
- Tissue culture studies for alkaloid production, clonal multiplication and preservation of endangered species
- Characterization, diagnostics development and pathogenicity study of plant viruses
- Deciphering the plant microbe interactions in response to both pathogenic and beneficial microbes

Research Facilities

The Department has well equipped laboratories for research. The available equipments include Growth chambers, BOD incubators, Refrigerated microfuges, Laminar air flow, Shakers, Environmental shaker incubator, Double beam spectrophotometer, PCR, High speed cold centrifuge, Deep freezer (-20, -80,), IRGA (Photosynthesis System), Leaf area meters,

Flame photometer, Sliding and rotary microtomes, Gel documentation system and Nikon Phase contrast microscope with photographic attachment, Weather station attached with gas monitoring sensors, Spectrophotometers, Chlorophyll Fluorometer, Plant Canopy Analyzer, Rotavapor, Sound level meter, Gas & dust analysing system and Inverted fluorescent microscope among others. A modest Green House and an environmentally controlled Glass House is also available.

Vision

The department yearns to be a *'centre-of-excellence'* with state-of-the-art facilities for promoting holistic study of plant sciences and realizing products and processes in alignment with sustainable goal developments for the overall well-being of society.

Mission

The **mission** of the department of botany is to
MS 1: attain excellence in teaching and research in botany;
MS 2: address global issues intervened by plants through cutting-edge research, dynamic graduate and postgraduate education with exemplary outreach;
MS 3: train and develop human resources in botany by tapping their inherent potential and enriching their learning experience;
MS 4: address the global issues of food insecurity and climate change by way of translational research;
MS 5: effect *in-situ* conservation of medicinal and aromatic plants native to the NCR of Delhi in the herbal garden which is an integral part of the department;
MS 6: develop state-of-the-art facility for plant-based herbal drug identification and characterization;
MS 7: introduce relevant and tailor-made courses to address burning global issues such as climate change;
MS 8: promote public outreach programmes such as World Environment Day, World Ozone Day, Fascination of Plants Day etc;
MS 9: adopt sustainable development goals (SDGs) in teaching and research;
MS 10: develop and maintain *Green India* and promote sustainable healthy environment by adopting and implementing social programmes like *Haritha Haram;* and
MS 11: maximize the employability opportunities of maximum number of students

Qualification Descriptors

On completing B.Sc. (Honors) component of B.Sc.-M.Sc. Dual Degree Programme in Botany, the graduates will be able to	
QD 1	demonstrate scientific temperament and comprehensive knowledge and skills in areas related to both basic and applied aspects of botany;
QD 2	use knowledge and skills required for identifying problems and issues, collection of relevant quantitative and/or qualitative data, analysis and evaluation using methodologies akin to plant sciences for formulating evidence-based solutions and arguments;
QD 3	apply disciplinary knowledge and transferable skills in areas related to plant diversity, plant systematics, molecular and cell biology, genetics, plant biochemistry, plant ecology and phytogeography, plant anatomy and embryology, plant biotechnology, economic botany to new/unfamiliar contexts in order to solve complex problems with well-defined solutions;
QD 4	communicate the results of studies undertaken in the biology and biotechnology of lower and higher plants accurately in a range of different contexts using the main concepts, constructs and techniques of botany; and
QD 5	demonstrate knowledge and transferable skills in teaching, research, scientific writing, patent analysis in organizations like Kendriya Vidyalaya, Navodaya schools, ICRISAT, NIPB, NIPGR, NBPGR, CCMB etc. and meet one's own learning needs, based on research and development work and professional materials.

	MS 1	**MS 2**	**MS 3**	**MS 4**	**MS 5**	**MS 6**	**MS 7**	**MS 8**	**MS 9**	**MS 10**	**MS 11**
QD 1	3	3	3	1	3	3	3	1	3	1	1
QD 2	3	3	3	3	3	3	2	2	2	1	3
QD 3	3	3	3	3	3	3	3	2	2	1	3
QD 4	3	1	3	3	3	3	2	1	2	2	2
QD 5	3	3	3	3	1	1	1	2	2	3	3

Programme Learning Outcomes (PLOs)

On completing B.Sc. (Honors) component of B.Sc.-M.Sc. Dual Degree Programme in Botany, the graduates will be able to	
PLO 1	propose logical and novel solutions to contemporary problems/issues supported by relevant facts and data;
PLO 2	develop scientific outlook and the ability to question the existence and relevance of universally accepted scientific concepts in all aspects of life;
PLO 3	identify, formulate and analyse complex scientific problems using principles of natural and applied sciences;
PLO 4	comprehend concepts, frameworks and inventions through various learning methods and effectively communicate the same orally or in writing to the stakeholders;
PLO 5	critically analyse the given scientific data, ascribe meaning to it and draw objective conclusions;
PLO 6	demonstrate empathetic social concern, skills to effectively participate in civic affairs and democratic decision making;
PLO 7	imbibe ethical, moral and social values to become cultured and civilised global citizens;
PLO 8	apply concepts of sustainable development in daily life to carve out a socially relevant and environment friendly living; and
PLO 9	foster and develop attitude and aptitude for acquisition of multidimensional skills by way of promoting lifelong learning.

Programme Specific Outcomes (PSO's)

On completing B.Sc. (Honors) component of B.Sc.-M.Sc. Dual Degree Programme in Botany, the graduates will be able to	
PSO 1	critically analyse the trends in overall structural and functional diversity of plants ranging from simple thallophytes such as algae to complex angiosperms and evolutionary shift from aquatic to terrestrial habitats, therein and outline the nature, structure and functional role played by microorganisms and plant pathogens in Nature (cognition level: analyze);
PSO 2	appreciate the importance, structure and function of bio-macromolecules in the life of a plant and deduce the significance of their interaction(s) in the normal physiology of plants. (cognition level: analyze); explain the structure and function of organelles found in plants. (cognition level: create); trace the development of plants from egg to embryo and relate it with their fine and gross anatomy. (cognition level: evaluate);
PSO 3	describe the basic concepts underlying the science of plant taxonomy and systematics (cognition level: evaluate); stress on the concepts in plant ecology and highlight the importance of geographical distribution of plants on the Earth (cognition level: analyze);
PSO 4	comply with the molecular and genetic basis of inheritance of traits in plants (cognition level: create); extrapolate the knowledge gained in research methodology, research work, bioinformatics, bio-fertilizer and basic plant sciences for harnessing products and processes of industrial importance as in plant biotechnology (cognition level: analyze); and
PSO 5	evaluate the importance of plants in food, feed, medicine, environment, industry, society and culture (cognition level: evaluate).

Programmes for human resource development offered by the department

B.Sc. (Hons.) (Botany)

Duration: Three years [with exit option at the end of III year (Sixth semester) with B.Sc. (Hons.) in Botany]

Seats: 20

Eligibility: Senior Secondary (XII/Intermediate) with Biology/Mathematics from CBSE or any other Board recognized by JH as equivalent thereto, securing at least 50% marks or equivalent CGPA in aggregate

M.Sc. Botany

Duration: Two years (Four semesters)

Seats: 40

Eligibility: Pass in B.Sc. or equivalent examination of a recognized university with Botany/Plant Sciences as one of the subjects securing at least 50% marks in the aggregate.

Selection procedure: Selection for M.Sc. Program in Botany will be based on the merit in the qualifying examination. Qualifying exam takes into account the mean average of three years marks of B.Sc. programme. In case, where final year exam results are not declared, the average of last two years marks will be counted for provisional selection of candidates.

Ph.D. Botany

Duration: Minimum three years

Seats: As per the availability of the faculty mentors

Eligibility: As per the Ph.D. Ordinance

Selection procedure: Entrance test will be exempted for candidates who have secured fellowship. In case of candidates not possessing any fellowship, there will be entrance tests. Candidates (both with and without fellowship) will have to appear before a committee for a comprehensive interview. Admissions are held twice in a calendar year.

Faculty

Department of Botany
Dr. Shahid Umar, M.Sc., M.Phil, Ph.D., Professor & Head
Dr. Abdul Mujib, M.Sc, Ph.D., Associate Professor
Dr. Md. Salik Noorani Khan, M.Sc., Ph.D., Assistant Professor
Dr. Mohd Ashraf Ashfaq, M.Sc., Ph.D., MBA, PGDIPR, PGC in Scientific Writing, Assistant Professor
Dr. Md Iqbal Raja Khan, M.Sc., Ph.D., Assistant Professor
Dr. Noushina Iqbal, M.Sc., Ph.D., Assistant Professor (Contractual)
Dr. Peer Saffeullah, M.Sc., Ph.D., Assistant Professor (Contractual)

Structure of B.Sc. (Hons.) component of B.Sc.-M.Sc. Dual Degree in Botany under CBCS

Core Courses
BBO-CC01: Basics of Computer Science and Statistics
BBO-CC02: Basics of Chemistry
BBO-CC03: Biomolecules
BBO-CC04: Cell Biology
BBO-CC05: Immunology
BBO-CC06: Enzymes and Proteins
BBO-CC07: Diversity of microbes, algae and fungi
BBO-CC08: Archegoniate
BBO-CC09: Plant Anatomy and Embryology
BBO-CC10: Plant Molecular Biology
BBO-CC11: Plant Biotechnology
BBO-CC12: Plant Ecology and Phytogeography
BBO-CC13: Plant Systematics
BBO-CC14: Plant Metabolism

Discipline Specific Electives (*Any four*)
Plant Breeding
Bioinformatics
Stress Biology
Research Methodology
Research Project

Generic Electives (*Any four*)
Basics of Physics and Biology
Basics of Physics and Mathematics
Bioethics and Intellectual Property Rights
Biotechnology and Human Welfare
Environmental Biotechnology
Economic Botany

Ability Enhancement Compulsory Courses
BBO-AEC01: English Communication
BBO-AEC02: Environmental Studies

Skill Enhancement Elective Courses
Ethnobotany
Biofertilizer

SCHEME AND PROGRAMMEME STRUCTURE
w.e.f. 2021-22
B.Sc. (Hons.) in Botany

Course Code	Name of the Paper	Paper Category	IA	SE	Total Marks	Course Credits
SEMESTER–I						
BBO-CC01	Basics of Computer Science and Statistics	Core	25	75	100	4
BBO-CC01-TU	Basics of Computer Science and Statistics	Core	13	37	50	2
BBO-CC02	Basics of Chemistry	Core	25	75	100	4
BBO-AEC01	English Communication	AEC	13	37	50	2
BBO-AEC02	Environmental Studies	AEC	13	37	50	2
BBO-GE01-A BBO-GE01-B	Basics of Physics and Biology OR Basics of Physics and Mathematics	GE	25	75	100	4
BBO-GE01-A-TU BBO-GE01-B-TU	Basics of Physics and Biology OR Basics of Physics and Mathematics	GE	13	37	50	2
		Total	**141**	**359**	**500**	**20**
SEMESTER–II						
BBO-CC03	Biomolecules	Core	25	75	100	4
BBO-CC04	Cell Biology	Core	25	75	100	4
BBO-CC05	Immunology	Core	25	75	100	4
BBO-CC06	Enzymes and Proteins	Core	25	75	100	4
BBO-GE02-A BBO-GE02-B	Bioethics and IPR OR Biotechnology and Human Welfare	GE	25	75	100	4
		Total	**125**	**375**	**500**	**20**
SEMESTER–III						
BBO-CC07	Diversity of Microbes, Algae and Fungi	Core	25	75	100	4
BBO-CC08	Archegoniate	Core	25	75	100	4
BBO-CC09	Plant Anatomy and Embryology	Core	25	75	100	4
BBO-CC10	Plant Molecular Biology	Core	25	75	100	4
BBO-CC11	Plant Biotechnology	Core	25	75	100	4
BBO-SEC01	Ethnobotany	SEC	13	37	50	2
BBO-GE03	Environmental Biotechnology	GE	25	75	100	4
		Total	**163**	**487**	**650**	**26**
SEMESTER–IV						
BBO-CC02 PR	Basics of Chemistry	Core	13	37	50	2
BBO-CC03 PR	Biomolecules	Core	13	37	50	2
BBO-CC03 PR	Cell Biology	Core	13	37	50	2
BBO-CC05 PR	Immunology	Core	13	37	50	2
BBO-CC06 PR	Enzymes and Protein	Core	13	37	50	2
BBO-CC12	Plant Ecology and Phytogeography	Core	25	75	100	4
BBO-CC13	Plant Systematics	Core	25	75	100	4
BBO-SEC02	Choose any ONE from the list of SECs	SEC	13	37	50	2
BBO-GE04	Choose any ONE from the list of GEs	GE	25	75	100	4
BBO-GE04 PR	Choose any ONE from the list of GEs	GE	13	37	50	2
		Total	**166**	**484**	**650**	**26**
SEMESTER–V						
BBO-CC14	Plant Metabolism	Core	25	75	100	4
BBO-CC14 PR	Plant Metabolism	Core	13	37	50	2
BBO-DSE01	Choose any ONE from the list of DSEs	DSE	25	75	100	4
BBO-DSE01 PR	Choose any ONE from the list of DSEs	DSE	13	37	50	2
BBO-DSE02	Choose any ONE from the list of DSEs	DSE	25	75	100	4
BBO-DSE02 PR	Choose any ONE from the list of DSEs	DSE	13	37	50	2
BBO-DSE03	Choose any ONE from the list of DSEs	DSE	25	75	100	4
BBO-DSE03 PR	Choose any ONE from the list of DSEs	DSE	13	37	50	2
		Total	**152**	**448**	**600**	**24**

SEMESTER–VI						
BBO-CC07 PR	Diversity of Microbes, Algae and Fungi	Core	13	37	50	2
BBO-CC08 PR	Archegoniate	Core	13	37	50	2
BBO-CC09 PR	Plant Anatomy and Embryology	Core	13	37	50	2
BBO-CC10 PR	Plant Molecular Biology	Core	13	37	50	2
BBO-CC11 PR	Plant Biotechnology	Core	13	37	50	2
BBO-CC12 PR	Plant Ecology and Phytogeography	Core	13	37	50	2
BBO-CC13 PR	Plant Systematics	Core	13	37	50	2
BBO-DSE04	Research Methodology	DSE	25	75	100	6
BBO-DSE04 PR	Research Methodology	DSE	13	37	50	
	OR					
BBO-DSE05	Research Project	DSE	40	110	150	
BBO-GE02-A PR	Bioethics and IPR	GE	13	37	50	2
	OR					
BBO-GE02-B PR	Biotechnology and Human Welfare					
BBO-GE03 PR	Choose any ONE from the list of DSEs	GE	13	37	50	2
		Total	**155**	**445**	**600**	**24**
To be chosen from the List of Generic Electives Papers						

IA = Internal Assessment
SE=Semester Exams
TH = Theory
PR = Practical
TU = Tutorial; CC = Core Courses
AEC = Ability Enhancement Compulsory Courses
SEC = Skill Enhancement Courses
DSE = Discipline Specific Elective
GE = Generic Electives

List of Generic Electives from different areas

BIOLOGICAL SCIENCES (Any Three)

1. Entrepreneurship Development
2. Biotechnology and Human Welfare
3. Developmental Biology
4. Secondary Plant Metabolism
5. Post-Harvest Biotechnology
6. Stress Biotechnology
7. Biochemical Correlations in Diseases
8. Stress Biology
9. Bioethics and Biosafety
10. Bio fertilizers
11. Plant Tissue Culture
12. Reproductive Biology of Angiosperms
13. Seed science Technology
14. Bioinstrumentation
15. Bioethics and IPR
16. Pre and Post-harvest techniques of Medicinal and Aromatic plants
17. Ethnobotany

MATHS (Any Three)

1. Object Oriented Programming in C++ (P)
2. Finite Element Methods
3. Mathematical Finance
4. Econometrics
5. Cryptography and Network Security
6. Information Security
7. Applications of Algebra
8. Combinatorial Mathematics

COMPUTER SCIENCE (Any Three)

1. Computer Fundamentals (4) + Lab (4)
2. Introduction to Database Systems (4) + Lab (4)
3. Introduction to Programming (4) + Lab (4)
4. Computer Networks and Internet Technologies (4) + Lab (4)
5. Multimedia and Applications (4) + Lab (4)
6. Programming in Visual Basic / Gambas (4) + Lab (4)
7. Information Security and Cyber Laws (4) + Lab (4)
8. Web and E-Commerce Technologies (4) + Lab (4)

CHEMISTRY (FOR OTHER COURSES) (Any Three)

1. Atomic Structure, Bonding, General Organic Chemistry, Aliphatic Hydrocarbons
2. Chemical Energetics, Equilibria and Functional Organic Chemistry - I
3. Solutions, Phase Equilibria, Conductance, Electrochemistry, & Functional Group Organic Chemistry - I
4. Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics
5. Organometallics, Bio-inorganic Chemistry, Polynuclear Hydrocarbons & UV, IR Spectra
6. Quantum Chemistry, Spectroscopy & Photochemistry
7. Molecules of Life
8. Chemistry of Main Group Elements, Theories of Acids & Bases

- *Selection of GE courses will be from the list of courses to be compiled by the respective Departments in the School of Chemical and Life Sciences and recommended by the BoS of the respective departments. A list of GEs as listed in the UGC curricula has been provided for ready reference.*
- *A Generic elective will be taught when more than 30% of students in the B.Sc- M.Sc. Programme opt for it.*

Rules and Regulations of the Programme

1. Programme of Study: B.Sc.(Hons.) Programme

B.Sc.-M.Sc. Dual Degree Programme shall be offered in the following subjects

- Biochemistry
- Biotechnology
- Botany
- Chemistry
- Clinical Research
- Toxicology

The courses (papers) in the first two semesters will be the same across all the programmes of study in the school.

2. Programme Code: Each programme shall be denoted by three-digit code as follows

- Biochemistry
- Biotechnology
- Botany 338
- Chemistry
- Clinical Research
- Toxicology

3. Programme Abbreviation: Each course of the programme shall be given a course number which shall be preceded by a three-letter abbreviation identifying the discipline as follows

- Biochemistry
- Biotechnology
- Botany BBO
- Chemistry
- Clinical Research
- Toxicology

All these are regular full-time programmes.

4. Outline of CBCS Scheme

- **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
- **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures candidate's proficiency/skill is called an Elective Course.
- **Discipline Specific Elective (DSE) Course**: Elective courses may be offered by the main discipline/subject of study and are referred to as Discipline Specific Elective.
- **Dissertation/Project**: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate

studies such a course on his own with an advisory support by a teacher/faculty member is called Dissertation/Project.

- **Generic Elective (GE) Course**: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.
- **Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course:** The Ability Enhancement Courses (AECs) are the courses based upon the content that lead to knowledge enhancement. They include Environmental Science and. English/MIL Communication which are mandatory for all disciplines.

The Core, Discipline Specific and Generic Elective Courses shall be abbreviated as follows:

Core Course	:	CC
Discipline Specific Elective	:	DSE
Generic Elective	:	GE
Ability Enhancement Courses	:	AEC
Skill Enhancement Courses	:	SEC

These abbreviations shall precede the course number of each course of the programme.
During an academic year, a candidate who is enrolled in the B.Sc. (Hons.) Programme, shall not be allowed to enroll for any other full-time programme of study and shall not appear in any other examination of a full-time course of this or any other university.

5. Duration: 3+2 Years

B.Sc-M.Sc. Dual Degree Programme is a 3+2 years full time academic programme of study spread over 6+4 semesters. Every year, the new session commences in July. The session for the 6+4 semesters are as under.

B.Sc.

Semester I	(1 year)	August-December (Odd Semester)
Semester II	(1 year)	January-May (Even Semester)
Semester III	(2 year)	August-December (Odd Semester)
Semester IV	(2 year)	January-May (Even Semester)
Semester V	(3 year)	August-December (Odd Semester)
Semester VI	(3 year)	January-May (Even Semester)

M.Sc.

Semester I (1 year)	August-December (Odd Semester)
Semester II (1 year)	January-May (Even Semester)
Semester III (2 year)	August-December (Odd Semester)
Semester IV (2 year)	January-May (Even Semester)

The number of working days in a semester shall not be less than 90 days.

The candidate will have the option to exit after 3 years with B.Sc. (Hons.) degree in the chosen subject.

6. Medium of instruction and examination: English

7. Eligibility for admission

Eligibility: A candidate seeking admission to the BSc-MSc Dual Degree Programme must have passed Senior Secondary (12 / Intermediate) examination with Biology /Mathematics from CBSE or any other Board recognized by Jamia Hamdard (JH) as equivalent thereto, securing at least 50% marks or equivalent CGPA in aggregate.

Selection procedure: Selection will be based on merit of qualifying examination.

8. Programme Structure

a. The programme, as approved by the Board of Studies of the respective Departments of the School and reviewed regularly, shall be divided into not less than 14 theory and practical core courses having 04 and 02 credits each. The programme will have two ability enhancement courses of 2 credits each. The student will have to undertake two Skill enhancement elective courses of 02 credits each along with 04 discipline specific and 04 generic electives of 06 credits each in the first six semesters. Each discipline specific and generic elective will have 04 credits assigned to theory component and two credits to either tutorial or practical component.

b. In Semester I and II, there will be common courses in basic subjects like Physics, Mathematics, Statistics, Computer Science, Biology and Chemistry across all the programmes.

c. A minimum of 02 credits and a maximum of 04 credits shall be assigned for each theory paper and 02 credits for each practical course. The lab work may also include a report or industrial visit.

d. One theory credit will be counted as 1 hour of contact per week, and two practical credits will be counted as 4 hours of contact per week.

e. There shall be no less than 20 credits and no more than 26 credits for each semester. This includes the lab work also.

f. The contents of each theory course shall be divided into four units. All the units shall preferably have equal teaching hours

9. Attendance

a) 100% attendance is desirable, but 75% attendance is mandatory in each paper for a student to enable him/her to appear in the Semester examination. In unforeseen contingencies, on the recommendation of the Dean of the School, 5% relaxation in attendance may be considered. This 5% shortage condoning may be on account of sickness, provided the medical certificate, duly certified by a Registered Medical Practitioner/Public Hospital had been submitted in the office of the Head of the Department at the time of re-joining the classes, immediately after the recovery from illness. The Head of Department shall forward such cases along with all related documents to the Dean. The relaxation should not be considered as the right of the student.

b) In order to maintain the attendance record of a particular course, a roll call will be taken by the teacher in every scheduled lecture and practical class. For the purpose of

attendance, each practical class will count as one attendance unit, irrespective of the number of contact hours. Attendance on account of participation in the prescribed and notified activities such as NCC, NSS, Inter-university sports, educational tours/field work, shall be granted provided the participation of the student is duly verified by the officer-in-charge and is sent to the Head of the Department within two weeks of the function/activity etc.

c) The subject teacher shall consolidate the attendance record for lectures and practicals at the end of each month and submit to the Head of the Department. At the end of the semester, the teacher shall consolidate the attendance record for the whole semester and submit it to the Head of the Department. The statement of attendance of students shall be displayed by the Head of the Department on the Notice Board/University Website. A copy of the same shall be preserved as record. Attendance record displayed on the Notice Board/University Website shall deem to be a proper notification for the students and no individual notice shall be sent to any student.

d) If a student is found to be continuously absent from the classes without any information for a period of 30 days, the concerned teacher shall report the matter to the Head of the Department who in turn will then report the matter to the Dean for appropriate action that may include striking off the name of such student(s) from the roll. Such a student may, however, apply for readmission within 7 days from the date of issue of the notice of striking off the name from the rolls. The request for re-admission may be considered by the Dean of the School. Such a student shall not be eligible for re-admission after the prescribed period of 7 days. The re-admission shall be effected only after the payment of prescribed re-admission fee.

e) The cases of students with less than 70% attendance may be forwarded to the Vice-Chancellor through Dean for considering these cases to further condone the attendance shortage as a special case.

f) A student detained on account of shortage of attendance in any semester shall be readmitted to the same class in the subsequent academic year on payment of prescribed fees applicable in that year to complete the attendance requirement of that programme.

10. Internal assessment

a) The performance of the student in each paper will be evaluated both continuously (Internal Assessment) and at the end of semester (Semester Examination). 25% marks for each theory paper will be allocated for internal assessment and 75% marks will be kept for semester end examination.

b) For the evaluation of the lab work, laboratory notebook, practical test/viva voce shall be taken into account. The marks shall be awarded by the respective teacher conducting the practical course. For sessional tests, discontinuance of classes will not be permitted and the teacher may take the test in his/her scheduled class. Under the compelling circumstance such as sickness of the student or mourning in the family, the candidate may be given another chance. For sickness only, a credible medical certificate issued by a hospital shall be considered. In case of casualties, a letter from the parents would be required.

c) Evaluation of tutorials will be done by conducting a written test or viva. Weightage shall also be given to the attendance in the tutorials.

11. Semester examination

a) Semester examination shall be held at the end of each semester as per schedule given in the Academic Calendar of the School.

b) Up to a maximum of seven days preparatory holidays may be given to the examinees before the start of the semester examinations.

c) There shall be not less than two theory courses and one lab course in each semester, except the 4 Semester. The detailed contents of the courses of studies shall be prescribed by the respective Board of Studies and shall be reviewed regularly.

d) Each theory paper having 04 credits shall be of 100 marks out of which 75% marks shall be for semester examination and 25% marks for internal assessment.

e) Each practical paper having 02 credits shall be of 50 marks out of which 75% marks shall be for semester examination and 25% marks for internal assessment.

f) The question paper for each theory paper shall have five questions. There shall be one question from each of the 4 units of the course and one question shall contain objective type/short answer questions covering all the units of the course. The candidate shall have to answer all the five questions. There shall, however, be internal choice within a unit. The choice shall be given by setting alternative questions from the same unit. The question paper should be such that it covers all the topics of that course.

g) The duration of the semester examination of a theory course shall be three hours. Practical exams of a lab course shall be of at least four hours duration. The practical examination shall be conducted by an internal and external examiner.

h) The question paper for semester examinations shall be set either by the external examiner or an internal examiner. The Board of Studies of the department shall draw a panel of names of examiners, both internal and external, for approval by the Vice Chancellor/Dean. If the external examiner is unable to send the question paper by the deadline set by the examination branch of the University, the dean after consultation with the examination branch shall get the paper set internally by a faculty. The papers set by the examiners can be moderated by a moderation committee. Teachers appointed on contractual basis with appointment of less than one academic session, and temporary as well as ad-hoc teachers may not ordinarily be appointed as examiners. All such teachers, however, will be expected to assist in the practical examination.

i) The botanical tour/educational tour shall be organized in the vacations. The final year students shall participate as per the University rules and regulations.

12. Choice Based Credit System (CBCS)

Definitions of keywords

a) **Academic Year:** Two consecutive (one odd + one even) semesters constitute one academic year.

b) **Choice Based Credit System (CBCS):** The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses).
c) **Course:** Usually referred to as 'paper', a 'course' is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory.
d) Work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/term papers/assignments/ presentations/ self-study etc. or a combination of some of these.
e) **Credit Point:** It is the product of grade point and number of credits for a course.
f) **Credit:** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.
g) **Cumulative Grade Point Average (CGPA):** It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.
h) **Grade Point:** It is a numerical weight allotted to each letter grade on a 10-point scale.
i) **Letter Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.
j) **Programme:** An educational programme leading to award of a degree, diploma or certificate.
k) **Semester Grade Point Average (SGPA):** It is a measure of performance of work done in a semester. It is the ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.
l) **Semester:** Each semester will consist of 15-18 weeks of academic work equivalent to not less than 90 actual teaching days. The odd semester may be scheduled from July to December and even semester from January to May.
m) **Transcript or Grade Card or Certificate:** Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.

13. Semester System and Choice Based Credit System

The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning. The credit-based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice-based credit system provides a 'Cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

14. Types of Courses

The courses in a programme may be of three kinds according to CBCS: Core, Elective and Foundation

15. Classification of Result

a) Two methods - relative grading or absolute grading- have been in vogue for awarding grades in a course. The relative grading is based on the distribution (usually normal distribution) of marks obtained by all the students of the course and the grades are awarded based on a cut-off marks or percentile. Under the absolute grading, the marks are converted to grades based on predetermined class intervals. To implement the following grading system, the colleges and universities can use any one of the above methods.

b) Following grading system with a 10-point scale shall be followed to represent performance of students in the examination.

Letter Grade*	**Grade Point****
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

***Letter Grade**: It is an index of the performance of students in a said course. Grades are denoted by letters viz, O, A+, A, B+, B, C, P and F.

****Grade Point**: It is numerical weight allotted to each letter grade on a 10-point scale.

Converting the marks into letter grades

Letter Grade	**Grade Point**	**Range of Percentage of Marks**
O (Outstanding)	10	90 and above 100 (90 -100)
A+ (Excellent)	9	80 and above and less than 90 (80<90)
A (Very Good)	8	70 and above and less than 80 (70<80)
B+ (Good)	7	65 and above and less than 70 (65<70)
B (Above Average)	6	55 and above and less than 65 (55<65)
C (Average)	5	50 and above and less than 55 (50<55)
P (Pass)	4	40 and above and less than 50 (40<50)
F (Fail)	0	00 and above and less than 40 (00<40)
Ab (Absent)	0	--

A student obtaining Grade 'F' shall be considered failed and will be required to reappear in the examinations.

Computation of SGPA and CGPA

As per UGC norms, the following procedure will be adopted to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all courses taken by a student and the number of credits of all the courses undergone by a student.

SGPA (Si) = ∑ (Ci x Gi) / ∑Ci where Ci is the number of credits of the ith course and Gi is the Grade point scored by the student in the ith course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e. CGPA = ∑ (Ci x Si) / ∑Ci where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Formula for Conversion of CGPA into Marks percentage

The percentage equivalent to the CGPA shall be obtained by using the following formula:

Equivalent percentage of CGPA = CGPA x 10

14. Criteria for award of CGPA

The result of successful candidates who fulfill the criteria for the award of M. Sc. shall be categorized after the IV semester, on the basis of his/her CGPA.

Award of division/class shall be done on the basis of following criteria

Range of CGPA	**Division/Class**
CGPA of 7.50 and above and upto 10	1st Division with Distinction
CGPA of 6.00 and above and less than 7.50	I Division
CGPA of 5.00 and above and less than 6.0	II Division
CGPA of 4.00 and above and less than 5.00	III Division

19. Promotion

a) Promotion from I semester to consecutive semesters shall be automatic. However, pre-registration is compulsory to move to a new semester.

b) A student shall be promoted from II to III semester and from IV to V semester of the programme provided that student has passed 50% papers of I and II semester taken together or III and IV semesters taken together, including practical and tutorial papers.

c) Students who do not fulfil the promotion criteria as given above shall be declared failed in the part concerned. However, they shall have the option to retain the marks in the papers in which they have secured Pass marks.

d) A student who has to reappear in a paper prescribed for Semester I/III/V may do so only in the Semester examinations to be held in November/December and a student who has to reappear in a paper prescribed for Semester II/IV/VI may do so only in the examinations to be held in April/May.

e) A candidate will be given a total number of 3 attempts, inclusive of the first attempt, to clear the papers in which he/she fails. The promotion to the next higher class will be considered subject to rules relating to passing the I and II /III and IV semester examinations within two academic years.

f) The award of degree shall be subject to successful completion of all the requirements of the programme of study within six years from admission.

g) A detained student is not allowed to reappear in sessional tests.

h) The minimum marks required to pass any paper in a semester shall be 40% in theory and in practical. The student must secure 40% in the End Semester Examination and 40% in the aggregate (End Semester Examination & Internal Assessment) of the paper for both theory and practical separately.

i) In case of VI semester, a student can appear in a supplementary examination in all backlog papers after declaration of their final semester results.

20. Classification of successful candidates

The result of successful candidates who fulfil the criteria for the award of B.Sc. (Hons.) after the VI semester shall be classified, on the basis of his/her CGPA of all the six semesters. The classification shall be done on the basis of following criteria:

. He/she will be awarded "I Division" if his/her final CGPA is 6.75 or above.
a. He/she will be awarded "II Division" if his/her final CGPA is 6 or above but less than 6.75.
b. He/she will be awarded "Pass" if his/her final CGPA is 5 or above but less than 6.
c. He/she will be treated as "fail" if his/her final CGPA is less than 5.

21. Span period

(a) I and II Semester Exams: Within two years from the first admission to the programme

(b) All requirements of B.Sc. (Hons.) degree within a total period of **six years** from the date of their first admission.

23. Improvement

A candidate, with Grade C, D or E, who wishes to improve the previous performance will be allowed to do so after the declaration of the result of VI semester as per the following regulation:

- A student shall be allowed only once to reappear in the semester examination of up to six theory courses along with regular students of that semester to improve upon the previous performance. The examination fee which will be charged from such candidates shall be double the current examination fee.

- Such a student shall inform the Head of the Department in writing of his/her intention to improve performance, two months before the date of semester examination to be held.

- If the student improves the performance, he/she shall be required to submit the earlier mark-sheet/degree. A new mark-sheet and degree bearing the year in which the student improved the grade shall be issued.

- In case, the grade obtained in improvement is lower than the one obtained earlier, the higher grade shall prevail.

24. Conduct and discipline

- Disciplinary policies of Jamia Hamdard are put in place to promote civility on campus and to ensure a secure and academically enriching environment.

- Students are expected to show personal integrity, respect for university resources and respect for others' rights.

- Students are expected to adhere to the rules and regulations of the University. Any violation will be handled according to the rules set forth in the disciplinary policies of the university.

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC01/ BBO-CC01-TU**

Title of the Course : **Basics of Computer Science and Statistics (Theory/Tutorial)**

Credits : **4+2**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**30**, **P=0**

Course Objectives

The course aims to provide basic knowledge of computers. Students will be introduced to hardware and software of computers. Students will also be introduced to commonly used software in research. Students will also learn basic concepts in information technology. In this course, students will be taught basic skills of statistics. This will allow them to develop analytical thinking and will also provide knowledge of statistical methods for critical evaluation of data.

Course Learning Outcomes (CLOs)

On completing this course, the students should be able to

CLO 1: Explain the basics of computer operations, concepts and terminology of statistics (understand);

CLO 2: recognize both hardware and software of a computer system (understand);

CLO 3: apply understanding of the use of computers for various applications (apply);

CLO 4: relate basic statistical methods to solve problems (analyze);

CLO 5: operate various statistical software packages (apply); and appreciate the importance of statistics in research (evaluate)

Mapping of Course Learning Outcomes (CLOs) with Programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO1				3										
CLO2				3										
CLO3			3					3						
CLO4			3											
CLO5									3					

Each CLOs may be mapped with one or more PLOs. Write '3' in the box for high-level mapping, '2' for medium level mapping and '1' for low-level mapping. Map with PSOs wherever applicable.

Detailed Syllabus

Unit-I: Elements of Computer Systems (L=15)

Computer: Definition, Characteristics, Hardware & Software, Computer Organization. Operating Systems: Multi-tasking, Multi programming, Multiuser. Types of Operating System: MS-Windows, Unix/Linux, Mac OS. Database Models: Network, Hierarchical, Relational, Object Oriented. MS-Office: MS-Word, MS-Excel, MS-Power Point, MS-Access.

Unit-II: Information Technology (L=15)

Elements of Computer Network. Network Topologies: Ring, Bus, Star, Mesh, Hybrid. Internet, Intranet, WWW, URL, Email, HTTP, HTML, Website, Portal, Web Browser, E-Commerce, IP Address. Issues and Threats of Cyber & Information Security: Virus, Worms, Trojan, Malware, Ransom ware, Anti-Virus, Basics of Computer Trouble Shooting.

UNIT-III: Statistics (L=15)

Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis. Probability classical & axiomatic definition of probability, Theorems on total and compound probability, Elementary ideas of Binomial, Poisson and Normal distributions.

UNIT-IV: Advanced Statistics (L=15)

Confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA) Correlation and Regression. Emphasis on examples from Biological Sciences.

Reference Books:

1. Rajaraman V., Adabala, Neeharika, "***Fundamentals of Computer***" 6th ed., PHI
2. Sinha & Sinha, "***Computer Fundamentals***", 6th ed., BPB Publications
3. Kahate A., "***Introduction to Database Management System***", Pearson's Education
4. Norton P, "***Introduction to Computers***", Mc Graw Hills
5. Online Tutorial, Jone L. & Curtis F., "***Microsoft Office 2016: Step by Step***", Microsoft Press
6. Le CT. ***Introductory Biostatistics***. 1st edition, John Wiley, USA
7. Glaser AN. ***High Yield TM Biostatistics***. Lippincott Williams and Wilkins, USA
8. Edmondson A and Druce D. ***Advanced Biology Statistics***, Oxford University Press.
9. Danial W. ***Biostatistics***: ***A foundation for Analysis in Health Sciences***, John Wiley
10. M.V.Ismail. ***Biostatistics***, Ist Edition, Laxmi ublication Pvt. Ltd.

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

Assessment methods for tutorials: The internal tutorial sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC02**

Title of the Course : **Basics of Chemistry (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course aims to provide basic knowledge of chemistry which is indispensable for an understanding of the several biomolecules and the way they interact to affect life processes in a plant. Thus, a sound understanding of basic principles of chemistry is required for appreciating biochemistry of plants.

Course Learning Outcomes (CLOs)

On completing this course, the students should be able to
CLO 1: understand molecular structures and associated bonds (understand);
CLO 2: analyze concepts of energy transductions and transformations (analyze);
CLO 3: apply basic principles of organic chemistry (apply);
CLO 4: illustrate molecular conformations and stereochemistry (analyze); and
CLO 5: critically analyze chemical information, synthesize the information, and present the information to a technical audience (analyze)**.**

Mapping of Course Learning Outcomes (CLOs) with Programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO1		3									3			
CLO2			3											
CLO3			3					3	3					
CLO4		2												
CLO5					3									

Detailed Syllabus

Unit-I: Chemical Bonding and Molecular Structure Ionic Bonding (L=15)

Lattice energy and solvation energy. Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, Covalent Bonding: VB Approach, Lewis theory, VSEPR theory to explain the shapes of molecules, salient features of the Valence bond (VB) theory and the concept of hybridization, MO Approach: limitations of the VB approach, salient features of the MO theory. Rules for the LCAO method, bonding and anti-bonding MOs and their characteristics for s-s-, s-p and p-p combinations of atomic orbitals, nonbonding combinations of orbitals MO treatment of homonuclear diatomic molecules of 1st period and heteronuclear diatomic molecules such as CO, HF.

Unit-II: Chemical Thermodynamics (L=15)

Qualitative idea of thermodynamics. First Law of Thermodynamics: Calculation of work (w), heat (q), changes in internal energy (ΔE) and enthalpy (ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w,q, ΔE, and ΔH for processes involving changes in physical states. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formation, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature Kirchhoff's equation. Second law of thermodynamics, concept of entropy, Gibbs free energy and Helmoltz free energy. Calculations of entropy change and free energy change for reversible and irreversible processes under isothermal and adiabatic conditions. Criteria of spontaneity, Gibbs Helmholtz equation. Maxwell's relations. Statements of Third Law of thermodynamics: calculation of absolute entropies of substances.

Unit-III: Fundamentals of Organic Chemistry (L=15)

Hybridization in organic compounds, cleavage of covalent bond, homolysis and heterolysis, Electronic effects: Electronic effects and their applications inductive, resonance and hyperconjugation effects. Structure and relative stability of reactive carbon species – carbocations, carbanions, free radicals and carbenes, Molecular Forces: types of intermolecular and intra-molecular forces and their characteristics: dipole-dipole, dipole induced dipole and dispersion (London) forces. Hydrogen bond (both intramolecular and intermolecular), Effect of inter/intramolecular forces on physical properties such as solubility, vapour pressure, melting and boiling points of different compounds, Aromaticity.

Unit-IV: Stereochemistry (L=15)

Stereochemistry and its importance. Geometrical isomerism, cis-trans and E/Z nomenclature Optical isomerism – optical activity, plane polarized light, enantiomerism, chirality, specific molar rotation, Stereoisomerism with two chiral centres: Diastereomers, mesoisomers,

Resolution of racemic modification. Projection diagrams of stereoisomers: Fischer, Newman and Sawhorse projections. Relative Configuration: D/L designation. Absolute Configuration: R/S designation of chiral centres, Conformational isomerism – ethane, butane and cyclohexane, diagrams and relative stability of conformers.

Reference Books:

1. J.D.Lee: ***A New Concise Inorganic Chemistry***, E.L.B.S.
2. P.W. Atkins: ***Physical Chemistry***, Oxford University Press
3. R.T. Morrison & R.N. Boyd: ***Organic Chemistry***, Prentice Hall
4. James E.Huheey etal. : ***Inorganic Chemistry: Principles of Structure and reactivity***
5. Mann, F.G. & Saunders, B.C. ***Practical Organic Chemistry***, Pearson Education
6. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. ***Practical Organic Chemistry***, *5th Ed.*, Pearson

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Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-AEC01**

Title of the Course : **English Communication (Theory)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Objectives

The course aims to train students to be more effective at communicating successfully in interviews, public speaking, letter writing, report writing, presentations, and inter-personal debates and conversations. The learner also imbibes the fundamentals of communication and the art of persuasive speaking and writing which depends crucially on clarity of thought and contextual understanding expressed through appropriate vocabulary.

Course Learning Outcomes (CLOs)

On completing this course, the students will be able to
CLO 1: identify deviant use of English both in written and spoken forms (remember);
CLO 2: recognize the errors of usage and correct them and write simple sentences without committing errors of spelling and grammar (understand);
CLO 3: understand and appreciate English spoken by others (understand and evaluate);
CLO 4: understand the importance of reading for life and develop an interest for reading (understand and create); and
CLO 5: understand the importance of writing in academic life and career (understand).

Mapping of Course Learning Outcomes (CLOs) with Programme Learning Outcomes (PLOs) and Programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO1					3									

CLO2				3										
CLO3						3								
CLO4									3					
CLO5				3										

Detailed Syllabus

UNIT – 1 (L=15)

Introduction: Theory of Communication, Types and modes of Communication

Language of Communication: Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication

Speaking Skills: Monologue, Dialogue Group Discussion, Effective Communication/ Mis-Communication Interview, Public Speech

UNIT – 2 (L=15)

Reading and Understanding: Close Reading, Comprehension, Summary Paraphrasing, Analysis and Interpretation, Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts

Writing Skills: Documenting, Report Writing, Making notes, Letter writing

Reference Books:

1. ***Fluency in English - Part II***, Oxford University Press.
2. ***Business English***, Pearson.
3. ***Language, Literature and Creativity***, Orient Blackswan.
4. ***Language through Literature*** (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

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Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End semester examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-AEC02**

Title of the Course : **Environmental Studies (Theory)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Objectives

The objective of this course is to provide basic concepts of environment, ecology, natural resources, importance of biodiversity and need for its conservation along with various environmental issues and Government policies and movements.

Course Learning Outcomes (CLOs)

On completing this course, the students will be able to
CLO 1: identify the concepts related to the environmental global scenario (remember);
CLO 2: comprehend the natural resources and environmental organizations (understand);
CLO 3: apply the acquired knowledge to sensitize individuals and public about the environmental crisis (apply);
CLO 4: analyze the causes and changes in the structure of biodiversity (analyze); and
CLO 5: enhance their skills in the society by solving the environmental problems and preserving nature by the acquired knowledge (evaluate).

Mapping of Course Learning Outcomes (CLOs) with Programme Learning Outcomes (PLOs) and Programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1			3									3		
CLO 2				3								3		
CLO 3								3				3		
CLO 4					3							3		
CLO 5								3	3			3		

Detailed Syllabus

UNIT – 1: The multidisciplinary nature of environmental studies (L=03)

Definition, scope and importance, Need for public awareness.

UNIT – 2: Natural resources: Renewable and non-renewable resources (L=07)

a) Natural resources and associated problems
- Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests, and tribal people.

- Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.
- Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers- pesticides problems, water logging, salinity, case studies.
- Energy Resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies
- Land Resources: Land as a resource, land degradation, man induced landslides, soil erosion, and desertification.

b) Role of individual in conservation of natural resources.
c) Equitable use of resources for sustainable life styles.

UNIT – 3: Ecosystems (L=06)

- Concept of an eco-system
- Structure and function of an eco-system.
- Producers, consumers, decomposers.
- Energy flow in the eco systems.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following eco systems:
- Forest ecosystem
- Grass land ecosystem
- Desert ecosystem.
- Aquatic eco systems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT – 4: Biodiversity and its conservation (L=07)

- Introduction-Definition: genetics, species and ecosystem diversity.
- Biogeographically classification of India.
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, national and local level.
- India as a mega diversity nation.
- Hot-spots of biodiversity.
- Threats to biodiversity: habitats loss, poaching of wild life, man wildlife conflicts.
- Endangered and endemic spaces of India.
- Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT – 5: Environmental pollution (L=07)

- Definition Causes, effects and control measures of:
  a. Air pollution
  b. Water pollution
  c. Soil pollution
  d. Marine pollution
  e. Noise pollution
  f. Thermal pollution
  g. Nuclear hazards
- Solid waste Management: Causes, effects and control measures of urban and
- industrial wastes
- Role of an individual in prevention of pollution

- Pollution case studies
- Disaster management: Floods, earth quake, cyclone and land slides

Reference Books:

1. ***Textbook of Environmental studies***, Erach Bharucha, UGC
2. ***Fundamental concepts in Environmental Studies***, D D Mishra, S Chand & Co Ltd

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Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End semester examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-GE01-A/BBO-GE01-A-TU**

Title of the Course : **Basics of Physics and Biology (Theory/Tutorial)**

Credits : **4+2**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**30**, **P=0**

Course Objectives

The aim of the course is to provide basic concepts in physics. The natural laws of physics have shaped the evolution of all bodies, both human and non-human. As a result of this, biologists need to understand physics in order to understand how the human body works. The course also provides basic concepts in biology. This portion will help students coming from diverse backgrounds.

Course Learning Outcomes (CLOs)

On completion of this course, the student will be able to
CLO 1: review the basic principles of motion (understand);
CLO 2: outline the components of electromagnetic spectrum (analyze);
CLO 3: describe the principles of waves (understand);
CLO 4: outline the classification of plants and animals (analyze); and
CLO 5: infer basic principles in physiology of plants and animals, concepts in genetics and cell structure and function (understand).

Mapping of Course Learning Outcomes (CLOs) with Programme Learning Outcomes (PLOs) and Programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3										
CLO 2				3										
CLO 3				3										
CLO 4				3						3		3		
CLO 5				3							3			

Detailed Syllabus

SECTION A: BASICS OF PHYSICS (02 CREDITS)

UNIT – 1 (L=15)

a) Oscillations: Periodic motion, time period, frequency, Simple Harmonic Motion (SHM) and its equations, phase, restoring force, Kinetic Energy and Potential Energy in SHM.
b) Electromagnetic waves: Electromagnetic Spectrum, Electromagnetic waves and their characteristics, Maxwell's Equations

UNIT – 2 (L=15)

a) Interference due to division of amplitude and division of wave fronts, Young's double slit Experiment, Principle of Superposition, Theory of Biprism, Newtons' Rings.

b) LASER: Introduction, Temporal and Spatial Coherence, Principle of LASER, Stimulated and spontaneous emission. Einstein's Coefficients, He-Ne Laser, Ruby Laser, Applications of Lasers.

SECTION B: BASICS OF BIOLOGY (02 CREDITS)

UNIT – 3 (L=15)

a) **Animal and Plant Kingdom**

Salient features and classification of plants into major groups - Algae, Bryophyta, Pteridophyta, Gymnospermae and Angiospermae. Salient features and classification of animals, non-chordates up to phyla level and chordates up to class.

b) **Cell-The Unit of Life**

Cell as the basic unit of life: Structure of prokaryotic and eukaryotic cells; Plant cell and animal cell; Cell envelope, cell membrane, cell wall; Cell organelles - structure and function. Elementary idea of cell cycle, mitosis, meiosis and their significance.

c) **Biomolecules**

Chemical constituents of living cells: biomolecules, structure and function of proteins, carbodydrates, lipids, nucleic acids.

UNIT – 4 (L=15)

a) Human and Plant Physiology

Plant: basic concepts of transport, photosynthesis, respiration and reproduction in higher plants.

Human: Basic concepts of digestion and absorption; respiration, body fluids and circulation; excretion, nervous system, and reproduction.

b) **Basic Principles of Inheritance and Variation**

Mendelian Inheritance; Deviations from Mendelism-Incomplete dominance, Co-dominance, Multiple alleles and Inheritance of blood groups, Pleiotropy; Elementary idea of polygenic inheritance; Chromosome theory of inheritance; Chromosomes and genes

Reference Books:

1. Ajoy Ghatak, ***Optics***, TMH
2. D.S.Mathur, ***Mechanics***
3. Griffith, ***Electrodynamics***
4. Brij Lal and Subramaniyam, ***Optics***

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

Assessment methods for tutorials: The internal tutorial sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc.(Hons.)**

Course Code : **BBO-GE01-B/ BBO-GE01-B-TU**

Title of the Course : **Basics of Physics and Mathematics (Theory/Tutorial)**

Credits : **4+2**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**30**, **P=0**

Course Objectives

The aim of the course is to provide basic concepts in physics. The natural laws of physics have shaped the evolution of all bodies, both human and non-human. As a result of this, biologists need to understand physics in order to understand how the human body works. The course also provides basic concepts in math. Mathematics plays a key role in many disciplines of science, primarily as a mathematical modelling tool. New innovations and developments in physics are by the influence of mathematics.

Course Learning Outcomes (CLOs)

On completion of this course, the student will be able to
CLO 1: review the basic principles of motion (understand);
CLO 2: outline the components of electromagnetic spectrum (analyze);
CLO 3: describe the principles of waves (understand);
CLO 4: indicate basic concepts in matrices and determinants (understand); and
CLO 5: analyze the principles of differentiation and integration (analyze).

Mapping of Course Learning Outcomes (CLOs) with Programme Learning Outcomes (PLOs) and Programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3										
CLO 2				3										
CLO 3				3										
CLO 4				3										
CLO 5					3									

Detailed Syllabus

SECTION A: BASICS OF PHYSICS (02 CREDITS)

UNIT – 1 (L=15)

Oscillations: Periodic motion, time period, frequency, Simple Harmonic Motion (SHM) and its equations, phase, restoring force, Kinetic Energy and Potential Energy in SHM.

Electromagnetic waves: Electromagnetic Spectrum, Electromagnetic waves and their characteristics, Maxwell's Equations

UNIT – 2 (L=15)

Interference due to division of amplitude and division of wave fronts, Young's double slit Experiment, Principle of Superposition, Theory of Biprism, Newtons' Rings.

LASER: Introduction, Temporal and Spatial Coherence, Principle of LASER, Stimulated and spontaneous emission. Einstein's Coefficients, He-Ne Laser, Ruby Laser, Applications of Lasers.

SECTION B: BASICS OF MATHEMATICS (02 CREDITS)

UNIT – 1: **Matrices and Determinants** (L=15)

Matrices: Concept, notation, order, equality, types of matrices, zero and identity matrix, transpose of a matrix, symmetric and skew symmetric matrices. Operation on matrices: Addition and multiplication and multiplication with a scalar. Simple properties of addition, multiplication and scalar multiplication.

Determinants: Determinant of a square matrix (up to 3 x 3 matrices), properties of determinants, minors, co-factors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix.

UNIT – 2: Calculus (L=15)

Continuity and Differentiability: Continuity and Derivative, derivative of composite functions, chain rule, derivative of implicit functions. Concept of exponential and logarithmic functions.
Derivatives of logarithmic and exponential functions. Logarithmic differentiation, derivative of functions expressed in parametric forms. Second order derivatives.

Integrals: Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts, Evaluation of simple integrals of the following types and problems based on them. Definite integrals as a limit of a sum, Basic properties of definite integrals and evaluation of definite integrals.

Differential Equations: Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given.

Reference Books:

1. Ajoy Ghatak, ***Optics***, TMH
2. D.S.Mathur, ***Mechanics***
3. Griffith, ***Electrodynamics***
4. Brij Lal and Subramaniyam, ***Optics***

Teaching – Learning Strategies in brief

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Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

Assessment methods for tutorials: The internal tutorial sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC03**

Title of the Course : **Biomolecules (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course aims to provide students with an understanding of biomolecules, the basic building blocks of living organisms, focusing on their structural underpinnings, unique properties, biological roles, functions and interrelationships. The course will outline the importance of water as a biological solvent and vitamins as vital ingredients of life. Emphasis will be on the association between structure and function of various biomolecules at a chemical interface with a biological perspective as well as hands-on approach.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO 1: understand the molecular and chemical foundations of life and appreciate the role of water in biological systems (understand);

CLO 2: comprehend the structure, function and acid base properties of amino acids (understand);

CLO 3: analyze the structure, properties and roles of carbohydrates, lipids and nucleic acids (analyze);

CLO 4: recognize the importance of vitamins in biological systems (understand); and

CLO 5: identify and differentiate between various biomolecules in the laboratory (analyze).

Mapping of Course Learning Outcomes (CLOs) with Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3							3			
CLO 2				3							3			
CLO 3				3							3			
CLO 4				3							3			
CLO 5			3								3			

Detailed Syllabus

UNIT – 1: Introduction to Biomolecules (L=15)

Introducing carbohydrates, proteins, fats. Biochemistry and its scope, physicochemical properties of water, weak interactions in aqueous systems, ionization of water, water as a reactant, buffers, fitness of the aqueous environment, structure and classification of amino acids, physical and chemical properties of amino acids.

UNIT – 2: Carbohydrates (L=15)

Characteristic features of sugars. Monosaccharides-structure of aldoses, ketoses, conformation of sugars, anomers, epimers, enantiomers, conformation of sugars, mutarotation, structure of biologically important sugar derivatives, disaccharides: formation, structure, reducing, non-reducing disaccharides. Polysaccharides: classification and function. Structure and function of glycoproteins and proteoglycans. Carbohydrates as signals.

UNIT – 3: Lipids (L=15)

Classification of fats, structure of fatty acids, triacylglycerol and waxes. Membrane lipids-glycerophospholipids, galactolipids, sphingolipids, sterols: types, structure and function of membrane lipids, gangliosides and lipopolysaccharides. Plant steroid, lipids as signals.

UNIT – 4: Nucleic acids and Vitamins (L=15)

Nucleotides, nucleosides-structure, properties, Nucleic acids: Deoxyribonucleic acid and Ribonucleic acid, Watson and Crick model of DNA, structure and function of messenger RNA, ribosomal RNA, transfer RNA, nucleic acid chemistry: UV absorption, physicochemical properties of DNA, nucleotides: energy source, coenzyme components, second messengers. Vitamins: classification, active forms, deficiency disorders, symptoms, hypervitaminosis.

Reference Books:

1. Nelson, D.L. & Cox, M.M.. ***Principles of Biochemistry, 5th Edn.,*** W.H. Freeman & Company.
2. Berg, M.J., Tymockzo, J.L. & Stryer, L. ***Biochemistry, 6th Edition***, W.H. Freeman & Company.
3. Wood. E.J. & Pickering, W.R. ***Introducing Biochemistry***. John Murray, London.
4. Nelson, D.L. & Cox, M.M. ***Lehninger: Principles of Biochemistry***, 6th Edn, W.H. Freeman and Company, New York.
5. Devlin, T.M. ***Textbook of Biochemistry with Clinical Correlations***, 7th Edn, John Wiley & Sons, New York.

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC04**

Title of the Course : **Cell Biology (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The objective of this paper is to offer insights into the basic structure and function of cell and organelles. The course also aims to impart understanding of cell cycle, cell death, cell renewal processes and various techniques in cell biology.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: discuss cell theory and basic cell structure (understand);
CLO 2: explain various tools and techniques in cell biology (evaluate);
CLO 3: relate the structure with the function of various cell organelles in an eukaryotic cell (evaluate);
CLO 4: express knowledge about the composition of cytoskeleton and extracellular matrix (understand); and
CLO 5: examine mechanisms of cell division and cell death (analyze).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3							3			
CLO 2		3									3			
CLO 3			3								3			
CLO 4				3							3			
CLO 5					3						3			

Detailed Syllabus

UNIT – 1: Introduction to cell biology, structure of different cell organelles (L=15)
Prokaryotic (Achaea and eubacteria) and eukaryotic cell (animal and plant cells), cells as experimental models, structure of nuclear envelope, nuclear pore complex, ER structure, Organization Golgi, Lysosome. Structure and function of mitochondria, chloroplast and peroxisomes, Zellweger syndrome.

UNIT – 2: Tools of cell biology (L=15)

Light microscopy, phase contrast microscopy, fluorescent microscopy, confocal microscopy, electron microscopy, FACS, centrifugation for sub cellular fractionation.

UNIT – 3: Cell wall, extracellular matrix and cytoskeletal protein (L=15)

Prokaryotic and eukaryotic cell wall, cell matrix protein, cell matrix interaction and cell to cell interaction, Adherence j unction, tight junctions, gap junction, desmosomes, hemidesmosomes, focal adhesion and plasmodesmata. Structure and organization of actin filaments, treadmilling and role of ATP in microfilament polymerization, organization of actin filament. Non muscle myosin, intermediate filament proteins, assembly and intracellular organization. Assembly, organization, and movement of cilia and flagella.

UNIT – 4: Cell cycle, cell death and cell renewable (L=15)

Eukaryotic cell cycle, restriction point, checkpoints. Cell division, Apoptosis and necrosis-brief outline. Salient feature of transformed cell.

Reference Books:

1. Becker, W.M., Kleinsmith, L.J., Hardin, J., Bertoni, G. P. ***The World of the Cell, 7th edition***. San Francisco, Cambridge: Pearson Benjamin Cummings Publishing
2. Cooper, G.M., Hausman, R.E. ***The Cell: A Molecular Approach, 5th edition***. Washington, D.C.: ASM Press & Sunderland, Sinauer Associates, MA.
3. Karp, G. ***Cell Biology, 6th edition***. New Jersey, U.S.A.: John Wiley & Sons.
4. Majumdar, R., Sisodia, R. ***Laboratory Manual of Cell Biology, with reference to Plant Cells***. New Delhi, Delhi: Prestige Publication.
5. Reven, F.H., Evert, R.F., Eichhorn, S.E. ***Biology of Plants***. New York, NY: W.H.Freeman and Company.
6. Lodish, H., Berk, A. Zipursky, S.L., Matsudaira, P., Baltimore, D. & Darnell, J. ***Molecular Cell Biology***, 7th Edn., W.H. Freeman & Company, New York.
7. Alberts, B., Johnson, A., Lewis, J. & Enlarge, M. ***Molecular Biology of the Cell***, 5th Edn., Garland Science (Princeton).

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

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Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC05**

Title of the Course : **Immunology (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

This course describes the molecular and cellular basis of the development and function of the immune system. The course provides the basic framework in immunology that will cover the major topics including innate and adaptive immunity, antibodies and antigens, molecular events leading to the generation of antibody, humoral and cell-mediated adaptive immune response, hypersensitivity, self-tolerance, autoimmunity and vaccines.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO 1: explain the cellular constituents of the immune system including cells, organs and receptors (apply);

CLO 2: describe the structure & functions of different classes of Immunoglobulins and mechanisms of antibody diversity (understand/evaluate);

CLO 3: sketch the players and processes involved in mediating an immune response - humoral and cell mediated (apply);

CLO 4: elaborate the mechanisms of tolerance, autoimmunity and transplantation (understand); and

CLO 5: relate and apply the concepts of immunology learnt in translational research (evaluate).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3										
CLO 2				3										
CLO 3					3									
CLO 4				3										
CLO 5								3						

Detailed Syllabus

UNIT – 1: (L=15)

Cells and organs of the immune system: Hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT).

Innate immunity and leucocyte extravasation: Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, cell adhesion molecules, chemokines, leukocyte extravasation, localized and systemic response.

Immunogens and antigens: Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes.

UNIT – 2: (L=15)

Antibody structure and function: Structure and distribution of classes and subclasses of immunoglobulins (lg), lg fold, Effector functions of antibody, antigenic determinants on lg and lg super family.

Complement system: Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies.

Generation of receptor diversity: Dreyer-Bennett hypothesis, multigene organization of lg locus, mechanism of V region DNA rearrangement, ways of antibody diversification.

UNIT – 3: Biology of B lymphocyte (L=15)

Antigen independent phase of B cell maturation and selection, humoral response T-dependent and T-independent response, anatomical distribution of B cell populations.

MHC complex cind antigen presentation: General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, linkage disequilibrium, pathways of antigen processing and presentation.

UNIT – 4: (L=15)

Biology of the T lymphocyte: Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation.

Cell mediated cytotoxic responses: General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC).

Tolerance, autoimmunity and hypersensitivity.

Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, Gell and Coombs classification, lgE mediated (Type I) hypersensitivity.

Reference Books:

1. Kindt, T.L., Goldsby, R.A. & Osborne, B.A. ***Kuby Immunology***, 6th Edn., W.H. Freeman Company, New York.
2. Coico, R. & Sunshine, G. ***Immunology: A Short Course***, 6th Edn., Jonh Wiley & Sons, New Jersey.
3. Murphy, K., Mowat, A. & Weaver, C.T. ***Janeway's Immunobiology***, 8th Edn., Garland Science (London & New York.)

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-GE01-B**

Title of the Course : **Enzymes and Proteins (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The objective of the course is to provide detailed knowledge about enzymes, the biological catalysts with remarkable properties that sustain life. The course also aims to outline the diverse applications of enzymes in disease diagnosis and therapy as well as in industry. Further, it introduces "proteins" and stresses on their importance in modern biochemistry, highlighting their structural features and unique characteristics that help them participate in most of the physiological processes.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO 1: explore the nature, importance and methods of isolation and analysis of proteins in living systems (understand);

CLO 2: appreciate the importance of structural diversity and levels of organization of proteins (evaluate);

CLO 3: outline the mechanism of enzyme catalyzed reaction and the kinetics involved (analyze);

CLO 4: appreciate enzyme inhibition and regulation of enzymes (evaluate);

CLO 5: estimate the applications of enzymes in diagnostics, therapy and industry (evaluate).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3										3			
CLO 2		3									3			
CLO 3				3							3			
CLO 4				3							3			
CLO 5								3			3			

Detailed Syllabus

Unit – 1: Proteins: Introduction, isolation and analysis (L=15)
Polypeptides and proteins. Subunit structures, conjugated proteins, diversity of function. Techniques to isolate and analyze proteins- salt fractionation, ion-exchange chromatography, gel permeation, HPLC, SDS-PAGE, and IEF. Protein primary structure - sequencing by Edman degradation, use of enzymes and chemical reagents to obtain overlap peptides. Synthesis of peptides using Merrifield method.

UNIT – 2: Introduction to protein three-dimensional structures (L=15)
Secondary structure- helices and sheets, Ramachandran maps. Nature of non-covalent bonds and covalent bonds in protein folding. Tertiary and quaternary structures. Oxygen binding curves, cooperativity models for hemoglobin.

UNIT – 3: Introduction to enzyme catalysis and kinetics (L=15)
Features of enzyme catalysis, superior catalytic power. General mechanisms of catalysis. Nomenclature. Principles of reaction rates, order of reactions and equilibrium constants. Derivation of Michaelis-Menten equation. Significance of Km and Vmax. Catalytic efficiency parameters. Competitive and mixed inhibitions. Kinetics and diagnostic plots. Types of irreversible inhibitors.

UNIT – 4: Mechanisms of enzyme action and regulation (L=15)
Mechanism of action of chymotrypsin. Inhibitors of enzymes - antibiotics. Regulation of enzyme activity and its importance - aspartate transcarboxylase. Enzymes used in clinical biochemistry as reagents, diagnostics and therapy. Role of immobilized enzymes in industry.

Reference Books:

1. Nelson, D.L. & Cox, M.M. ***Lehninger: Principles of Biochemistry***, 6th Edn, W.H. Freeman and Company, New York.
2. Price, N.C. & Stevens, L. ***Fundamentals of Enzymology***, 3rd Edn., Oxford University Press Inc, New York.

Teaching – Learning Strategies in brief

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Assessment methods and weightages in brief

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Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-GE02-A**

Title of the Course : **Bioethics and IPR (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

Through this course, students will learn the significance and framework of intellectual property rights and understand the protocols of patenting. Students will also learn the importance of biosafety protocols and bioethics. This course helps to adhere to the ethical practices appropriate to the discipline and to adopt safe working practices relevant to the bioindustries and field of research.

Course Learning Outcomes (CLOs)

On completion of this course, the students will be able to
CLO 1: gain awareness about Intellectual Property Rights (IPRs) and take measures for their protection (understand);
CLO 2: devise business strategies on the basis of IPRs (create);
CLO 3: assist in technology upgradation and enhancing competitiveness (understand);
CLO 4: review the basics of biosafety protocols (understand);
CLO 5: employ biosafety protocols in experimental research (apply).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3										
CLO 2					3									
CLO 3	3													
CLO 4				3										
CLO 5								3						

Detailed Syllabus

UNIT – 1: Fundamentals of bioethics (L=15)

Definition, historic evolution, codes and guidelines, universal principles of bioethics. Codes, agreements, Declarations and Guidelines. Define the term "Bioethics" in relation to profession, society, and biomedicine, learn about gradation of moral and ethical norms and learn about prayers, oaths, agreements, declarations, guidelines and codes which have relevance to bioethics Clinical ethics. Describe the sanctity of human life and the need to preserve human life, explain about issues related to prenatal screening, clinical trials (Phase I/II/III/IV) studies. Informed consent, Ethics committees.

UNIT – 2: Bioethics in practice (L=15)

Medical errors and Negligence Medical error and medical negligence difference, remedies against medical negligence, protection and compensation related to it. Care in infectious diseases, identify ethical issues in clinical practice of HIV, TB, leprosy and its prevention, research ethics related to infectious diseases Ethical use of animals in the laboratory

UNIT – 3: Introduction to intellectual property rights (L=15)

Basics of Intellectual Property, History and Evolution of Intellectual Property, Treaty and Convention on IP, World Intellectual Property Organization and International Cooperation, Types of IPR, Economic importance of IPR

UNIT – 4: Intellectual property laws and its role in development (L=15)

Patents, Trademarks, Copyright, Designs, Geographical Indications, Other related rights, Prosecution of IPR, Infringement and Enforcement of IPRs, Effect of Intellectual Property Protection in Development, Ideal industrial and institutional setup for Intellectual Property Outcomes, Role of Licensing and commercialization, IP Cells and Technology Transfer Offices, Future scope and career in Intellectual Property Field

Reference Books:

1. IPR, Biosafety and Bioethics by Goel and Parashar
2. Genetically Modified Crops and Agricultural Development (Palgrave Studies in Agricultural Economics and Food Policy)" by Matin Qaim
3. Biosafety and Bioethics" by Rajmohan Joshi
4. Bioethics and Biosafety in Biotechnology" by V Sree Krishna
5. "An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology" by Padma Nambisan

Teaching – Learning Strategies in brief

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Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

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DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-GE02-B**

Title of the Course : **Biotechnology and Human Welfare (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course aims to introduce applications of these techniques in production of recombinant therapeutic proteins and vaccines will also be outlined in this course. The course aims to provide an understanding of the applications of biochemistry in forensic sciences through analysis of evidences, which will help students develop analytical and problem-solving skills for real life situation. The course also introduces various environmental pollutants that affect human health.

Course Learning Outcomes (CLOs)

On completion of this course, the students will be able to
CLO 1. Understand the concepts in protein engineering
CLO 2. Introduces concept in Forensic sciences
CLO 3. Understanding of plant microbe introduction
CLO 4. Outline the environmental pollutants affecting human health
CLO 5. Understand concepts in gene therapy

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3							3			
CLO 2				3										
CLO 3				3										
CLO 4				3								3		
CLO 5				3										2

Detailed Syllabus

UNIT – 1 (L=15)

Protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation. Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

UNIT – 2 (L=15)

Nitrogen fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT – 3 (L=15)

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

UNIT – 4 (L=15)

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E. coli, human genome project.

Reference Books:

1. Biotechnology and Human Welfare for Competitive Examinations by Dr. Subroto Biswas

Teaching – Learning Strategies in brief

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DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC07**

Title of the Course : **Diversity of Microbes, Algae and Fungi (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The objective of this course is to make students gain knowledge about viruses and diverse life forms such as bacteria, algae, fungi, lichens - their morphology, life cycles and economic importance.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: develop an understanding of microbes, algae, fungi and lichens and appreciate their adaptive strategies (understand)
CLO 2: classify microbes, algae, fungi and lichens (understand)
CLO 3: compare and contrast the general characteristics of viruses, bacteria, algae, fungi and lichens. (analyze and evaluate)
CLO 4: assess the economic importance of viruses, bacteria, algae, fungi and lichens (evaluate)

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3	3						3				
CLO 2		3	3							3		3		
CLO 3		3	3							3		2		
CLO 4		3	3					3		3				3

Detailed Syllabus

UNIT – 1: Viruses (L=15)
Discovery, general characteristics, ultrastructure of DNA virus (T- odd or even phage) and RNA virus (tobacco mosaic virus (TMV)), replication - lytic and lysogenic cycle and economic importance.

UNIT – 2: Bacteria (L=15)
Discovery, general characteristics, ultrastructure, reproduction – vegetative, asexual and sexual (conjugation, transformation and transduction) and economic importance of bacteria.

UNIT – 3: Algae (L=15)

General characteristics, ecology and distribution, classification, range of thallus organization, cellular organization, reproduction and economic importance.

Morphology and life-cycles of the following: *Oedogonium, Chara, Vaucheria, Laminaria, Batrachospermum.*

Lichens: General account, reproduction and economic importance.

UNIT – 4: Fungi (L=15)

General characteristics, ecology and distribution, classification, range of thallus organization, cellular organization, nutrition, reproduction and economic importance.

Morphology and life-cycles of *Rhizopus*, *Penicillium*, *Alternaria*, *Puccinia, Agaricus*.

Mycorrhiza: ectomycorrhiza and endomycorrhiza and their economic importance.

Reference Books:

1. Kumar, H.D. ***Introductory Phycology***. Affiliated East-West.Press Pvt. Ltd. Delhi.2 nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. ***Microbiology: An Introduction***, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. ***Text book of Fungi & Their Allies***, MacMillan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. ***Introductory Mycology***, John Wiley and Sons (Asia), Singapore.4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., ***Biology***. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., ***Pteridophyta***, S. Chand. Delhi, India. 7. Bhatnagar, S.P. and Moitra, A. ***Gymnosperms***. New Age International (P) Ltd Publishers, New Delhi, India.
7. Parihar, N.S. ***An introduction to Embryophyta***. Vol. I. Bryophyta. Central Book Depot, Allahabad.

Teaching – Learning Strategies in brief

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DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC08**

Title of the Course : **Archegoniate (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

This course strives to highlight the morphological, anatomical and reproductive features of bryophytes, pteridophytes, gymnosperms and fossils and their ecological and economic importance.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO 1: describe the adaptations acquired during the transition from water to land (understand);

CLO 2: discuss the general characteristics and classification of bryophytes, pteridophytes, gymnosperms and fossils (understand);

CLO 3: compare the morphological, anatomical and reproductive features of bryophytes, pteridophytes, gymnosperms and fossils (analyze/evaluate);

CLO 4: enumerate the various ecological and economical uses of bryophytes, pteridophytes, gymnosperms (evaluate); and

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	2							3				
CLO 2		3	2							3		3		
CLO 3		3	2							3				
CLO 4		3	2	3						3				3

Detailed Syllabus

UNIT – 1: Bryophytes (L=15)

General characteristics; Adaptations to land habit; Range of thallus organization; Classification (up to order). Morphology, anatomy and reproduction of *Marchanchia, Anthoceros* and *Sphagnum* (developmental stages not to be included); Ecological and economic importance.

UNIT – 2: Pteridophytes (L=15)

General characteristics; Classification (up to order); morphology, anatomy and reproduction of *Psilotum*, *Sellagenella*, *Equisetum* and *Pteris* (Developmental details not to be included); Stele: Type and evolution; Heterospory, seed habit, telome theory; Ecological and economic importance.

UNIT – 3: Gymnosperms (L=15)

General characteristics; classification (up to order); morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum* (Developmental details not to be included), Ecological and economic importance.

UNIT – 4: Paleobotany (L=15)

Fossils: Types and process of fossilization, methods to study fossils; Geological time scale and origin of plant groups during different periods in geological history; General account of *Rhynia*, *Calamites* and *Lepidodendron;* Contribution of Birbal Sahni to paleobotany.

Reference Books:

1. Kumar, H.D. ***Introductory Phycology***. Affiliated East-West.Press Pvt. Ltd. Delhi.2 nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. ***Microbiology: An Introduction***, Pearson Benjamin Cummings, U.S.A. 10th edition.
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DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC09**

Title of the Course : **Plant Anatomy and Embryology (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The objective of the course is to provide students with an understanding of the internal structure of plants and the developmental journey taken by a plant cell from egg to embryo and finally to its mature adult form.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: develop an understanding of concepts and fundamentals of plant anatomy and embryology (understand);
CLO 2: develop critical understanding of the evolution of the concept of organization of shoot and root apex (understand);
CLO 3: evaluate the adaptive and protective systems of plants (evaluate);
CLO 4: recall the history of reproductive biology of angiosperms (remember); and
CLO 5: recognize the importance of genetic and molecular aspects of flower development, pollination and fertilization (understand).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO1		2	3								3			
CLO2		2	3								3			
CLO3		2	3								3			
CLO4		2	3								3			
CLO5		2	3		2						3			

Detailed Syllabus

UNIT – 1: Primary and secondary growth (L=15)
Meristematic tissue: Root and shoot apical meristems; **Permanent tissues:** Simple and complex; **Primary plant body:** Structure of root, stem and leaf (dicot and monocot); **Secondary Growth: S**tructure and function of vascular and cork cambium, seasonal activity, secondary growth in root and stem, types of wood.

UNIT – 2: Protective and adaptive systems (L=15)

Protective systems: Epidermis, cuticle, suberin, wax, stomata, trichomes and bark; **Adaptive systems:** General account of adaptations in xerophytes and hydrophytes; Complex tissues differentiation; Secretory ducts and laticifers.

UNIT – 3: Structural organization of flower, pollination and fertilization (L=15)

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac; **Pollination:** Mechanisms and adaptations; **Fertilization:** Double fertilization; **Seed**: Structure appendages and dispersal mechanisms.

UNIT – 4: Embryo, endosperm, apomixis and polyembryony (L=15)

Embryo and endosperm: Dicot and monocot embryo; Endosperm types, structure and functions; Embryo and endosperm relationship; **Apomixis and polyembryony:** Definition, types and practical applications.

Reference Books:

1. Bhojwani, S.S. & Bhatnagar, S.P. ***Embryology of Angiosperms***. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. ***Plant Anatomy***. The Benjamin/Cummings Publisher, USA.

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DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC10**

Title of the Course : **Plant Molecular Biology (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course envisages to explain the structure and function of informational molecules involved in the central dogma of molecular biology.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: analyse the structures and chemical properties of DNA and RNA (analyze);
CLO 2: differentiate between prokaryotes and eukaryotes on the basis of molecular mechanisms involved in replication, transcription and translation of nucleic acids (analyze);
CLO 3: evaluate the factors regulating gene expression at DNA, RNA and protein levels (evaluate);
CLO 4: appreciate the processes that generate heterogeneity in the structure and function of RNA (evaluate); and

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3		2						3			
CLO 2		3	3		2						3			
CLO 3		3	3								3			
CLO 4		3	3								3			

Detailed Syllabus

UNIT – 1: Nucleic acids: Carriers of genetic information (L=15)

Historical perspective; Types of genetic material, DNA as the carrier of genetic information. Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment, DNA Structure, Types of DNA, Miescher to Watson and Crick- historic perspective, Salient features of double helix, denaturation and renaturation, Prokaryotes, Viruses, Eukaryotes.RNA Structure,

UNIT – 2: The Structures /organization of DNA and the replication machinery (L=15)

Organization of DNA, The Nucleosome, Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.

Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi-conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA, replication of the 5'end of linear chromosome; Enzymes involved in DNA replication.

UNIT – 3: Transcription, Processing and modification of RNA (L=15)

Transcription in prokaryotes and eukaryotes: Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNA processing (5' cap, 3' polyA tail); Ribozymes; mRNA transport.

Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in *E. coli*. Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones.

UNIT – 4: Genetic code and translation (L=15)

Genetic code (deciphering & salient features)

Ribosome structure and assembly, tRNA and charging of tRNA, aminoacyl tRNA synthetases; mRNA

Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Inhibitors of protein synthesis; post-translational modifications of proteins.

Reference Books:

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. ***Molecular Biology of the Gene***, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2. Snustad, D.P. and Simmons, M.J. ***Principles of Genetics***. John Wiley and Sons Inc., U.S.A. 5th edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. ***Concepts of Genetics***. Benjamin Cummings. U.S.A. 9th edition.
4. Russell, P. J. ***i-Genetics- A Molecular Approach***. Benjamin Cummings, U.S.A. 3rd edition.
5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. ***Introduction to Genetic Analysis***. W. H. Freeman and Co., U.S.A. 10th edition.

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DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC11**

Title of the Course : **Plant Biotechnology (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course takes students through the tools and techniques in plant biotechnology such as gene cloning, development of gene constructs and their deployment intissue-cultured raised explants and subsequent analysis of the transgenic progeny. It also deals with the nuances of culturing and cultivating explants *in vitro*.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO 1: understand the core concepts and fundamentals of plant tissue culture and biotechnology (understand);

CLO 2: differentiate between the principles and applications of various aspects of plant tissue culture (analyze);

CLO 3: categorize the enzymes and vectors for genetic manipulations (analyze);

CLO 4: develop transgenic plants by any of the methods of gene transfer (create); and

CLO 5: critically analyze the major concerns and applications of transgenic technology (analyze).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3						3				3	
CLO 2		3	3										3	
CLO 3		3	3										3	
CLO 4		3	3										3	
CLO 5		3	3			3		2					3	

Detailed Syllabus

UNIT – 1: Plant tissue culture (L=15)

Historical perspective, totipotency, composition of media, inorganic and organic nutrient components, Plant growth regulators and their requirements, role of vitamins; Explants, selection of explants, sterilization of explant, sterilizing agents, wet and dry heat sterilisation methods, Filter sterilisation etc. Laboratory set up, role of physical factors like light, temperature etc. Applications of plant tissue culture in Industry and agriculture.

Callus, direct and indirect organogenesis, embryogenesis (somatic and zygotic), micropropagation, meristem culture and virus elimination, anther culture and haploid production, protoplast isolation, culture and fusion; secondary metabolite production, cryopreservation, germplasm conservation.

UNIT – 2: Tools of recombinant DNA technology (L=15)

Cloning vectors - Prokaryotic (pUC18/pUC19, pBR322, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC). Restriction endonucleases (History, Types I-III, biological role and applications); restriction mapping.

UNIT – 3: Gene cloning and methods of gene transfer (L=15)

Steps involved in gene cloning, PCR and PCR mediated gene cloning, construction of genomic and cDNA libraries, screening DNA libraries by genetic selection and complementation, colony hybridization, gene construct.

Indirect and direct methods of plant gene transfer; Utility of selectable marker and reporter genes (luciferase, GUS, GFP) in selection of transgenics.

UNIT – 4: Products of plant transgenesis and recombinant protein production (L=15)

Pest resistant (*Bt*-cotton); herbicide resistant plants (*RoundUp Ready* soybean); Transgenic crops with improved quality traits (*FlavrSavr* tomato, Golden rice); Role of transgenics in bioremediation (Superbug); Industrial enzymes (aspergillase, protease, lipase); genetically engineered products–Human growth hormone; humulin; biosafety concerns.

Reference Books:

1. Bhojwani, S.S. and Razdan, M.K., ***Plant Tissue Culture: Theory and Practice***. Elsevier Science Amsterdam.The Netherlands.
2. Glick, B.R., Pasternak, J.J. ***Molecular Biotechnology- Principles and Applications of recombinant DNA***. ASM Press, Washington.
3. Bhojwani, S.S. and Bhatnagar, S.P. ***The Embryology of Angiosperms***. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
4. Snustad, D.P. and Simmons, M.J. ***Principles of Genetics***. John Wiley and Sons, U.K. 5th edition.
5. Stewart, C.N. Jr. ***Plant Biotechnology & Genetics: Principles***, ***Techniques and Applications***. John Wiley & Sons Inc. U.S.A.

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DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-SEC01**

Title of the Course : **Ethnobotany (Theory)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Objectives

The course aims at introducing and appreciating India as land and home of multiple identities with diverse culture, tradition and lifestyles. It emphasizes on bringing the native wisdom to the mainstream not only to gain from the indigenous knowledge but also to acknowledge the services of the privileged and pursue benefit sharing with the communities that had been safe guarding the same.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO 1: explore use of plants by people as practiced by ethnic communities dwelling in various regions of India (understand);

CLO 2: understand and document information on hitherto unknown use of the plants (understand);

CLO 3: advocate on copyright and ownership to help the ethnic people for what is due to them (evaluate);

CLO 4: present the traditional knowledge and use of plants for various purposes to stream line the use for the larger benefit of the nation (apply); and

CLO 5: appraises on the steps needed to safeguard our rights in the copy right and intellectual property right regime (evaluate).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		2						3						3
CLO 2		2	3					3						3
CLO 3		2												3
CLO 4		2				3	3							3
CLO 5		2				3	3							3

Detailed Syllabus

UNIT – 1: Ethnobotany (L=08)

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils

UNIT – 2: Methods and techniques in ethnobotanical study and research (L=07)

a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

UNIT – 3: Ethnobotany and modern medicine (L=08)

Role of ethnobotany in modern medicine with special example of *Rauvolfia serpentina*, *Artemisia annua*, *Withania somnifera*; Significance of *Azadiractha indica*, *Ocimum sanctum* and *Ficus religiosa* in ethnobotanical practices (along with their habitat and morphology). Application of natural products to certain diseases: diarrhea and dysentery, gout and rheumatism, liver complaints, jaundice, cardiac, infertility, diabetics, blood pressure and skin diseases

UNIT – 4: Ethnobotany, conservation, traditional knowledge and legal aspects: (L=07)

Role of ethnic groups in conservation of plant genetic resources, Sacred groves for protection of many rare, threatened, and endemic species of plants and biodiversity; Ethnobotany as a tool to protect interests of ethnic groups; Credibility of traditional knowledge; Biopiracy, Intellectual Property Rights.

Reference Books:

1. S.K. Jain, ***Manual of Ethnobotany***, Scientific Publishers, Jodhpur.
2. S.K. Jain (ed.) ***Glimpses of Indian. Ethnobotny***, Oxford and I B H, New Delhi
3. Lone et al,.***Palaeoethnobotany***
4. S.K. Jain (ed.). ***Methods and Approaches in Ethnobotany***. Society of ethnobotanists, Lucknow, India.
5. S.K. Jain, ***Contributions of Indian Ethnobotany***. Scientific publishers, Jodhpur.
6. Colton C.M. ***Ethnobotany – Principles and applications***. John Wiley and sons – Chichester
7. Faulks, P.J. ***An introduction to Ethnobotany***, Moredale pub. Ltd.

Teaching – Learning Strategies in brief

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Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 13 marks. End semester exam is of 37 marks.

Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End semester examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**
Course Code : **BBO-GE03**
Title of the Course : **Environmental Biotechnology (Theory)**
Credits : **4**
L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course aims to make students understand the current applications of biotechnology to environmental quality evaluation, monitoring and remediation of contaminated environments.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: describe the microbial treatment of waste waters and the processes involved in bioconversion of wastewater to value-added products (understand);
CLO 2: explain the intricacies associated with biogeochemical cycles and the approaches deployed to prevent contamination of those cycles (create);
CLO 3: explain various policies and regulations surrounding protection of environment (understand);
CLO 4: communicate the knowledge of environmental pollution and the advanced biotechnological approaches to mitigate pollution (apply); and
CLO 5: describe the current environmental issues and biotechnological approaches to ensure a sustainable ecosystem (create).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3			3				3		3		
CLO 2		3	3									3		
CLO 3		3	3			3						3		
CLO 4		3	3				3		3			3		
CLO 5		3	3					3				3	3	

Detailed Syllabus

UNIT – 1: Environment and global environmental concerns (L=15)
Basic concepts and issues, global environmental problems - ozone depletion, UV-B, greenhouse effect and acid rain due to anthropogenic activities, their impact and biotechnological approaches for management.
Environmental pollution - types of pollution, sources of pollution, measurement of pollution, methods of measurement of pollution, fate of pollutants in the environment

UNIT – 2: Microbiology of wastewater treatment (L=15)

Aerobic process - activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic process - anaerobic digestion, anaerobic filters, upflow anaerobic sludge blanket reactors. Treatment schemes for wastewaters of dairy, distillery, tannery, sugar and antibiotic industries.

UNIT – 3: Xenobiotic compounds (L=15)

Organic (chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants) and inorganic (metals, radionuclides, phosphates, nitrates). Bioremediation of xenobiotics in environment - ecological consideration, decay behaviour and degradative plasmids, molecular techniques in bioremediation.

UNIT – 4: Sustainable Development (L=15)

Economics and Environment: Economic growth, Gross National Productivity and the quality of life, Tragedy of Commons, Economics of Pollution control, Cost-benefit and cost effectiveness analysis, WTO and Environment, Corporate Social Responsibility, Environmental awareness and Education; Environmental Ethics.

Reference Books:

1. ***Waste water engineering - treatment, disposal and reuse***, Metcalf and Eddy Inc., Tata McGraw Hill, New Delhi.
2. ***Bioremidation***, Baaker, KH and Herson D.S. Mc.GrawHillInc, NewYork.
3. ***Industrial and Environmental Biotechnology,*** Nuzhat Ahmed, Fouad M. Qureshi and Obaid Y. Khan, Horizon Press.
4. ***Environmental Molecular Biology***, Paul. A, Rochelle, Horizon Press.
5. ***Environmental Protection and Laws*** by Jadhav and Bhosale, V.M.Himalaya publ. House
6. ***Biodiversity Assessment and Conservation*** by PC Trivedi, Agrobiospubl

Teaching – Learning Strategies in brief

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Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF BOTANY

Name of the Academic programmeme : **B.Sc. (Hons.)**

Course Code : **BBO-CC02 PR**

Title of the Course : **Basics of Chemistry (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**00,** T=**0**, **P=30**

Course Objectives

The lab course intends to provide students the basic knowledge of chemistry including the techniques, concepts, and calculations related to the foundation for a better understanding of processes in chemistry to enable students for future work and thinking.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: describe and understand the purification of organic compounds by the application of crystallization using different solvents (understand);
CLO 2: learn and analyse the melting point of compounds using different methods (analyse);
CLO3: determine the mixed melting point of liquid compounds with the impact of impurities on melting point determination (understand, apply); and
CLO 4: determination of boiling point of liquid compounds (apply)

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3										
CLO 2			3											
CLO 3					3									
CLO 4					3									

Detailed Syllabus

Checking the calibration of the thermometer

- Purification of organic compounds by crystallization using the following solvents:
  - Water
  - Alcohol
  - Alcohol-Water
- Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
- Effect of impurities on the melting point – mixed melting point of two unknown organic compounds

- Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation and capillary method)

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC03 PR**

Title of the Course : **Biomolecules (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The practicals in this course aim to provide students with an understanding of basics in biomolecules study. It will enhance the analytical skill together with expertise in dealing with experimental procedures with safety. The course will enhance knowledge about various biomolecules and techniques.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: learn about the safety measures in laboratory (apply);
CLO 2: acquire skill in preparing normal and molar solution (apply);
CLO 3: determine pKa of acetic acid and glycine (apply);
CLO 4: knowledge about the qualitative analysis of carbohydrates, lipids, amino acids, proteins and nucleic acid (understand);
CLO 5: learn the technique of thin layer chromatography for separation of aminoacids, sugars and nitrogenous bases (apply); and

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	2										3			
CLO 2		3									3			
CLO 3		3									3			
CLO 4				3							3			
CLO 5				4							3			

Detailed Syllabus

1. Safety measures in laboratories.
2. Preparation of normal and molar solutions.
3. Preparation of buggers.
4. Determination of pKa of acetic acid and glycine.
5. Qualitative tests for carbohydrates, lipids, amino acids, proteins and nucleic acids.
6. Separation of amino acids/sugars/bases by thin layer chromatography.
7. Estimation of vitamin C.

Reference Books:

1. Nelson, D.L. & Cox, M.M. ***Principles of Biochemistry, 5th Edn.,*** W.H. Freeman & Company.
2. Berg, M.J., Tymockzo, J.L. & Stryer, L. ***Biochemistry, 6th Edition***, W.H. Freeman & Company.
3. Wood. E.J. & Pickering, W.R. ***Introducing Biochemistry***. John Murray, London.
4. Nelson, D.L. & Cox, M.M. ***Lehninger: Principles of Biochemistry***, 6th Edn, W.H. Freeman and Company, New York.
5. Devlin, T.M. ***Textbook of Biochemistry with Clinical Correlations***, 7th Edn, John Wiley & Sons, New York.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC04 PR**

Title of the Course : **Cell Biology (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

On completing this course, students would gain hand-on training in current cell biological methods and familiarize with techniques used in cell biology. They will learn to identify different stages of amitosis and mitosis and learn sub-cellular fractionation and comprehend the basic of cellular functions.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: visualization and differentiation of animal and plant cell (analyse);
CLO 2: knowledge about identification of the different stages of amitosis and mitosis (apply);
CLO 3; understand the different cell components and sub cellular fractionation (analyse);
CLO 4: learn about the temperature effect on cell membrane permeability (evaluate); and
CLO 5: acquire the knowledge to stain and visualize mitochondria (apply).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1			3								3			
CLO 2				3							3			
CLO 3				3							3			
CLO 4			3								3			
CLO 5	3										3			

Detailed Syllabus

1. Visualization of animal and plant cell by methylene blue.
2. Identification of different stages of amitosis in onion root tip.
3. Identification of different stages of meiosis in onion bud.
4. Micrographs of different cell components (dry lab).
5. Sub-cellular fractionation.
6. Effect of temperature and organic solvent on the permeability of cell membrane
7. Staining and visualization of mitochondria by Janus green stain.

Reference Books:

1. Cooper, G.M. & Hausman, R.E. (2009). The Cell: A Molecular Approach, 5th Edn., ASM Press &* Sunderland (Washington DC), Sinauer Associates, M.A.
2. Lodish, H., Berk, A. Zipursky, S.L., Matsudaira, P., Baltimore, D. & Darnell, J. (2012). Molecular Cell Biology, 7th Edn., W.H. Freeman & Company, New York.
3. Alberts, B., Johnson, A., Lewis, J. & Enlarge, M. (2008). Molecular Biology of the Cell, 5th Edn., Garland Science (Princeton).

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

Name of the Academic programme : **B.Sc.(Hons.)**

Course Code : **BBO-CC05 PR**

Title of the Course : **Immunology (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The course will help students to identify the cellular and molecular basis of immune responsiveness and hands-on on different techniques used in immunology for concept clearance and understanding.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO1: learn to purify immunoglobulins (apply)
CLO2: understand the assays based on precipitation reactions – Ouchterlony double diffusion (ODD) and Mancini radial immunodiffusion (understand)
CLO3: acquire knowledge about agglutination reactions – Blood typing (active) & passive agglutination (apply)
CLO4: perform ELISA, DOT blot and Immonoblot (apply).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1			3											
CLO 2				3										
CLO 3			3											
CLO 4			3											

Detailed Syllabus

1. Purification of immunoglobulins.
2. Assays based on precipitation reactions – Ouchterlony double diffusion (ODD) and Mancini radial immunodiffusion.
3. Assays based on agglutination reactions – Blood typing (active) & passive agglutination.
4. Enzyme linked immune-sorbent assay (ELISA).
5. DOT blot
6. Immunoblot

Reference Books:

1. Kindt, T.L., Goldsby, R.A. & Osborne, B.A. ***Kuby Immunology***, 6th Edn., W.H. Freeman Company, New York.
2. Coico, R. & Sunshine, G. ***Immunology: A Short Course***, 6th Edn., Jonh Wiley & Sons, New Jersey.
3. Murphy, K., Mowat, A. & Weaver, C.T. ***Janeway's Immunobiology***, 8th Edn., Garland Science (London & New York.)

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC06 PR**

Title of the Course : **Enzymes and Proteins (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The practical in this course will provide knowledge about the basic properties and characteristics of enzymes and their action and students can learn enzyme kinetics and role of the inhibitors of enzymes in enzyme catalysed reactions.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO1: estimate proteins by UV absorbance and Biuret, Lowry/Bradford method (evaluate);
CLO2: perform ammonium sulfate fractionation of crude homogenate from germinated mungbean and set up assay for acid phosphatase and activity measurement of ammonium sulfate fractions (apply);
CLO3: determine Km and Vmax of enzyme enriched fraction (apply); and
CLO4: understand inhibition of acid phosphatase by inorganic phosphate (understand).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1			3		3						3			
CLO 2			3								3			
CLO 3			3								3			
CLO 4				3							3			

Detailed Syllabus

1. Protein estimation by UV absorbance and Biuret method.
2. Protein micro assay by Lowry/Bradford method.
3. Ammonium sulphate fractionation of crude homogenate from germinated mung bean.
4. Setting up assay for acid phosphatase and activity measurements of the ammonium sulphate fractions (progress curve and effect of pH).
5. Determination of Km and Vmax of enzyme enriched fraction.
6. Inhibition of acid phosphatase activity by inorganic phosphate.

Reference Books:

1. Nelson, D.L. & Cox, M.M. ***Lehninger: Principles of Biochemistry***, 6th Edn, W.H. Freeman and Company, New York.
2. Price, N.C. & Stevens, L. ***Fundamentals of Enzymology***, 3rd Edn., Oxford University Press Inc, New York.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC12**

Title of the Course : **Plant Ecology and Phytogeography (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

This course strives to familiarize students with principles of ecology and phytogeography. The student is directed to understand the significance and interplay of ecological factors across population, community, succession, ecosystem and biome. Further, it attempts to categorise plants in diverse climatic zones of the world.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO 1: recognize concepts of ecology, ecological factors, their various types and interactions (understand);

CLO 2: describe the population dynamics and structure of communities (evaluate);

CLO 3: evaluate the structure and function of ecosystem (evaluate);

CLO 4: describe the principles of phytogeography and endemism and analysis of phytogeography or phytogeographical divisions of India and the world (understand).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3									3		
CLO 2		3	3									3		
CLO 3		3	3					3				3		
CLO 4		3	3									3		

Detailed Syllabus

UNIT – 1: Ecology and ecological factors (L=15)

Introduction, Basic concepts, levels of organization, subdivisions, relations and scope of ecology; **Ecological Factors:** Physical factors (Light, temperature, wind and Water: Importance, States of water in the environment, Atmospheric moisture, Precipitation types, Hydrological Cycle, Water in soil, Water table); Edaphic factor (Soil: Importance, Origin, Formation, Composition and Soil profile); Biotic factor and biotic interactions

UNIT – 2: Population dynamics and community structure (L=15)

Population ecology: Characteristics and Dynamics; Ecological Speciation.
Plant communities: Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.

UNIT – 3: Ecosystems and their functional aspects (L=15)
Ecosystem: Structure; Processes; Trophic organization; Food chains and Food webs; Ecological pyramids. **Functional aspects of ecosystem:** Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.

UNIT – 4: Phytogeography (L=15)
Phytogeography: Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India.

Reference Books:

1. Odum, E.P. ***Fundamentals of Ecology***. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. ***Ecology Environment and Resource Conservation***. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. ***Ecology and Environment***. Rastogi Publications, Meerut, India.8th edition.
4. Wilkinson, D.M. ***Fundamental Processes in Ecology: An Earth Systems Approach***. Oxford University Press. U.S.A.
5. Kormondy, E.J. ***Concepts of Ecology***. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

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DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC13**

Title of the Course : **Plant Systematics (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course attempts to simplify concepts pertaining to plant species description, identification, classification, nomenclature and phylogeny.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: recognize the concept, components and aims of plant systematics (understand);
CLO 2: estimate the importance of herbarium and botanical garden (understand);
CLO 3: explain the taxonomic hierarchy and interpret the rules of ICN in botanical nomenclature (understand/evaluate);
CLO 4: classify and predict the relationship among the plants (understand and evaluate) and
CLO 5: analyse the diagnostic features and economic importance of certain families of angiosperms (analyze).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3						3			3		
CLO 2		3	3					3	3			3		
CLO 3		3	3						3			3		
CLO 4		3	3		3				3			3	3	
CLO 5		3	3					3	3			3		3

Detailed Syllabus

UNIT – I: Introduction to plant systematics (L=15)

Systematics and taxonomy; Fundamental components of systematics (description, identification, nomenclature, classification and phylogeny); Aims of systematics; Taxonomic resources: Herbaria and botanical gardens; Taxonomic literature: Flora; Taxonomic keys: single access and multi-access.

UNIT – 2: Taxonomic hierarchy and botanical nomenclature (L=15)

Taxonomic groups, categories and ranks; concept of species, genus and family; History of botanical nomenclature: polynomial and binomial nomenclature; Principles and rules (ICN), type concept, author citation, effective and valid publication, rejection of names, principle of priority and its limitations

UNIT – 3: Classification and phylogeny (L=15)

History and type of classification: artificial, natural and phylogenetic. Salient features of the classification proposed by Linnaeus, Bentham and Hooker and Hutchison, their merits and demerits; Brief reference of Angiosperm Phylogeny Group (APG-IV); important phylogenetic terms and concepts: Plesiomorphic and apomorphic characters, homology and analogy, parallelism and convergence, monophyly, paraphyly, polyphyly and clade, phonetic and cladistics methods, phenogram and cladogram (definition and differences).

UNIT – 4: Diagnostic features and economic importance (L=15)

Diagnostic features and economic importance of the families of Dicotyledons: Ranunculaceae, **Brassicaceae, Malvaceae**, Euphorbiaceae, Ruteaceae, **Leguminosae, Cucurbitaceae, Asteraceae,** Apiaceae, **Apocynaceae, Solanaceae**, Lamiaceae; Monocotylidons: **Commelinaceae, Liliaceae, Cyperaceae and Poaceae.**

Reference Books:

1. Reven, F.H., Evert, R. F., Eichhorn, S.E. ***Biology of Plants***. New York, NY: W.H. Freeman and Company.
2. Singh, G. ***Plant Systematics: Theory and Practice***, 3rd edition. New Delhi, Delhi: Oxform and IBH Pvt. Ltd.
3. Jeffrey, C. ***An Introduction to Plant Taxonomy***. Cambridge University Press, Cambridge.
4. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. ***Plant Systematics-A Phylogenetic Approach***. Sinauer Associates Inc., U.S.A. 2nd edition.
5. Maheshwari, J.K. ***Flora of Delhi***. CSIR, New Delhi. 5. Radford, A.E. ***Fundamentals of Plant Systematics***. Harper and Row, New York.

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DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-SEC02**

Title of the Course : **Biofertilizer (Theory)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Objectives

The objective of the course is to make students gain knowledge on the use of eco-friendly biofertilizers like *Azospirillium Azotobacter* and mycorrhizae (VAM), their characteristic features, identification, multiplication and recycling of the organic waste.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO 1: develop an understanding on the concept of biofertilizers and organic agriculture (analyze);
CLO 2: estimate the potential of bacteria, fungi and mycorrhizae as sources of biofertilizers (understand);
CLO 3: understand the importance of depleting levels of phosphorus reserves on the Earth and role of phosphate solubilizing and mobilizing microorganisms in ensuring availability of the same (understand);
CLO 4: stress on the importance of biofertilizers and organic farming as alternatives to chemical/synthetic based fertilizers (analyze);
CLO 5: evaluate methods of production and application of biofertilizers and organic manure for better crop production and yield (evaluate)**.**

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3							3				3
CLO 3		3	3											3
CLO 4		3	3						3					3
CLO 5		3	3						3					3

Detailed Syllabus

UNIT – 1: (L=07)

Biofertilizer – definition and types; Bacterial biofertilizers – structure and characteristic features of *Azospirillum*, *Azotobacter*, *Rhizobium* and *Frankia (*actinorhiza*).* Nitrogen fixation - Free living and symbiotic. Cyanobacterial biofertilizers – *Anabaena*, *Azolla* and *Nostoc.*

UNIT – 2: (L=08)

Mycorrhizal biofertilizers - mycorrhiza, types of mycorrhizal association, taxonomy, occurrence and distribution, colonization of VAM – isolation and inoculum production of VAM, mechanism of phosphate solubilization and phosphate mobilization, K solubilization, influence of mycorrhiza on growth and yield of crop plants.

UNIT – 3: (L=07)

Production technology of biofertilizers - strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertilizers. FCO specifications and quality control of biofertilizers.

UNIT – 4: (L=08)

Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and industrial wastes – biocompost making methods, types and method of vermicomposting – field application.

Reference Books:

1. Dubey, R.C., A ***Text book of Biotechnology*** S.Chand& Co, New Delhi.
2. Kumaresan, V., ***Biotechnology***, Saras Publications, New Delhi.
3. John JothiPrakash, E. ***Outlines of Plant Biotechnology***. Emkay Publication, New Delhi.
4. Sathe, T.V. ***Vermiculture and Organic Farming***. Daya publishers.
5. SubhaRao, N.S., ***Soil Microbiology***, Oxford & IBH Publishers, New Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. ***Bio-fertilizers and organic Farming*** Akta Prakashan, Nadiad

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 13 marks. End semester exam is of 37 marks.

Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End semester examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-GE04**

Title of the Course : **Economic Botany (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course bridges the gap between pure and applied botany by focusing on the uses of plants by people. The course presents potential plants of livelihood and commercial interests. Intending to apprise students on utility value of selected species, it seeks to present the market and commercial value and also offer an idea on the processes concerning the cultivation of economically useful plants.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO 1: understand core concepts of economic botany and relate them with environment, populations, communities and ecosystems (understand);

CLO 2: develop critical understanding on the evolution of concept of organization of apex new crops/varieties, importance of germplasm diversity and issues related to access and ownership (create);

CLO 3: acquire knowledge on the binomial nomenclature and morphology of economic crops (apply);

CLO 4: understand the cultivation of various economically important crops. (understand); and

CLO 5: appreciate the diversity of plants and the plant products encountered in everyday human use (evaluate).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT – 1: Origin of cultivated plants (L=15)

Concept of Centers of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.

UNIT – 2: Cereals, legumes and timbers (L=15)

Origin, morphology, processing & uses of wheat and rice.
Origin, morphology and uses of chickpea, pigeon pea and fodder legumes.
General account with special reference to teak and pine.

UNIT – 3: Oilseeds, beverages and fiber-yielding plants (L=15)

Taxonomy, general morphology and economic importance of mustard, groundnut, linseed and coconut.
General account of fiber-yielding plants (cotton and jute).

UNIT – 4: Spices and medicinal plants (L=15)

General description, taxonomy, morphology and economic importance of turmeric, black pepper and clove.
Taxonomy, morphology, processing, the exploited plant part, the bioactive compounds, uses and health hazards of *Cinchona*, *Papaver*, *Catharanthus* and tobacco.

Reference Books:

1. Kochhar, S.L. ***Economic Botany in Tropics***, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. ***Economic Botany: Principles & Practices***. Kluwer Academic Publishers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. ***Plants, Genes and Agriculture***. Jones & Bartlett Publishers.

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-GE04 PR**

Title of the Course : **Economic Botany (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The course will enlighten the concept of origin, domestication, cultivation, genetics, and production of cereals, legumes, spices, beverages and other economically important crops. After the completion of this course students will be able to establish a link between biology and anthropology and learn ways to understand and exploit cereals, legumes and important crops for food and other purposes.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: understand the structure and internal structure of various economically important crops (understand);
CLO 2: appreciate the diversity of plants and the plant products of various economically and medicinally important crops (evaluate);
CLO 3: learn to do micro-chemical tests on different crops encountered in daily life (analyze); and
CLO 4: gather knowledge to tests for fats in crushed seeds of oil yielding crops (apply).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3			2				3					3
CLO 2		3			2			3	3					3
CLO 3		3			2				3					3
CLO 4		3			2			3	3					3

Detailed Syllabus

Cereals: Wheat (habit sketch, L. S/T.S. grain, starch grains, micro-chemical tests)Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
Legumes: Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).

Sources of sugars and starches: Sugarcane (habit sketch; cane juice- micro-chemical tests), Potato(habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, w.m. starch grains, micro-chemical tests).

Spices: Black pepper, Fennel and Clove (habit and sections).
Beverages: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
Sources of oils and fats: Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds.
Essential oil-yielding plants: Habit sketch of Rosa, Vetiveria, Santalum and Eucalyptus (specimens/photographs).
Rubber: specimen, photograph/model of tapping, samples of rubber products.
Drug-yielding plants: Specimens of Digitalis, Papaver and Cannabis.
Tobacco: specimen and products of Tobacco.
Woods: Tectona, Pinus: Specimen, Section of young stem.
Fiber-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).

Reference Books:

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture. Jones & Bartlett Publishers.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC14**

Title of the Course : **Plant Metabolism (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course attempts to make students understand and appreciate the importance of structure and function of biomolecules in metabolic pathways.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: differentiate between anabolic and catabolic pathways of metabolism (analyze);
CLO 2: recognize the importance of carbon assimilation in Nature (remember);
CLO 3: explain the catabolic pathways and electron transport system/oxidative phosphorylation leading to ATP synthesis (evaluate);
CLO 4: appreciate the structure, function and metabolism of lipids in plants (evaluate); and
CLO 5: interpret the role played by biological nitrogen fixation in Nature (apply).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	2	3	3						3		3			
CLO 2		3	3						3		3			
CLO 3		3	3						3		3			
CLO 4		3	3						3		3			
CLO 5		3	3						3		3			

Detailed Syllabus

UNIT – 1: Concepts in metabolism (L=15)
Introduction, anabolic and catabolic pathways, regulation of metabolism, enzyme regulation (allosteric, covalent modulation and isozymes).

UNIT – 2: Photosynthesis and carbohydrate metabolism (L=15)
Historical background, photosynthetic pigments, antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO2 reduction – C3, C4 and Crassulacean acid metabolism (CAM) pathways; photorespiration; factors affecting photosynthesis.

Synthesis and catabolism of sucrose and starch.

UNIT – 3: Respiration (L=15)

Glycolysis, fate of pyruvate, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, TCA cycle, mitochondrial electron transport, oxidative phosphorylation, Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, inhibitors, uncouplers and ionophores, factors affecting respiration.

UNIT – 4: Lipid metabolism and Nitrogen metabolism (L=15)

Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α-oxidation.

Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination.

Reference Books:

1. Bhatla, S.C., Lal, M.A. ***Plant Physiology, Development and Metabolism***. Springer, Singapore.
2. Buchanan, B.B., Gruissem, W. and Jones, R.L. ***Biochemistry and Molecular Biology of Plants***, 2nd edition. Wiley Blackwell, New Jearsey, U.S.
3. Hopkins, W.G., Huner, N. ***Introduction of Plant Physiology***, 4th edition, John Wiley and sons, New Jearsey, U.S
4. Jones, R.,Ougham, H., Thomas,H.,Waaland, S. ***The Molecular Life of Plants***. Chichester, England: Wiley-Blackwell.
5. Nelson, D.L., Cox, M.M. ***Lehninger Principle of Biochemistry***, 7th edition. New York, NY: W.H. Freeman, Macmillan learning.
6. Taiz, L., Zeiger, E., Moller, I.M., Murphy, A. ***Plant Physiology and Development***, 6th edition. Massachusetts: Sinauer Associates Inc. Sunderlands.
7. Harborne, J.B. ***Phytochemical Methods***. John Wiley & Sons. New York.

Teaching – Learning Strategies in brief

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Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC14 PR**

Title of the Course : **Plant Metabolism (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The course aims to give the student an idea of the basics of the various plant processes bearing a subtle relationship between the internal organization as well as metabolic processes within the plant. Complete understanding of the pigment systems and photosynthesis will broaden the concept of photosynthetic responses in plants through these practicals.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO1: learn to separate photosynthetic pigments (apply);
CLO2: recognize the importance of light and carbon dioxide in photosynthesis (understand)
CLO3: analyze the difference in respiration rate in different plant parts (analyse);
CLO4: identify the importance of Nitrate reductase in germinating leaves of different plant sources (apply);
CLO5: learn to analyse the activity of lipases in germinating oilseeds and the mobilization of lipids during germination (understand); and

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3						2		3			
CLO 2		3	3					2	2		3			
CLO 3		3	3						2		3			
CLO 4		3	3						2		3			
CLO 5		3	3						2		3			

Detailed Syllabus

1. Chemical separation of photosynthetic pigments.
2. Demonstration of Hill's reaction.
3. Effect of light intensity on the rate of photosynthesis.
4. Effect of carbon dioxide on the rate of photosynthesis.
5. Comparison of the rate of respiration in different parts of a plant.
6. Demonstrate activity of Nitrate reductase in germinating leaves of different plant sources.

7. Study the activity of lipases in germinating oilseeds and demonstration of mobilization of lipids during germination.
8. Demonstration of fluorescence by isolated chlorophyll pigments.
9. Demonstration of absorption spectrum of photosynthetic pigments.

Reference Books:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology.John Wiley and Sons.U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-DSE01**

Title of the Course : **Plant Breeding (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course strives to study the tools and techniques of improving the genetic pattern of plants in relation to their economic use. It basically advocates creating variability by breeding novel traits from diverse sources or by inducing mutations.

Course Learning Outcomes (CLOs)

On completing this course, the students should be able to
CLO 1: understand the principles and significance of plant breeding for crop improvement (understand);
CLO 2: judge the suitability of various plant breeding methods to achieve specific objectives (analyze);
CLO 3: analyze, evaluate and synthesize information relevant to plant breeding (evaluate);
CLO 4: examine prospective career-oriented choices with information regarding centers of origin, germplasm collection, conservation and cataloguing, varietal maintenance, and crop breeding through hybridization and transgenic approaches (analyze); and
CLO 5: apply the experimental procedures involved in generating new varieties using classical and contemporary breeding practices (apply).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3					3	2
CLO 2		3	3										3	2
CLO 3		3	3										3	2
CLO 4		3	3										3	2
CLO 5		3	3					3					3	2

Detailed Syllabus

UNIT – 1: Plant breeding (L=15)

Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.

UNIT – 2: Methods of crop improvement (L=15)

Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self-pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.

UNIT – 3: Inbreeding depression and heterosis (L=15)

History, genetic basis of inbreeding depression and heterosis; Applications.

UNIT – 4: Crop improvement and breeding (L=15)

Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.

Reference Books:

1. Acquaah, G. ***Principles of Plant Genetics & Breeding***. New Jearsey, U.S.: Blackwell Publishing.
2. Singh, B.D. ***Plant Breeding: Principles and Methods***, 7th edition. New Delhi, Delhi: Kalyani Publishers.
3. Chaudhari, H.K. ***Elementary Principles of Plant Breeding***, 2nd edition. New Delhi, Delhi: Oxford – IBH.

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-DSE01 PR**

Title of the Course : **Plant Breeding (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The practicals in this course will introduce the students with the fundamental concepts of plant breeding and adaptations relevant to agricultural and natural systems. They will gather knowledge of principles of breeding and detail strategies for enhancing key traits in a breeding programme.

Course Learning Outcomes (CLOs)

CLO1: introduce with the concept of breeding through the importance of different plant parts and processes (understand);
CLO2: learn to calculate Pollen: Ovule Ratio in different crops (analyse)
CLO3: develop the ability to calculate Index of self-incompatibility together with confirmation of self-Incompatibility (apply);
CLO4: understand qualitative and quantitative characteristics in selected crops and importance of pollinator (understand); and
CLO5: apply the use of molecular markers to assess genetic diversity (apply).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3					3	2
CLO 2		3	3										3	2
CLO 3		3	3										3	2
CLO 4		3	3										3	2
CLO 5		3	3					3					3	2

Detailed Syllabus

1. Introduction to field /controlled pollinations in field and laboratory (temporal details of anthesis, anther dehiscence, stigma receptivity and pollen viability, emasculation, bagging).
2. Analysis of the breeding system of chosen crop species by calculating Pollen: Ovule Ratio
3. Calculation of Index of self-incompatibility (ISI) and Confirmation of Self Incompatibility.
4. Study of Quantitative and qualitative characters in select crops.

5. Study of Pollinators.
6. Assessment of genetic diversity by using Molecular Markers.

Reference Books:

1. Acquaah, G. ***Principles of Plant Genetics & Breeding***. New Jearsey, U.S.: Blackwell Publishing.
2. Singh, B.D. ***Plant Breeding: Principles and Methods***, 7th edition. New Delhi, Delhi: Kalyani Publishers.
3. Chaudhari, H.K. ***Elementary Principles of Plant Breeding***, 2nd edition. New Delhi, Delhi: Oxford – IBH.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-DSE02**

Title of the Course : **Bioinformatics (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

This course presents the fundamentals of *in silico* biology based on the basic principles and concepts of biology, computer science and mathematics to make sense of the explosion in sequence information. Further, it pursues independent investigation to provide detailed knowledge on plant "-omics" using bioinformatics tools.

Course Learning Outcomes (CLOs)

On completing this course, the students should be able to
CLO 1: understand the basic concepts of bioinformatics and its significance in biological data analysis (understand);
CLO 2: explain the methods to characterize and manage the different types of biological data (evaluate);
CLO 3: classify the different types of biological databases (understand);
CLO 4: analyze the nuances of sequence alignment and analysis (analyze); and
CLO 5: construct meaning of the data using relevant bioinformatics software to address issues/problems in biology the protein sequence (create).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3		3				2				3	
CLO 2		3	3		3				2				3	
CLO 3		3	3		3				2				3	
CLO 4		3	3		3				2				3	
CLO 5		3	3		3				2				3	

Detailed Syllabus

UNIT – I: Introduction to bioinformatics and biological database (L=15)
Bioinformatics: Concept, chronological history, branches, aim, and scope; Classification of Biological databases: Primary, secondary, and Specialized; Nucleic acid sequence databases: NCBI, EMBL, and DDBJ; Protein sequence databases: SWISS-PROT, TrEMBL, and PIR Nucleic acid and protein structure database: PDB, CSD, and NDB

UNIT – II: Sequence alignment tools and algorithms (L=15)

Sequence alignment and database searching tools: Sequence file formats, PAM, and BLOSUM matrices, BLAST, and FAST-Alignment; Pairwise and Multiple sequence alignments: Various approaches for MSA, CLUSTAL-W/X

UNIT – III: Molecular phylogenetics (L=15)

Taxonomy and phylogeny: concepts in systematics, phenetics and cladistics, molecular evolution, significance of molecular data, modern applications of phylogenetics; Various types of phylogenetic trees: concept of cladogram, dendrograms and its interpretation; Methods of phylogenetic analysis: Distance and character-based methods, UPGMA, Fitch and Margoliash method, maximum parsimony method, maximum likely hood method, neighbour-joining method and evaluation of phylogenetic methods.

UNIT – IV: Modern applications of bioinformatics (L=15)

Structural Bioinformatics: Retrieval of Protein from PDB and visualization of secondary structure elements: RasMol, PyMol, and Chimera; Molecular Modeling and Drug Designing: Protein-ligand Docking, ADMET and QSAR; Genomics of model prokaryotic organisms: *Escherichia coli*, *Helicobacter pylori* and *Bacillus subtilis;* Applications of Bioinformatics approaches in crop improvement:

Reference Books:

1. Ghosh Z. and Bibekanand M. ***Bioinformatics: Principles and Applications***. Oxford Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition.Wiley-Blackwell.
2. Campbell A. M., Heyer L. J. ***Discovering Genomics, Proteomics and Bioinformatics***. II Edition. Benjamin Cummings.
3. ***Fundamental Concepts in Bioinformatics*** – Krane and Raymer
4. ***Introduction to Bioinformatics*** – T.K. Attwood and Parry Smith
5. ***Introduction to Bioinformatics*** – Arthur M. Lesk
6. ***Computational Molecular Biology – An algorithmic approach*** – Pavel A. Pevzner.
7. ***Biological sequence analysis***: By – Durbin R. Eddy
8. ***Bioinformatics – Sequence and Genome analysis*** By David W. Mount
9. ***Molecular Evolution and Phylogenetics*** – Nei and Kumar.

Teaching – Learning Strategies in brief

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Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-DSE02 PR**

Title of the Course : **Bioinformatics (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The practical in this course will help to manage data and allow easy access to the existing information to develop technological tools that help analyze the biological data and interpret it.

Course Learning Outcomes (CLOs)

On completing this course, the students should be able to
CLO1: understand the basic concepts of bioinformatics and its significance in analysis of nucleic acid and protein database (understand);
CLO 2: learn the methods for sequence retrieval from database (apply);
CLO 3: analyse the importance of sequence alignment in database (analyze);
CLO 4: understand the concept of sequence homology and gene annotation (understand); and
CLO 5: learn to construct phylogenetic trees to understand the concept of how genes, genomes, species and molecular sequences evolve (create).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3		3				2				3	
CLO 2		3	3		3				2				3	
CLO 3		3	3		3				2				3	
CLO 4		3	3		3				2				3	
CLO 5		3	3		3				2				3	

Detailed Syllabus

1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.
3. Sequence alignment.
4. Sequence homology and Gene annotation.
5. Construction of phylogenetic tree.

Reference Books:

1. Ghosh Z. and Bibekanand M. ***Bioinformatics: Principles and Applications***. Oxford Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition.Wiley-Blackwell.
2. Campbell A. M., Heyer L. J. ***Discovering Genomics, Proteomics and Bioinformatics***. II Edition. Benjamin Cummings.
3. ***Fundamental Concepts in Bioinformatics*** – Krane and Raymer
4. ***Introduction to Bioinformatics*** – T.K. Attwood and Parry Smith
5. ***Introduction to Bioinformatics*** – Arthur M. Lesk
6. ***Computational Molecular Biology – An algorithmic approach*** – Pavel A. Pevzner.
7. ***Biological sequence analysis***: By – Durbin R. Eddy
8. ***Bioinformatics – Sequence and Genome analysis*** By David W. Mount
9. ***Molecular Evolution and Phylogenetics*** – Nei and Kumar.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-DSE03**

Title of the Course : **Stress Biology (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course is all about the natural environmental battle between the plants and a variety of biotic (pathogens) and abiotic (salinity, drought, heat and cold stresses etc.) stresses. The course attempts to present the mechanisms of these stresses and ways and means to overcome the same.

Course Learning Outcomes (CLOs)

On completing this course, the students should be able to
CLO 1: recognize stresses that drastically affect plant growth and productivity under field conditions (understand);
CLO 2: classify the various stresses (understand);
CLO 3: examine the molecular triggers and mechanisms underlying these stresses (analyze);
CLO 4: devise methods to mitigate, manage and control these stresses (apply); and
CLO 5: translate the knowledge gained in the confines of a lecture room to the agricultural field (create).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3			3	3		2
CLO 2		3	3								3	3		
CLO 3		3	3								3	3		
CLO 4		3	3					3			3	3		
CLO 5		3	3		3						3	3		

Detailed Syllabus

UNIT – 1: Plant abiotic stress (L=15)
Concept of abiotic stress in plants; Drought stress; Salinity stress, Temperature stress, heavy metal toxicity, flooding stress

UNIT – 2: Plant biotic stress (L=15)
Concept of biotic stress in plants; Hypersensitive reaction; Pathogenesis– related (PR) proteins; Systemic acquired resistance; disease resistance mechanisms in plants.

UNIT – 3: Stress sensing and defense mechanisms in plants (L=15)
Calcium modulation, Phospholipid and MAPK signaling; reactive oxygen/nitrogen species– production and scavenging mechanisms

UNIT – 4: (L=15)
Physiological and molecular mechanisms to protect plants against environmental stress, omics strategies for stress tolerance in plants

Reference Books:

1. Hopkins, W.G. and Huner, A. ***Introduction to Plant Physiology***. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A ***Plant Physiology and Development***. Sinauer Associates Inc. USA. 6th edition.

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-DSE03 PR**

Title of the Course : **Stress Biology (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The content in this practical syllabus will enable students with the skill to enhance their knowledge about plant stress physiology through study of oxidative stress markers and antioxidants, one of the basis of understanding the concept of stress physiology.

Course Learning Outcomes (CLOs)

On completing this course, the students should be able to

CLO 1: learn the impact of oxidative stress markers in stress conditions and incorporate techniques to unravel their estimation/determination (apply);

CLO 2: explore the technique for estimation of superoxides in plant that could help in understanding stress impact on plants (apply)

CLO 3: determine the ROS/RNS content in plant sample to study adverse effect of biotic or abiotic stress on plants (analyze); and

CLO 4: diagnose the antioxidative potential in plants by determining the antioxidants content present in plant samples (apply).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3			3	3		2
CLO 2		3	3								3	3		
CLO 3		3	3								3	3		
CLO 4		3	3					3			3	3		
CLO 5		3	3		3						3	3		

Detailed Syllabus

1. Basics of oxidative stress markers and techniques used in estimation/determination in plants
2. Histochemical estimation of superoxide in plant samples.
3. Determination of ROS/RNS content in plant samples.
4. Determination of antioxidant (s) content in plant samples.

Reference Books:

1. Roy, A. Stress biology theory & practicals

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC07 PR**

Title of the Course : **Diversity of Microbes, Algae and Fungi (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The objective of this practical course is to make students familiarise about bacteria, viruses, fungi, algae and lichens through exploring morphology and life cycles and appreciate the diversity in life forms. Study of morphology, anatomy and reproduction would help in understanding the diversity in plants together with their taxonomy.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: develop an understanding of microbes through models and electron micrographs and learn the procedure of gram staining (understand);
CLO 2: acquire practical knowledge of the vegetative and reproductive structures of *Oedogonium, Chara, Vaucheria, Laminaria* and *Batrachospermum* through temporary preparations and permanent slides and learn to recognise and differentiate them (analyse); and
CLO 3: learn about the growth forms of lichens (crustose, foliose and fruticose); Mycorrhiza: ectomycorrhiza and endomycorrhiza (understand).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3	3						3				
CLO 2		3	3							3		3		
CLO 3		3	3							3		2		

Detailed Syllabus

Appreciation of (through line drawing/photographs):
EMs/Models of viruses – T-Phage and TMV, lytic and lysogenic cycle, EM of bacterium, binary fission, conjugation and root nodule; types of Bacteria as visualized from temporary/permanent slides/photographs
Gram staining.
Study of vegetative and reproductive structures of *Oedogonium* (electron micrographs), *Chara, Vaucheria, Laminaria* and *Batrachospermum* through temporary preparations and permanent slides.

Rhizopus* and *Penicillium: Asexual stage from temporary mounts and sexual structures through permanent slides.

Alternaria: Specimens/photographs and tease mounts.

Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on wheat and permanent slides of both the hosts.

Agaricus: Specimens of button stage and full-grown mushroom; Sectioning of gills of *Agaricus.*

Lichens: Study of growth forms of lichens (crustose, foliose and fruticose); Mycorrhiza: ectomycorrhiza and endomycorrhiza (Photographs)

Reference Books:

1. B. P. Pandey Modern Practical Botany Vol-I. S Chand Publishing

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic programmeme : **B.Sc. (Hons.)**

Course Code : **BBO-CC08 PR**

Title of the Course : **Archegoniate (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

After the completion of this course, students will be able to appreciate the diversity in life forms present and practically delineate the basis of their differentiation and classification.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO1: completely understand the morphology of *Marchantia* through study of its external and internal features along with sectioning of thallus, antheridiophore, archegoniophore and sporophyte (understand);

CLO2: learn the morphology of *Funaria* and the capability to differentiate it from *Marchantia* (analyse);

CLO3: understand the morphology and internal structure of *Selaginella*, *Equisetum* and *Pteris* through working on the available specimens and slides (understand and analyse);

CLO4: appreciate the gymnosperm *Cycas* and *Pinus* through study of their morphology and internal structures and differentiate the two from each other (analyze); and

CLO5: learn through photographs about Rhynia, Calamites and Lepidodendron (understand).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	2							3				
CLO 2		3	2							3		3		
CLO 3		3	2							3				
CLO 4		3	2	3						3				3
CLO 5		3	2	3						3				3

Detailed Syllabus

1. *Marchantia*- morphology of thallus, W.M. rhizoids and scales, V.S. thallus through gemma cup, W.M. gemmae (all temporary slides), V.S. antheridiophore, archegoniophore, L.S. sporophyte (all permanent slides).

2. *Funaria*- morphology, W.M. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, L.S. capsule and protonema.
3. *Selaginella*- morphology, W.M. leaf with ligule, T.S. stem, W.M. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), L.S. strobilus (permanent slide).
4. Equisetum- morphology, T.S. internode, L.S. strobilus, T.S. strobilus, W.M. sporangiophore, W.M. spores (wet and dry) (temporary slides); T.S rhizome (permanent slide).
5. *Pteris*- morphology, T.S. rachis, V.S. sporophyll, W.M. sporangium, W.M. spores (temporary slides), T.S. rhizome, W.M. prothallus with sex organs and young sporophyte (permanent slide).
6. Cycas- morphology (coralloid roots, bulbil, leaf), T.S. coralloid root, T.S. rachis, V.S. leaflet, V.S. microsporophyll, W.M. spores (temporary slides), L.S. ovule, T.S. root (permanent slide).
7. *Pinus*- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), W.M. dwarf shoot, T.S. needle, T.S. stem, L.S./T.S. male cone, W.M. microsporophyll, W.M. microspores (temporary slides), L.S. female cone, T.L.S. & R.L.S. stem (permanent slide).
8. *Rhynia*, *Calamites* and *Lepidodendron* (Study through photograph)

Reference Books:

1. B. P. Pandey Modern Practical Botany Vol-I. S Chand Publishing
2. B. P. Pandey Modern Practical Botany Vol-II. S Chand Publishing

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic programmeme : **B.Sc. (Hons.)**

Course Code : **BBO-CC09 PR**

Title of the Course : **Plant Anatomy and Embryology (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The objective of this practical is to provide basic knowledge of plant internal architecture including tissue types and their function. The anatomical differences in monocot and dicot and adaptive anatomy of plants will brighten their concept to adaptation in plants with structural modifications. The emphasis on study of ovules, pollen, anther and egg apparatus and pollination mechanism will clear understanding of the process of sexual reproduction in plants.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO1: understand the meristem concept and gather information on different types of tissues present in plants (understand);
CLO2: learn to differentiate monocot and dicot on the basis of their internal morphology in root, stem and leaves (understand);
CLO3: widen knowledge about adaptive anatomy in plants for survival under different condition (analyse);
CLO4: understand the differentiation occurring in anther or organisation in female gametophyte, ovule and egg apparatus for sexual reproduction processes (understand);
CLO4: learn about the different types of pollination and seed dispersal mechanism (understand);
CLO5: dissect embryo to analyse its structure (analyse) and;
CLO6: calculate pollen germination with the importance of the germinating medium (evaluate)

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		2	3								3			
CLO 2		2	3								3			
CLO 3		2	3								3			
CLO 4		2	3								3			
CLO 5		2	3		2						3			

Detailed Syllabus

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, 69 Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays*; Dicot: Helianthus; Secondary: *Helianthus* (only Permanent slides). 4. Root: Monocot: *Zea mays*; Dicot: Helianthus; Secondary: *Helianthus* (only Permanent slides). 5. Leaf: Dicot and Monocot leaf (only Permanent slides).
4. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
5. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
6. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
7. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
8. Ultrastructure of mature egg apparatus cells through electron micrographs.
9. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
10. Dissection of embryo/endosperm from developing seeds.
11. Calculation of percentage of germinated pollen in a given medium.

Reference Books:

1. Bhojwani, S.S. & Bhatnagar, S.P. ***Embryology of Angiosperms***. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. ***Plant Anatomy***. The Benjamin/Cummings Publisher, USA.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic programmeme : **B.Sc. (Hons.)**

Course Code : **BBO-CC10 PR**

Title of the Course : **Plant Molecular Biology (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

After completion of this course, students will be able to prepare media to cultivate *E. coli* and other microorganisms and isolate DNA and plasmid DNA from them. They will learn to appreciate the molecular biology tools and techniques for better understanding of the concepts of molecular biology of plants.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO1: learn to prepare media for cultivation of microorganisms including *E. coli* (apply);
CLO2: acquire knowledge on DNA estimation through various techniques (apply)
CLO3: Differentiate prokaryotic RNA polymerase from eukaryotic RNA polymerase II (understand); and
CLO4: gaining understanding about nucleic acid as the genetic material and concept of assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing (understanding).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3		2						3			
CLO 2		3	3		2						3			
CLO 3		3	3								3			
CLO 4		3	3								3			

Detailed Syllabus

1. Preparation of LB medium and raising *E. coli*.
2. Isolation of genomic DNA from *E. coli*.
3. DNA isolation from cauliflower head.
4. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
5. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).
6. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.

7. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel&Conrat's experiments)
   Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.

Reference Books:

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. ***Molecular Biology of the Gene***, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2. Snustad, D.P. and Simmons, M.J. ***Principles of Genetics***. John Wiley and Sons Inc., U.S.A. 5th edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. ***Concepts of Genetics***. Benjamin Cummings. U.S.A. 9th edition.
4. Russell, P. J. ***i-Genetics- A Molecular Approach***. Benjamin Cummings, U.S.A. 3rd edition.
5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. ***Introduction to Genetic Analysis***. W. H. Freeman and Co., U.S.A. 10th edition.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic programmeme : **B.Sc. (Hons.)**

Course Code : **BBO-CC11 PR**

Title of the Course : **Plant Biotechnology (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The course will help to acquire the basic concepts of biotechnology with emphasis on the fundamental cellular events that occur during the development of a plant cell. Knowledge on gene transfer methods and genetic engineering techniques will broaden the ability for carrying out molecular work together with inculcating an interest for biotechnology.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO1: learn preparation of MS media with sterilization techniques and inoculation methods (apply);
CLO2: understanding culture of anther, embryo and endosperm together with micropropagation, somatic embryogenesis & artificial seeds (understand);
CLO3: gain knowledge on construction of restriction map of circular and liner DNA from provided data (apply);
CLO4: information on steps in genetic engineering for production of genetically modified crops.
CLO5: Isolation, restriction digestion and gel electrophoresis of plasmid DNA (apply); and

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3						3				3	
CLO 2		3	3										3	
CLO 3		3	3										3	
CLO 4		3	3										3	
CLO 5		3	3			3		2					3	

Detailed Syllabus

1. Preparation of MS medium. Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of tobacco.
2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
3. Construction of restriction map of circular and linear DNA from the data provided.

4. Study of methods of gene transfer through photographs: *Agrobacterium*-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
5. Study of steps of genetic engineering for production of *Bt* cotton, Golden rice, *FlavrSavr* tomato through photographs.
6. Isolation of plasmid DNA.
7. Restriction digestion and gel electrophoresis of plasmid DNA.

Reference Books:

1. Bhojwani, S.S. and Razdan, M.K., ***Plant Tissue Culture: Theory and Practice***. Elsevier Science Amsterdam.The Netherlands.
2. Glick, B.R., Pasternak, J.J. ***Molecular Biotechnology- Principles and Applications of recombinant DNA***. ASM Press, Washington.
3. Bhojwani, S.S. and Bhatnagar, S.P. ***The Embryology of Angiosperms***. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
4. Snustad, D.P. and Simmons, M.J. ***Principles of Genetics***. John Wiley and Sons, U.K. 5th edition.
5. Stewart, C.N. Jr. ***Plant Biotechnology & Genetics: Principles***, ***Techniques and Applications***. John Wiley & Sons Inc. U.S.A.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC12 PR**

Title of the Course : **Plant Ecology and Phytogeography (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

This practical course will enrich the knowledge about the ecology of plants and inculcate in students - the major concepts, areas of current research and issues in plant ecology. They will learn about the distribution and abundance of plant species.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO1: learn to determine pH of soil and water samples and analyse the presence of carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples (analyse);
CLO2: determine organic matter in different soil samples (Walkley & Black titration) and compare bulk density, porosity and rate of infiltration of water in soils to get an understanding of type of soil (evaluate);
CLO3: enhancement in knowledge about the morphological adaptations in xerophytes and hydrophytes and the biotic interaction between stem and root parasite, epiphytes and predations (understand);
CLO4: learn quantitative analysis of herbaceous vegetation in the college campus for frequency, density and abundance (evaluate).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3									3		
CLO 2		3	3									3		
CLO 3		3	3					3				3		
CLO 4		3	3									3		

Detailed Syllabus

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper)

3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
4. Determination of organic matter of different soil samples by Walkley& Black rapid titration method.
5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
   (a). Study of morphological adaptations of hydrophytes and xerophytes (four each). (b). Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobanche*) Epiphytes, Predation (Insectivorous plants).
7. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
8. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
9. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.
10. Field visit to familiarise students with ecology of different sites.

Reference Books:

1. Odum, E.P. (2005). Fundamentals of ecology.Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation.Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment.Rastogi Publications, Meerut, India.8th edition.
4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A. 5. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-CC13 PR**

Title of the Course : **Plant Systematics (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

After completing this course, the students will be able to understand principles of taxonomy and can apply rules of nomenclature in plants and discuss its importance.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO1: recognize the vegetative and floral characteristics of plants belonging to dicots and monocots (understand)

CLO2: explore floral diversity in a specific geographical area (analyse)

CLO3: prepare a herbarium (create)

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3						3			3		
CLO 2		3	3					3	3			3		
CLO 3		3	3						3			3		

Detailed Syllabus

1. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification):
   - Ranunculaceae - *Ranunculus, Delphinium*
   - Brassicaceae - *Brassica, Alyssum / Iberis*
   - Umbelliferae - *Coriandrum /Anethum / Foeniculum*
   - Asteraceae - *Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax*
   - *Apocynaceae: Nerium, Cascabela, Catharanthus*
   - Solanaceae- *Solanum nigrum/Withania*
   - Lamiaceae - *Salvia/Ocimum*
   - Euphorbiaceae - *Euphorbia hirta/E. milii, Jatropha*
   - Liliaceae - *Asphodelus/Lilium/Allium*
   - Poaceae - *Triticum/Hordeum/Avena*

2. Field visit (local) – Subject to grant of funds from the university.

3. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Reference Books

1. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rdedition.
2. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
3. 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.
4. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi. 5. Radford, A.E. (1986). Fundamentals of Plant Systematics.Harper and Row, New York.
5. B. P. Pandey Modern Practical Botany Vol-I. S Chand Publishing

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-DSE04**

Title of the Course : **Research Methodology (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course aims at realization of the importance of research in knowledge acquisition and attempts to equip students to scientifically collect, analyze and interpret data.

Course Learning Outcomes (CLOs)

On completing this course, the students should be able to
CLO 1: gather knowledge about the basic concepts of research and tools to address research (understand and apply);
CLO 2: identify the general laboratory practices and their importance and application in research (understand and apply);
CLO 3: develop scientific knowledge on data collection and documentations of result (apply);
CLO 4: apply the art of scientific writing and ways of presenting scientific information and facts (apply); and
CLO 5: develop research ethics without indulging in academic misconduct /plagiarism (create).

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3											
CLO 2		3	3											
CLO 3		3	3											
CLO 4		3	3											
CLO 5		3	3											

Detailed Syllabus

UNIT – 1: Basic concepts of research (L=15)
Research - definition and types (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research method vs methodology.
Literature-review and its consolidation.
Library research; field research; laboratory research.

UNIT – 2: General laboratory practices (L=15)

Good laboratory practices (GLPs); Material safety data sheet (MSDS); Pipette – volumetric and micro; Disposal of harmful laboratory wastes.

Methods for expressing concentration-Molarity normality, molality, percentage.

Preparation of solutions and dilution.

UNIT – 3: Data collection and documentation of observations (L=15)

Laboratory record; tabulation and generation of graphs; imaging of specimens; field photography.

UNIT – 4: The art of scientific writing and its presentation (L=15)

Scientific writing - numbers, units, abbreviations and nomenclature as used in scientific writing; quoting references; copyright; ethics and academic misconduct/plagiarism.

Information documentation and presentation – word document, powerpoint and poster;

Reference Books:

1. Dawson, C. ***Practical Research Methods***.UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. ***Scientific writing for agricultural research scientists – a training reference manual***. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S.E. ***Plant microtechnique and microscopy***. Oxford University Press, New York, U.S.A.

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-DSE04 PR**

Title of the Course : **Research Methodology (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

This course will provide students with a general introduction to the methodologies used and tools employed to perform experiments and impart knowledge of scientific writing with the concept of plagiarism, oral presentation and art of photography much relevant to the research work.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO1: learn general calculations that are used in experiments (apply);
CLO2: exposure to different micro technique experiments (apply);
CLO3: learn the art of imaging through microphotography and field photography (apply); and
CLO4: become competent in poster presentation and technical writing (apply)

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3										3	
CLO 2		3	3										3	
CLO 3		3	3										3	
CLO 4		3	3										3	

Detailed Syllabus

1. Experiments based on chemical calculations.
2. Plant microtechnique experiments.
3. The art of imaging of samples through microphotography and field photography.
4. Poster presentation on defined topics.
5. Technical writing on topics assigned.

Reference Books:

1. Dawson, C. ***Practical Research Methods***.UBS Publishers, New Delhi.

2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. ***Scientific writing for agricultural research scientists – a training reference manual***. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S.E. ***Plant microtechnique and microscopy***. Oxford University Press, New York, U.S.A.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc.(Hons.)**

Course Code : **BBO-DSE05**

Title of the Course : **Research Project**

Credits : **6**

L=Lecture; T=Tutorial; P=Practical : L=**90,** T=**0**, **P=0**

Course Objectives

The purpose of this course is to engage students in active learning through minor projects and to develop their analytical thinking and problem-solving abilities under the guidance of a mentor. This course will instruct students how to carry out scientific research so that they can go on to get professional training or venture into research and development in any field of botany.

Course Learning Outcomes

On completing this course, the students should be able to
CLO 1: think critically, plan and carry out a research project independently (apply);
CLO 2: gather, analyze and execute data in the right manner (analyze);
CLO 3: acquire proficiency in handling instruments (understand); and
CLO 4: enhance scientific writing skill (create);

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3								3			3	
CLO 2			3										3	
CLO 3				3									3	
CLO 4				3									3	

Course Content

The students will be allotted topics for project work in the beginning of the academic session, under the supervision of the concerned teacher(s) as decided by the Head of the Department, keeping in view the student's desire and the teacher's consent. The students will complete the assigned work in the department or at any other laboratory/institute identified and arranged for this purpose. **They will submit a dissertation which will contain some original experimental data and their interpretation, in addition to the survey of relevant literature**. The student may deliver a seminar lecturer or face the *viva voce* by a panel of teachers appointed by the Head of the Department. The dissertations will be

examined by a panel of examiners including the external examiner(s) who will also conduct oral examination of the students.

Teaching – Learning Strategies in brief

Learning by doing is the major teaching-learning strategy for realizing the objectives envisaged in work related to research project.

Assessment methods and weightages in brief

There will be periodic assessment of the progress of research work carried out under the mentorship of a faculty member. A total of 150 marks are earmarked for the project work out of which 37 marks are allotted for internal assessment and the external *viva-voce* examination will be conducted for 113 marks.

DEPARTMENT OF BOTANY

Name of the Academic Programme	: **B.Sc. (Hons.)**
Course Code	: **BBO-GE02 PR**
Title of the Course	: **Bioethics and IPR (Practical)**
Credits	:
L=Lecture; T=Tutorial; P=Practical	: L=**0,** T=**0**, **P=30**

Course Objectives

To be provided by the Department of …….

Course Learning Outcomes (CLOs)

Reference Books:

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme	: **B.Sc. (Hons.)**
Course Code	: **BBO-GE02-B PR**
Title of the Course	: **Biotechnology and Human Welfare (Practical)**
Credits	: **2**
L=Lecture; T=Tutorial; P=Practical	: L=**0,** T=**0**, **P=30**

Course Objectives

To be provided by the Department of Biotechnology

Course Learning Outcomes (CLOs)

Reference Books:

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF BOTANY

Name of the Academic Programme : **B.Sc. (Hons.)**

Course Code : **BBO-GE03 PR**

Title of the Course : **Environmental Biotechnology (Practical)**

Credits : 2

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

This course aims to introduce to students the impact of different chemicals on microorganisms and quality of soil and water. The course aims to explore the various chemical and biological ways and means that can be applied to identify and rectify environmental deterioration.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO1: analyse the quality of water and soil (analyse);
CLO2: gravimetric analysis of effluents (analyse); and
CLO3: microbial assessment of air and water sample (evaluate)

Mapping of Course Learning Outcomes (CLOs) with programme Learning Outcomes (PLOs) and programme Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3			3				3		3		
CLO 2		3	3									3		
CLO 3		3	3			3						3		

Detailed Syllabus

1. Water/Soil analysis - DO, salinity, pH, chloride, total hardness, alkalinity, acidity, nitrate, calcium, Magnesium and phosphorus.
2. Gravimetric analysis-Total solid, dissolved solid, suspended solid in an effluent
3. Microbial assessment of air (open plate and air sample) and water

Reference Books:

1. ***Waste water engineering - treatment, disposal and reuse***, Metcalf and Eddy Inc., Tata McGraw Hill, New Delhi.
2. ***Bioremidation***, Baaker, KH and Herson D.S. Mc.GrawHillInc, NewYork.
3. ***Industrial and Environmental Biotechnology,*** Nuzhat Ahmed, Fouad M. Qureshi and Obaid Y. Khan, Horizon Press.
4. ***Environmental Molecular Biology***, Paul. A, Rochelle, Horizon Press.
5. ***Environmental Protection and Laws*** by Jadhav and Bhosale, V.M.Himalaya publ. House

6. ***Biodiversity Assessment and Conservation*** by PC Trivedi, Agrobiospubl

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).