SCHEME & SYLLABUS

B. Sc. Life Sciences/Discipline Specific

(3/4 years Honours and Honours with Research)

Four Year Under-Graduate (FYUG) Programme as per NEP

Choice Based Credit System Semester Scheme with Multiple Entry and Exit Options in the Undergraduate and Post-graduate Degree Programmes

Programe Code: UG046

(Academic Session 2024-25 onwards)

Department of Life Sciences
(UIS)
Sant Baba Bhag Singh University
2024

ABOUT THE DEPARTMENT

The department of Life Sciences formerly known as the Department of Natural Sciences was established in the year 2015 with only two UG programmes. Over the years this department has flourished and is offering various Programmes and courses at graduate, post-graduate and doctorate level in field of Botany, Zoology, Biotechnology, Biochemistry, Microbiology and Laboratory Sciences. The department is nurtured by the highly qualified and dedicated Faculty, honoured by various international and national awards. The department is blessed to have specialized faculties in various fields of Life Sciences viz. Plant physiology, Plant Biochemistry, Plant Microbe interaction, Stress Physiology, Chemical ecology, Microbial Physiology, Industrial Microbiology, Clinical microbiology, Microbial Biotechnology, Animal Biotechnology, Fisheries, Parasitology, Molecular biology, Entomology, Sericulture, Animal toxicology, Endocrinology, Biochemistry and Biodiversity.

SALIENT FEATURES OF THE DEPARTMENT

- At SBBS University the focus of Department is on conducting innovative teaching, fundamental multidisciplinary research in life sciences.
- The department is disseminating various educational missions via e-learning platform in the form of SWAYAM, Virtual lab etc.
- The department is equipped with a number of instruments and facilities like, UV- Visible Spectrophotometer, High Speed Centrifuge, Deep Freezer, Laminar Air flow, Air Samplers, Autoclave, Incubator, Photo actometer, Air condition Labs, WiFi, Library etc.
- The department has organized a large number of conferences, seminars, symposia and workshops. National and International eminent scientists of the country have been associated with the Department as visiting and honorary professors.
- Curricular and the co-curricular activities are well balanced in the Teaching Learning environment to provide holistic education to the students.
- The outcome based teaching model of faculty comprising of theoretical work, regular academic activities such as research projects, seminars, resource learning and hands-on laboratory work.

ABOUT THE PROGRAMME

B. Sc. (Honours/ Honours with Research)
[Four Year Under-Graduate (FYUG) Programme as per NEP]

B. Sc. (Honours/ Honours with Research) is a 4 year Under-Graduate (FYUG) Programme as per NEP which is Choice Based Credit System Semester Scheme with Multiple Entry and Exit Options in the Undergraduate and Post-graduate Degree Programmes. This course is fundamentally based on the basic principles of scientific studies namely Zoology, Chemistry and Botany for the synthesis, analysis and instrumentation. Knowledge of these basic subjects is essential for thorough understanding of the concepts and applications of Zoology, Chemistry and Botany which will help students to understand the fundamentals laws of nature which are essential in understanding the principles of the technology.

VISION

To bridge the gap between demand and supply for Life Sciences and Allied Health Professionals with grooming young generations along with their moral and spiritual development.

MISSION

To radiate the knowledge of Life Sciences and Allied Health Sciences through quality education by using latest technology, modern infrastructure and the framework needed for the development of professionals.

ELIGIBILITY CRITERIA

10+2 with physics, chemistry and biology as their main subject by a recognizedBoard/University/Council with minimum aggregate of 50 % marks (45 % in case of candidate belonging to reserve category).

DURATION

4 Years

CAREER PATHWAYS

The program is designed to meet the growing requirement of qualified professionals in field of IT industry and education. B.Sc. graduates are hired both by Government and private organizations. They may join Post Graduation Courses further.

- **Government Jobs:** Prepare students for various government jobs such as banking sector, civil services etc.
- **Higher Studies:** This pathway prepares students for Higher Studies and helps in their researchalso.
- **Entrepreneurship:** To set up new ventures.

PROGRAMME EDUCATIONAL OBJECTIVE (PEO)

PEO1: To provides a hands-on experience of the latest techniques that are in current usage both in the advanced research laboratories and in Industry.
PEO2: To improves critical and analytical abilities.
PEO3: To inculcates scientific ideas in the students for new discoveries in the fields of the biological sciences.
PEO4: To facilitate higher education and professional skills amongst students

PROGRAMME OUTCOMES (PO)

PO1.Disciplinary Knowledge: Students will be able to understand specialized areas and explain major concepts in the Life sciences and its applications.

PO2: Critical Thinking: Critical thinking as an attribute enables a student to identify, formulate and analyze a complex variety of problems in Life Sciences (Zoology, Chemistry &Botany).

PO3: Problem Solving: The student will be well-equipped to solve complex problems related to Zoology, Chemistry & Botany that are best approached with critical thinking.

PO4: Practical skills: Student will be able to demonstrate the ability to read, understand, and critically review scientific information.

PO5: Modern Tool Usage: Increasing the usage of appropriate techniques, resources having interface with computers and use of computers in laboratory work creates this attribute.

PO6: Multicultural Competence: Development of a set of competencies in order to enhance and promote the growth of multicultural sensitivity with in universities to assess societal, health, safety, legal and cultural issues. Integrating multicultural awareness such as race, gender, physical ability, age, income and other social variables and by creating an environment that is, welcoming for all students"

PO7: Environment & Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Research related skills & Ethics: Students will be able to motivate and communicate scientific knowledge in oral and written form accurately using a range of formats.

PO9:Self-directed Learning: Students are encouraged to accept challenges in Life Sciences by information available to them. Various activities/advanced ideas equip the students to find relevant information and educate themselves.

PO10: Individual and Team Work: Leadership is essential in making teamwork into a reality. Working in teams promotes both teamwork and leadership qualities in the student. Teams may comprise of peers in classroom, laboratory or any other team of members from diverse fields. The student is capable of contributing meaningfully to team ethos and goals.

PO11: Communication Skills: Effective communication is a much desirable attribute across courses. However, a Chemistry student is expected to assimilate technical information about chemistry from various sources and convey it to intended audience, both orally and in writing in an intelligible manner.

PO12: Life long Learning: Having a strong conceptual framework in the subject along with the skills of teamwork, analytical reasoning, problem solving, critical thinking etc. make the students lifelong learners.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1: Graduates will be able to explain how organisms function at the level of gene, genetic data, cells, tissues, organ and organ system level.

PSO2: Graduates will be able to understand the physiological adaptations, development, reproduction and diversity of different forms of life.

PSO3: Graduates will understand the different morphological features of animals & plants. They will also understand the genetics and variations of different organisms.

PSO4: Graduates will be able to understand chemical nomenclature, classification, structure and reactivity of organic and inorganic matter.

Salient Features of the Four Years Multidisciplinary Undergraduate Programmes with Multiple Entry and Exit Options (Four-Year Choice Based Credit System Semester Scheme)

1. The Undergraduate (UG) degree programmes of either 3 or 4-year duration, shall be structured in a semester mode with multiple exit options with the followings with multiple entry and exit points and re-entry options, with appropriate certifications such as:

a) Certification (UG Certificate) at the completion of first year (1 year = 2 semesters)

b) Diploma (UG Diploma) at the completion of second year (2 years = 4 semesters)

c) Bachelor's Degree at the completion of third year (3 years = 6 semesters)

2. The candidate who completes the four yearsUndergraduate Program, either in one stretch or through multiple exits and re-entries (within the stipulated maximum period of seven years) would get a Bachelor's degree with Honours or Research. For example:

a) Bachelor's Degree (Honours) at the completion of fourth year (4 years = 8 semesters)

b) Bachelor's Degree (Honours with Research) at the completion of fourth year (4 years = 8 semesters)

3. The four years undergraduate Honours degree holders with a research component anda suitable grade are eligible to enter the

- Ph.D. (Doctoral) Programme in a relevant discipline or
- Two Semester Master's Degree programme with project/research work

4. Candidates who wish to enter the master's/doctoral programme in a discipline other than the major discipline studied at the undergraduate programmes, have to take additional courses in the new discipline to meet the requirement or to make up thegap between the requirement and the courses already studied.

5. There may be parallel five years integrated master's degree programmes with exit options at the completion of third and fourth years, with the undergraduate degree andundergraduate degree with honours in a discipline, respectively.

6. There may also be an integrated doctoral programme with an exit option at the end of the first year with the Master's degree.

7. The students who exit with Certification, Diploma and Basic Bachelor Degree shallbe eligible to re-enter the programme at the exit level to complete the programme or to complete the next level.

8. The areas of specialization which the students are required to choose are either two disciplines/ subjects or a discipline called **'major course'**. Students gain deep disciplinary knowledge through theory and practical experiences in their area of specialization (major). Students should secure the prescribed number of credits (about 50% of total credits) through core courses in the major discipline.

9. The areas of additional discipline which the students are required to choose are called **'minor course'**. Students gain a reasonable understanding of the area of additional study (minor) that they choose.

10. The students may study two disciplines at the same level or breadth up to the sixth semester and choose one of them for study in the fourth year to obtain **the Honours degree in that discipline**. A student who wishes to get **dual honours degrees** may repeat the fourth year of the program in the second discipline.

11. The students may choose one discipline and vocational subject or Teacher Education for their study in the undergraduate program. This will enable them to get an Honours degree either in the discipline or in the vocational subject/ Teacher Education or both,in the discipline and in the vocational subject/ Teacher Education.

12. Students shall be given options to choose courses from a basket of courses being offering.

CURRICULUM STRUCTURE AS PER NEP

Under Graduate (UG) Degree of 3 or 4 (FYUGP – Honours/ Honours with Research) years:

1. **Discipline Specific Core (DSC):** Discipline Specific Core (DSC) is a course of study which is to be pursued by a student as a mandatory requirement of his/her study. The DSCs specified in the framework would be identified by the concerned Department as core courses to be taught in a program. DSC is also known as Major discipline and subject of main focus and the degree will be awarded in that discipline. Students should secure the prescribed number of credits (50% of total credits) through core courses in the major discipline.

   For example, for the award of single discipline specific Honours Degree, such as BA (Honours) History, B.Com (Honours), B.Sc. (Honours) Physics and similar such programs, DSCs shall be the core courses of History, Commerce and Physics respectively.

   However, to pursue Honours Degree Program in a 'Field of Multidisciplinary Courses of study' (rather than a single discipline) such as B.Sc. (Honours) Life Sciences, BA (Honours) Social Sciences/ Humanities, the DSCs shall comprise of core credit courses of more than one discipline. For example, for B.Sc. (Honours) Life Sciences program, a student shall study credit courses of three disciplines i.e., Botany, Zoology and Chemistry. DSC may be of Discipline *viz*., Botany, Zoology and Chemistry. However, the fourth year of such Honours and Honours with Research Degree program shall be devoted to the study of only one discipline. Hence, the DSC courses in the VII and VIII semesters shall be of discipline Botany or Zoology or Chemistry, and not a combination of three disciplines.
2. **Discipline Specific Elective (DSE):** Discipline Specific Elective (DSE) shall be from a pool of credit courses of that particular discipline (single discipline program of study) or those disciplines (multidisciplinary program of study) as the case may be, which a student chooses to study from his/ her particular discipline(s) and framework of DSEs is to be decided by the concerned department.

   For example, to pursue B.Sc. (Honours) Physics, DSEs chosen should be from a pool of DSEs of Physics. Similarly, to pursue B.Sc. (Honours) Life Sciences program, the DSEs chosen should be a pool of courses of DSEs of Botany, Zoology and Chemistry, the core subjects for program of study.
3. **Generic Elective (GE)**: Generic Electives shall a pool of courses, which is meant to provide multidisciplinary or interdisciplinary education to students. GEs shall consist of a pool of courses offered by various disciplines of study (excluding the GEs offered by the parent discipline and unrelated to DSC). In case, a student opts for DSEs beyond his/her discipline specific course(s) of study, such DSEs shall be treated as GEs for that student. It can be stated Open Elective (OE) as well.
4. **Multidisciplinary Courses (MDC)**: Student has to go through **3 introductory level courses related to multi-disciplines of 9 credits** and student has to make the choice of the different disciplines in three different semesters.
5. **Ability Enhancement Courses (AEC):** AEC of 8 credits and will be related to languages (Modern Indian Language and English) and in two years (in first four semesters), student will do the course of 2 credits in each semester.
6. **Skills Enhancement Courses (SEC):** SEC of 9 credits will impart practical training and skills, hands-on training, soft skills to enhance the employability of the students. The courses may be designed as per the needs of the students and the resources of the university.
7. **Value Added Courses (VAC)**: VAC of 6 credits will be offered in first two semesters. VAC will be the courses beyond the curriculum domain and is to enhance the personality.
8. **Physical Training (PT):** In this University, in first four semesters, non-credit PT courses of 2 contact hours a week (namely PT-I, PT-II, PT-III and PT-IV) will be offered from bucket of NCC, NSS, NSO, Co-curricular (Literary or Cultural) activities.

Name of Programme: B.Sc. (Life Sciences), (3 year/4 years Honours or Honours with research)

Eligibility: In addition to other eligibility criteria, students who have successfully completed Grade 12 School Leaving Certificate shall be eligible for admission to a first-degree program.

Nomenclature of Degree/Programme: The Under Graduate Degree will be either of 3 year or 4 year duration, with multiple exit options within this period, with appropriate certifications.

I. **UG Certificate** after completing 1 year in a discipline or field including vocational and professional areas with minimum 40 credits in two semesters and also, to do another vocational course having theory and practical of 4 credits during summer term or internship/apprenticeship (**from 1st June to 30th July) of the first year,** in addition to 6 credits from skill based courses earned during first and second semester as required in first year (if already earned 3 credits from second semester then another 3 credits to be earned: with a total 6 credits to be completed from skill based courses during the summer term).

II. **UG Diploma** after 2 years of study with required credits and complete one vocational course of 4 credits during the summer vocation of the second year.

In case, student wants to make exit after 1st and 2nd year for **UG Certificate** (minimum 40 credits) or **UG Diploma** minimum 80 Credits) after two years, he will communicate the University by 31st March by filling the required Proforma, so that necessary arrangement for doing vocational course and pending skill based course if any, could be made in advance,

otherwise the University will not be responsible for the required exit. Internship/Apprenticeships may be carried out in a local firm, local industry or organization or Training in Labs with faculty and researchers in their own or other HEI/research institutions, health allied areas, local governments (such as Panchayats, Municipalities, Parliament or elected representatives, media organizations or any other enterprise), in which students may be engaged with the practical side of the training to help them in employability. These students are allowed to re-enter the degree program within three years and complete the degree program within the stipulated maximum period of seven years.

2. NOMENCLATURE USED:

A. Graduate Core Courses
Discipline Specific Core (DSC)
Discipline Specific Elective (DSE)
Theory subject (T)
Practical (P)

Minor
i. Ability Enhancement Courses (AEC)
ii. Skill Enhancement Courses (SEC)
iii. Value added Courses (VAC)
iv. Multi disciplinary Courses (MDC)
v. Generic Elective (GE)

Course Scheme for B. Sc. Life Sciences/Discipline Specific
(3/4 years Honours and Honours with Research)
Semester I

I. Theory Subjects

S. No.	Course Category	Course Sub-Category	Course Code	Course Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit
1	Major/Minor	DSC-I	BOT161	Botany I: Introduction to Microbes and Plant Kingdom	4:0:0	4:0:0	4	4
2	Major/Minor	DSC-II	CHM161	Chemistry I : Fundamentals of Chemistry	4:0:0	4:0:0	4	4
3	Major/Minor	DSC-III	ZOO161	Zoology I: Animal Biodiversity	4:0:0	4:0:0	4	4
4	MDC-1	MDC-I	MDC074	Multidisciplinary Course-I Basics of Artificial Intelligence	3:0:0	3:0:0	3	3
5	AEC-1	AEC-I	AEC0010	Ability Enhancement Course-I Communication Skills in English-I	2:0:0	2:0:0	2	2
7	VAC-1	VAC-I	VAC036	Value Added Course-I Indian Knowledge System (IKS): Concepts and Applications in Sciences	3:0:0	3:0:0	3	3

II. Practical Subjects

1	Major/Minor	DSC	BOT163	Botany I: Introduction to Microbes and Plant Kingdom (Practical)	0:0:2	0:0:2	2	1
2	Major/Minor	DSC	CHM163	Chemistry I: Chemical Analysis I (Practical)	0:0:2	0:0:2	2	1
3	Major/Minor	DSC	ZOO163	Zoology I: Animal Biodiversity	0:0:2	0:0:2	2	1
4	Physical Training-1	PT-I	PT161/ PT163/ PT165/ PT167	NSO/ NCC/ NSS/ Cultural & Literary Activities	2:0:0	Non-credit	2	NC
				Total			**28**	**23**

Total Contact Hours: 28
Total Credit Hours: 23

DSC: Discipline Specific Core Course
AEC-Ability Enhancement Compulsory Courses
MDC: Multidisciplinary/Interdisciplinary
VAC: Value added Course

Please Note: In Value-added courses student can opt for MOOC/SWAYAM Course of equivalent or more credits.

Course Scheme for B. Sc. Life Sciences/Discipline Specific
(3/4 years Honours and Honours with Research)
Semester II

I. Theory Subjects

S No.	Type of Course		Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	otal Credit Hours
1	Major/Minor	DSC-IV	BOT162	Botany II : Fundamentals of Plant Ecology and Systematics	4:0:0	4:0:0	4	4
2	Major/Minor	DSC-V	CHM162	Chemistry II: Inorganic & Physical Chemistry-I	4:0:0	4:0:0	4	4
3	Major/Minor	DSC-VI	ZOO162	Zoology II: Comparative Anatomy and Developmental Biology of Vertebrates	4:0:0	4:0:0	4	4
5	AEC-2	AEC-II	AEC0011	Ability Enhancement Course- II Communication Skill in English–II	2:0:0	2:0:0	2	2
6	SEC-1	SEC-I	SEC016 SEC021	Skill Enhancement Course-I Honey Processing, Packaging and Entrepreneurship Nursery and Gardening	3:0:0	3:0:0	3	3
7	VAC-2	VAC-II	EVS200	Value added course-II Vedic Science Environment Education	4:0:0	4:0:0	4	4

II. Practical Subjects

1	Major (DS)	DSC	BOT164	Botany II : Fundamentals of Plant Ecology and Systematics	0:0:2	0:0:1	2	1
2	Major (DS)	DSC	CHM164	Chemical Analysis II(Practical)	0:0:2	0:0:1	2	1
3	Major (DS)	DSC	ZOO164	Zoology II: Comparative Anatomy and Developmental Biology of Vertebrates (Practical)	0:0:2	0:0:1	2	1
4	Physical Training-2	PT-II	PT162/ PT164/ PT166/ PT168	NSO/ NCC/ NSS/ Cultural & Literary Activities	2:0:0	Non-credit	2	NC
Total							**28**	**23**

Total Contact Hours: 28
Total Credit Hours: 23

DSC: Discipline Specific Core Course
AEC-Ability Enhancement Compulsory Courses
SEC: Skill Enhancement Course
MDC: Multidisciplinary/Interdisciplinary
VAC: Value added Course
VOC: *Vocational course/summer internship is mandatory for students who are willing to exit after 2nd sem

1.	VOC/Summer Internship	VOOC002 VOOC005	Landscaping and Nursery Management Vermitechnology	4:0:0	4:0:0	4	4

Course Scheme for B. Sc. Life Sciences/Discipline Specific
(3/4 years Honours and Honours with Research)
Semester III

I. Theory Subjects

S. No.	Type of Course		Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit
1	Major Course 7	DSC	BOT261	Botany III: Plant Anatomy	3:0:0	3:0:0	3	3
2	Major Course 8	DSC	CHM261	Chemistry III: Physical Chemistry (Solutions, Phase and Ionic Equilibrium, Conductance and Electrochemistry)	3:0:0	3:0:0	3	3
3	Major Course 9	DSC	ZOO261	Zoology III: Structure & Function of Invertebrates	3:0:0	3:0:0	3	3
4	Major Course 10	DSE	ZOO269	IKS: Ethnozoology-II	4:0:0	4:0:0	4	4
5	Minor Course 1		BOT265 CHM265 ZOO265	Elective subject-I (anyone of the following) Medicinal Botany Basic Analytical Chemistry Sericulture	4:0:0	4:0:0	4	4
6	Minor Course 2		BOT267 CHM267 ZOO267	Elective Subject-II (anyone of the following) Floriculture Green Methods in Chemistry Medical Diagnostics	4:0:0	4:0:0	4	4
7	AEC	AEC-III	AEC0012	Ability Enhancement Course- III Communication Skill in English– III	2:0:0	2:0:0	2	2
8	SEC	SEC-II	SEC015	Skill Enhancement-II Vermicomposting & Entrepreneurship	3:0:0	3:0:0	3	3
9	MDC	MDC-II	MDC072	Multidisciplinary Course-II Human Rights	3:0:0	3:0:0	3	3

II. Practical Subjects

1	Major Course	DSC	BOT263	Botany III: Practical Course on Plant Anatomy	0:0:2	0:0:1	2	1
2	Major Course	DSC	CHM263	Basics of Organic Chemistry and Physical Chemistry Practical	0:0:2	0:0:1	2	1
3	Major Course	DSC	ZOO263	Zoology III: Structure & Function of Invertebrates Practical	0:0:2	0:0:1	2	1
		Total					**35**	**32**

Total Contact Hours: 32
Total Credit: 35

Course Scheme for B. Sc. Life Sciences/Discipline Specific
(3/4 years Honours and Honours with Research)
Semester IV

I. Theory Subjects

S No.	Type of Course		Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit
1	Major Course 11	DSC	BOT262	Botany IV: Essentials of Plant Physiology and Biochemistry	3:0:0	3:0:0	3	3
2	Major Course 12	DSC	CHM262	Chemistry IV: Transition Metals & Coordination Chemistry, Organic Functional Groups - II	3:0:0	3:0:0	3	3
3	Major Course 13	DSC	ZOO262	Zoology IV - A: Biosystematics, Taxonomy & Evolution	3:0:0	3:0:0	3	3
4	Major Course 14	DSE	BOT270	IKS: Vrikshayurveda	3:0:0	3:0:0	3	3
5	Minor Course 3		BOT266 CHM266 ZOO266	Elective Subject-III (anyone of the following) Ethnobotany Fuel Chemistry Apiculture	4:0:0	4:0:0	4	4
6	Minor Course 4		BOT268 CHM268 ZOO268	Elective Subject-IV (anyone of the following) Mushroom Culture Technology Pharmaceutical Chemistry Aquarium Fish Keeping	4:0:0	4:0:0	4	4
7	AEC	AEC-IV	AEC0013	(Ability Enhancement Course- IV) Communication Skill in English– IV	2:0:0	2:0:0	2	2
8	SEC	SEC-III	SEC017	Skill Enhancement-II Introduction to Bioinformatics	3:0:0	3:0:0	3	3
9	MDC	MDC-III	MDC017	(Multidisciplinary Course-II) Nutrition and Health Education/Food Security	3:0:0	3:0:0	3	3

II. Practical Subjects

1	Major Course	DSC	BOT264	Botany IV: Practical Course on Essentials of Plant Physiology and Biochemistry	0:0:2	0:0:1	2	1
2	Major Course	DSC	CHM264	Chemistry IV: Transition Metals & Coordination Chemistry, Organic Functional Groups – II Practical	0:0:2	0:0:1	2	1
3	Major Course	DSC	ZOO264	Zoology IV - A: Biosystematics, Taxonomy & Evolution Practical	0:0:2	0:0:1	2	1
4	Major Course	DSE	BOT272	IKS: Practical Course on Vrikshayurveda	0:0:2	0:0:1	2	1
5	Physical Training-3	PT-IV	PT262/ PT264/ PT266/ PT268	NSO/ NCC/ NSS/ Cultural & Literary Activities	2:0:0	Non-credit	2	NC
		Total					**38**	**32**

Total Contact Hours: 38
Total Credits: 32

AEC- Ability Enhancement Course
SEC- Skill Enhancement Course

(Major/Minor Courses)

DISCIPLINE SPECIFIC CORE COURSES

(Semester I-IV)

SEMESTER

Ist

BOTANY I: INTRODUCTION TO MICROBES AND PLANT KINGDOM

Semester	**I**
Course Code	**BOT161**
Course Title	**Botany I: Introduction to Microbes and Plant Kingdom**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	The aim of this course is to enable the students to 1. Impart knowledge about various life forms from microbes to gymnosperms 2. Establishment of phylogenetic relationship through classification of various life forms from microbes to gymnosperms and development of systems from simple to complex with division of labour.
Course outcomes (CO)	Student will able to 1. Understand about the diversity of virus, bacteriophages, bacteria and their economic importance. 2. Understand about the diversity, distribution, ecology life cycle and economic importance of algae. 3. Understand about the diversity, distribution, ecology life cycle of some genera of fungi, symbiotic association like lichens, mycorhizza and their significance 4. Understand about the diversity archaegoniates (Bryophytes, Pteridophytes and Gymnosperm) their distribution, morphology, anatomy, ecology, life cycle and economic importance.

Syllabus
(Theory Course)

Unit-I

Microbial Diversity: Microbes-Introduction and significance; hierarchical organization of microbes in living world. Microbes-Whittaker's Five Kingdom concept; distribution in soil, air, water and food; economic importance. Viruses-Discovery, structure, general account of plant and animal viruses and bacteriophages, concept of lytic and lysogenic cycles. Bacteria-Discovery, general characteristics, cell structure and modes of reproduction.

Unit-II

Algal, Fungal and Lichen Diversity: Algae-Distribution, habitat, thallus organization, cell structure, pigments and reservefood, general reproduction, life cycle and economic importance (in brief). Fungi- Occurrence, general characteristics, cell structure, reproduction, life cycle and economic importance (in brief). Lichen-Morphology, types and reproduction; economic importance. Mycorrhiza-General account, types and significance.

Unit-III

Cryptogam Diversity: Bryophytes- Origin, occurrence, thallus structure and general features. Bryophytes- lternation of generations; reproduction and life cycle; ecological and economic importance (in brief). Pteridophytes-General features, affinity with bryophytes, occurrence and alternation of generations. Pteridophytes - Reproduction, life cycle and economic importance.

Unit-IV

Phanerogam Diversity: Gymnosperms-Distribution, general characters, reproduction and life cycle. Gymnosperms-Affinities and evolutionary significance; economic importance. Angiosperms-Occurrence and general features; reproduction and life cycle. Angiosperms-Categorization into monocots and dicots; economic and evolutionary significance (in brief).

Text and Reference books:

S. No.	Book Title	Author	Publisher
1	Diversity of Microbes and Cryptogams	H.N.Srivastava	Pradeep Publisher
2	Text Book of Thallophytes	O.P.Sharma	McGraw Hill Publishing Co.
3	Text Book of Pteridophyta	O.P.Sharma	McMillan India Ltd
4	Cryptogamic Botany, Vol. II, Bryophytes & Pteridophytes	G.M Smith	Tata McGraw Publisher
5	Botany for degree students B. Sc 1st Year	V K Aggarwal	S. Chand Publishing
6	A Text book of Botany-I	S.P. Jain	Rastogi Publishers
7	University Botany-I, Algae, Fungi, Bryophyta &Pteridophyta	S.M. Reddy	New Age International Publisher
	Microbial Diversity: Form and Function in Prokaryotes	Oladele Ogunseitan	Wiley- Blackwell
	Pteridophyta	Vashistha, P.C., Sinha, A.K., Kumar, A.	S. Chand. Delhi, India
	Gymnosperms	Bhatnagar, S.P., Moitra, A.	New Age International (P) Ltd Publishers, New Delhi, India

CHEMISTRY I: FUNDAMENTALS OF CHEMISTRY

Course Code	**CHM161**
Course Title	**Chemistry I: Fundamentals of Chemistry**
Type of course	**Major (DSC)**
L T P	4 0 0
Credits	4
Course prerequisite	10+2 with chemistry as core subject
Course Objective	The aim of the subject is to enhance the knowledge of students in Chemical bonding atomic / molecular structure, About basic concepts of inorganic chemistry.
Course Outcomes	**By the end of the course, students will be able to** CO1 acquire coherent knowledge of models of atomic structure in explaining various chemical phenomenon. CO2 Apply the Concept of periodicity trends in the atomic properties in predicting the chemical behaviour of atoms. CO3 Understand the basic concepts and phenomenon of organic chemistry CO4 Understand the basics of gaseous state. CO5 Derive mathematical expressions for different properties of gas and understand their physical significance.

UNIT I

Introduction to Indian ancient chemistry and contribution of Indian chemists. Atomic Structure: Dual nature of electron, de Broglie hypothesis, Heisenberg uncertainty principle, Schrodinger wave equation, significance of Ψ and Ψ 2 , concept of atomic orbitals, shapes of s, p, d orbitals, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s , 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals.

Significance of quantum numbers, Normalized and orthogonal wave functions. Contour boundary and probability diagrams. Orbital angular momentum and quantum numbers. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Energies of atomic orbitals, Anomalous electronic configurations. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

UNIT II

Periodicity of Elements: s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s and p-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
(b) Atomic radii (van der Waals)
(c) Ionic and crystal radii.
(d) Covalent radii (octahedral and tetrahedral)
(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
(f) Electron gain enthalpy, trends of electron gain enthalpy.
(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

UNIT III

Basic Concepts in Organic Chemistry Electronic effects (inductive, resonance, hyperconjugation) and steric effects and their applications (acid/base property). Hydrogen bonding. Electrophiles and nucleophiles, nucleophilicity and basicity..Energy considerations. Reactive intermediates: carbocations, carbanions, free radicals, carbenes, arynes, and nitrenes. Assigning formal charges in intermediates and other ionic species.

Classification and nomenclature of organic compounds, hybridization-types, shapes of organic molecules, influence of hybridization on bond properties. Nature of bonding in Organic molecules Types of chemical bonding, formation of covalent bond, notations used to represent electron movements and directions of reaction- curly arrows, formal charges.Types of bond breaking- homolytic and heterolytic.

Electronic displacement effects: Inductive effects, Electrometric effect, Resonance effect, Hyperconjugation and steric effects, explanation with examples.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. Types of Organic Reactions: Substitution, addition, elimination, rearrangement and pericyclic reactions, explanation with examples

UNIT IV

Gaseous state: Gaseous State Elementary aspects of kinetic theory of gases, Ideal and real gases. Postulates and derivation of the kinetic gas equation, Boyle temperature (derivation not required), Molecular velocity, collision frequency, collision diameter, Collision cross section, collision number and mean free path and coefficient of viscosity, calculation of σ and η, variation of viscosity with temperature and pressure. Maxwell's Boltzmann distribution law of molecular velocities (Most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and average kinetic energies. (Mathematical derivation not required), law of equipartition of energy.

Behaviour of real gases: Deviation from ideal gas behavior. Compressibility factor (Z) and its variation with pressurefor different gases. Causes of deviation from ideal behaviour, vander Waals equation of state (no derivation) andapplication in explaining real gas behaviour. Critical phenomena - Andrews isotherms of CO2, critical constants andtheir calculation from van der Waals equation, Continuity of states, Law of corresponding states. Numerical problems.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1	Concise Inorganic Chemistry	1.D. Lee	ELBS
2	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Organic Chemistry	Morrison and Boyd	Prentice Hall
4	Fundamentals of Organic Chemistry	Solomons	John Wiley
5	Physical Chemistry, 10th Ed.	Atkins, P.W. & Paula, J.	Oxford University Press, 2014
6	Organic reaction mechanism	Singh and Mukharje	New age International
	Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.	Morrison, R. T. & Boyd, R. N.	Pearson Education
	Principles of Physical Chemistry,	Puri, Sharma & Pathania,	1. Vishal Publishing Co.
	Basic Inorganic Chemistry, 3rd Edition.	F A Cotton, G Wilkinson and P. L. Gaus	1. Wiley. India

Semester	**I**
Course Code	**ZOO161**
Course Title	**Zoology I: Animal Biodiversity**
Type of course	Theory
L T P	4 00
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	**Completion of this course is to enable the students to** 1. Impart knowledge about co-existence of different forms of living organisms ranging from acelluar to multicellular animals. 2. Know about classification and general characters of the phyla up to classes/orders.
Course Outcomes (CO)	**By the end of this course, students will be able to** 1. Understand the history and evolution of phylum. 2. Know about the general characters and classification of different organisms. 3. Understand the economic importance of different animals.

UNIT-I

Kingdom Protista: General characters and classification up to classes; Locomotory Organelles and locomotion in Protozoa

Phylum Porifera: General characters and classification up to classes; Canal System in *Sycon*

Phylum Cnidaria: General characters and classification up to classes; Polymorphism in Hydrozoa

Phylum Platyhelminthes: General characters and classification up to classes; Life history of *Taenia solium*

UNIT-II

Phylum Nemathelminthes: General characters and classification up to classes; Life history of *Ascaris lumbricoides* andits parasitic adaptations

Phylum Annelida: General characters and classification up to classes; Metamerism in Annelida

Phylum Arthropoda: General characters and classification up to classes; Vision in Arthropoda, Metamorphosis inInsects

Phylum Mollusca: General characters and classification up to classes; Torsion in gastropods

UNIT-III

Phylum Echinodermata: General characters and classification up to classes; Water-vascular system in Asteroidea

Protochordates: General features and Phylogeny of Protochordata

Agnatha: General features of Agnatha and classification of cyclostomes up to classesPisces: General features and Classification up to orders; Osmoregulation in Fishes

UNIT-IV

Amphibia: General features and Classification up to orders; Parental care

Reptiles: General features and Classification up to orders; Poisonous and non-poisonous snakes, Bitingmechanism in snakes

Aves: General features and Classification up to orders; Flight adaptations in birds, Mammals: Classification up to orders; Origin of mammals.

Text and Reference Books:

S. No.	Title	Author(s)	Publisher
1	Invertebrate Zoology	P.S. Dhami	R Chand and Company
2	Cell Biology	V K Aggarwal	S. Chand Publishing
3	AText Book of Invertebrate Zoology	Gurcharn Singh	Campus Books International
4	Cell Biology	C B Pawar	Himalaya Publishing House
5	Modern Text Book of Zoology Invertebrates	Prof. R. L. Kotpal	Rastogi Publisher
6	Zoology	P S Dhami	Pradeep Publishers

BOTANY I: PRACTICAL COURSE ON INTRODUCTION TO MICROBES AND PLANT KINGDOM

Semester	**I**
Course Code	**BOT163**
Course Title	**Botany I: Practical Course on Introduction to Microbes and Plant Kingdom**
Type of course	**Major:** Practical
L T P	0 0 2
Credits	1
Course prerequisite	10+2 Medical
Course Objective (CO)	The aim of this course is to enable the students to 1. Aware about biopdiversity among different groups of plants, characteristic features of each group and to give preliminary knowledge of microbes. 2. Observing the real specimen, slides live, preserved or mounted and making cut slides give better understanding about the various life forms.
Course Outcomes (CO)	Student will able to 1. Know about the structure of virus and bacteriophages 2. Aware about the structure and life cycles of Algae, fungi by preparing temporary and permanent slides 3. Learn about the various forms of Lichens by watching the specimens and live samples. 4. Learn about the morphological structure, anatomy and reproductive structure of Byryophytes, Ptridophytes and Gymnosperms by watching the specimes of organism, live or preserved and by section cutting and experiencing the anatomical structure in microscope.

LIST OF EXPERIMENTS

1. Good Laboratory Practices and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, spirit lamp, inoculation loop, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory
3. Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
4. Types of Bacteria from temporary/permanent slides/photographs and by Gram staining technique
5. Study of vegetative and reproductive structures of important algae.
6. Preparation of culture media for bacterial cultivation (Demonstration).
7. Sterilization of medium using Autoclave and assessment for sterility
8. Sterilization of glassware using Hot Air Oven and assessment for sterility
9. Sterilization of heat sensitive material by membrane filtration and assessment for sterility.
10. Study of diversity in thallus forms of algae: Cyanophyceae, Chlorophyceae, Xanthophyceae, Phaeophyceae and Rhodophyceae through temporary mounts, specimens or permanent slides.
11. Study of various types of fungi and lichens through temporary mounts or locally available specimens.
12. Study of various types of Bryophytes and Pteridophytes using live/ preserved specimens.
13. Study of various types of Gymnosperms and monocots and dicots with the help of specimens collected from local areas during field trips.
14. Electron micrographs/Models of viruses.
15. Gram staining technique in bacteria.
16. Types of Bacteria from temporary/permanent slides/photographs and by Gram staining technique
17. Electron micrographs of bacterial reproduction
18. Binary Fission and Conjugation.
19. **Field Visit and Educational Tour**

Text and Reference Books:

S. No.	Book Title	Author	Publisher
1	Diversity of Microbes and Cryptogams	H.N.Srivastava	Pradeep Publisher
2	Text Book of Thallophytes	O.P.Sharma	Tata McGraw Hill
3	Text Book of Pteridophyta	O.P.Sharma	McMillan India Ltd
4	The Fungi	P.D. Sharma	Rastogi Publisher
5	Cryptogamic Botany, Vol. II, Bryophytes & Pteridophytes	G.M Smith	Tata McGraw Hill
6	Biology	P H Raven, G B Johnson, SIR R Singer	Tata McGraw Hill
7	Gymnosperms	SP Bhatnagar and A Moitra	S Chand

CHEMISTRY I: CHEMICAL ANALYSIS I (PRACTICAL)

Course Code	**CHM163**
Course Title	**Chemistry I: Chemical Analysis I (Practical)**
Type of course	Major (Practical)
L T P	0:0:4
Credits	2
Course prerequisite	10+2 with chemistry as core subject
Course Objective	The aim of this course is to impart practical knowledge to the students about the separation of organic molecules and quantitative estimation of inorganic salt through titrimetric study.
Course Outcome	**By the end of the course, students will be able to:** CO1 Weigh accurately compounds up to fourth decimal CO2 Know the importance of calibration of instruments, pipette, burette andvolumetric flask CO3 Prepare standard/working solutions, standardization of solutions anddetermination of the respective analytes CO4 Handle proficiently byproducts and disposal of waste, Learn the importance ofgreen methods over conventional methods. CO5 Enthuse students to conduct experiments by arousing the curiosity which wouldhelp them in learning basics and advanced concepts through simulation-based lab

General Instruction in Chemistry Laboratory:

- Green Principles to be adopted in the laboratories
- Specific arrangements to be made for disposal of chemicals and solutions after the experiments
- Calibration of instruments, glasswares etc to be performed in the beginning of the experiments
- Preparation of Standard solution along with calculations to be taught
- Handling and dilution of mineral acids to be emphasized
- Selection and usage of Indicators to be explained

TITRIMETRY

1. Determination of carbonate and hydroxide present in a mixture.
2. Determination of oxalic acid and sodium oxalate in a given mixture using standard KMnO4/NaOH solution
3. Standardization of potassium permanganate solution and determination of nitrite in a water sample
4. Determination of alkali content in antacids
5. Determination of chlorine in bleaching powder using iodometric method.
6. Determination of concentration of Potassium Permanganate solution using Ferrous Ammonium sulphate
7. Standardization of silver nitrate and determination of chloride in a water sample 8. Soil Analysis-Determination ofpH of soil

Volumetric Analysis

Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.Estimation of oxalic acid by titrating it with $KMnO_4$.
Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

Organic Chemistry

Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)

Separation of mixtures by Chromatography:

Measure the Rf value in each case (combination of two compounds to be given)
Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamicacid, tyrosine or any other amino acid) by paper chromatography
Identify and separate the sugars present in the given mixture by paper chromatography.

**Perform any four experiments from each section*

Text books and References:

S. No.	Name	Author (S)	Publisher
1	Vogel's Qualitative Inorganic Analysis (7^{th} Edition)	G Svehla	Prentice Hall
2	Laboratory Manual in Organic Chemistry	R.K. Bansal,	Wiley Eastern
3	Advanced Experimental Chemistry.Vol. I	J.N. Gurtu and R.Kapoor	S. Chand & CO.
4	Vogel's Qualitative Inorganic Analysis	Svehla	Orient Longman
5	Vogel's Textbook of Quantitative Inorganic Analysis (revised)	J. Basseff, R.C. Dennery, G.H. Jeffery and J. Mendham	ELBS

ZOOLOGY I: ANIMAL BIODIVERSITY PRACTICAL

Semester	**I**
Course Code	**ZOO163**
Course Title	**Zoology I: Animal Biodiversity Practical**
Type of course	Practical
L T P	004
Credits	2
Course prerequisite	10+2 Medical
Course Objective	**The aim of this course is to enable the students to** 1. Impart knowledge about classification of animals up to orders by studying the specimens. 2. Impart knowledge about life history and anatomy of some important animals by studing the slides
Course Outcomes (CO)	**By the end of this course, students will be able to** 1. Comparing and contrasting structural features in members of different animal phyla. 2. To know about the anatomy and life history of some important animals. 3. To identify the poisonous and non-poisonous snakes.

LIST OF SUGGESTED LAB EXERCISES:

1. Study of the following specimens:
Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Hyalonema, and Euplectella, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium, Male and female of *Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria and Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis*, Any six common birds from different orders, Sorex, Bat, Funambulus, Loris

2. Study of the following permanent slides:
T.S. and L.S. of *Sycon*, Study of life history stages of *Taenia*, T.S. of Male and female *Ascaris*

3. Key for Identification of poisonous and non-poisonous snakes
4. An "animal album" containing photographs, cut outs, with appropriate write up about the above-mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

Text and Reference Books:

S. No.	Title	Author(s)	Publisher
1	Invertebrate Zoology	P.S. Dhami	R Chand and Company
2	Cell Biology	V.K. Aggarwal	S. Chand Publishing
3	A Text Book of Invertebrate Zoology	Gurcharn Singh	Campus Books International
4	Cell Biology	C.B. Pawar	Himalaya Publishing House

*SEMESTER II^nd^*

BOTANY II: FUNDAMENTALS OF PLANT ECOLOGY AND SYSTEMATICS

Semester	**II**
Course Code	**BOT162**
Course Title	**Botany II: Fundamentals of Plant Ecology and Systematics**
Type of course	Theory
L T P	4 0 0
Credits	2
Course prerequisite	10+2 Medical
Course Objective (CO)	The aim of this course is to enable the students to 1. Understand basics of ecosystem and its working. 2. Understand the basic of taxonomy, its history and general angiosperm families.
Course Outcomes (CO)	Student will able to understand 1. The basics of ecology with its ineraction of biotic and abiotic components. 2. The energy flow, trophic system and biogeochemical cycle operating in the ecosystems 3. The plant taxonomy, identification keys, herbarium and its function. 4. The various principle and rules of ICN, Binomial systems classification of angiosperms and few important families of the plants.

UNIT-I

Introduction to Ecology: History of Ecology; Basic concepts in Ecology; Subdivisions of Ecology; Terminology related to Ecology; Scope of Ecology. **Ecological factors:** Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford lawof tolerance. Adaptation of hydrophytes and xerophytes. Plant communities: Characters; Ecotone and edge effect; Succession; Processes and types.

UNIT-II

Ecosystem: Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and phosphorous. **Phytogeography:** Principle biogeographical zones; Endemism

UNIT-III

Introduction to plant systematic: Introduction to systematics; Plant identification, Classification, Nomenclature. Taxonomic Evidences from palynology, cytology, phytochemistry and molecular data. Taxonomy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy: Ranks, categories and taxonomic groups; Species concept (taxonomic, biological, evolutionary). Identification Functions of Herbarium, important herbaria and botanical gardens of the world and India, Documentation: Flora, Keys: single access and multi-access.

UNIT-IV

Botanical nomenclature: Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations. **Classification:** Types of classification-artificial, natural and phylogenetic. **Biometrics, numerical taxonomy and cladistics**: Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences). **General characters Angiosperms:** Important angiosperm families- habit, habitat, characters, important plants, economic importance.

Text and Reference Books:

S. No.	Title	Author	Publisher
1	Concepts of Ecology	Kormondy, E.J	Prentice Hall, U.S.A. 4th edition.
2	Ecology and Environment	Sharma, P.D	Rastogi Publications, Meerut, India. 8thed.
3	Plant Systematics	Simpson, M.G.	Academic Press, San Diego, CA, U.S.A.
4	Plant Systematics: Theory and Practice.	Singh, G.	Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
5	An Introduction to Plant Taxonomy	Jeffrey, C.	Cambridge University Press, London
6	Fundamental of Plant Systematics	Radford, A.E.,	Harper and Row, New York
7	Principles of Angiosperm Taxonomy	Davis, P.H.and Heywood, V.H	Oliver and Boyd, London.

CHEMISTRY-II: INORGANIC & PHYSICAL CHEMISTRY-I

Semester	**II**
Course Code	**CHM162**
Course Title	**Chemistry-II: Inorganic & Physical Chemistry-I**
Type of course	Major (DSC)
L T P	4:0:0
Credits	4
Course prerequisite	10+2 with chemistry as core subject
Course Objective	The aim of the subject is to enhance the knowledge of studentsregarding chemical bonding, chemistry of noble gases To develop coherent understanding of different states of matter, associated phenomenon and their application
Course Outcome	**By the end of the course, students will be able to:** CO1 Acquire the knowledge of chemical bonding. CO2 Acquire the knowledge of chemistry of noble gases, basic concept of states of matter CO3 Interpret structures and properties of different crystals, crystal defects

UNIT-I

Chemical Bonding:

(i) Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N2, O2, C2, B2, F2, CO, NO, and their ions; HCl, BeF2, CO2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

UNIT II

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds

Liquid State Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, Surface Tension: Definition and its determination using stalagmometer, effect of temperature and solute on surface tension Viscosity: Definition, Coefficient of viscosity. Determination of viscosity of a liquid using Oswald viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases

UNIT III

Refraction: Specific and molar refraction- definition and advantages. Determination of refractive index by Abbes Refractometer. Additive and constitutive properties.

Parachor: Definition, Atomic and structure parachor, Elucidation of structure of benzene and benzoquinone. Viscosity and molecular structure. Molar refraction and chemical constitution. Numerical Problems.

UNIT IV

Dilute solutions- Review of colligative properties and concentration terms Determination of molecular mass of a soluteby: (i) Berkeley-Hartley's method ; (ii) Beckmann's method (ΔTf) and (iii) Landsberger's method. Numerical problems Distribution Law Nernst Distribution Law – Statement. Distribution constant, factors affecting distribution constant, validity of Distribution Law, Modification of distribution law when molecules undergo a) Association b) Dissociation. Application of Distribution Law in Solvent extraction, numerical Problems

Solids Forms of solids: Unit cell and space lattice, anisotropy of crystals, size and shape of crystals. Laws of Crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of symmetry (Symmetryelements), Crystal systems, Bravais lattice types and identification of lattice planes. Miller indices and its calculation, X–Ray diffraction by crystals: Bragg's law and derivation of Bragg's equation, Single crystal and powder diffraction methods. Defects in crystals, glasses and liquid crystals. Numerical problems. Analysis of powder diffraction patternsof NaCl, CsCl and KCl. Defects in crystals.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1	Concise Inorganic Chemistry	1.D. Lee	ELBS
2	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Basic Inorganic Chemistry, Edition 3	FA Cotton, G Wilkinson and PL Gaus	Wiley. India
4	Advanced Physical Chemistry,	Gurdeep Raj,	Goel Publishing House (2018)
5	Physical Chemistry, 10th Ed.	Atkins, P.W. & Paula, J.	Oxford University Press, 2014
6	Organic reaction mechanism	Singh and Mukharje	New age International
7	Organic Chemistry,	Morrison, R. T. & Boyd, R.N.	Pearson Education
8	Principles of Physical Chemistry,	Puri, Sharma & Pathania,	Vishal Publishing Co.
9	Physical Chemistry, Volume 1, States of Matter and Ions	K L Kapoor	Mcmillan

ZOOLOGY II: COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

Semester	**II**
Course Code	**ZOO162**
Course Title	**Zoology II: Comparative Anatomy and Developmental Biology of Vertebrates**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	**The aim of this course is to enable the students to** 1. Impart knowledge about comparative account of the morphology, general anatomy and physiologyof the vertebrates. 2. Impart knowledge about the development of vertebrates.
Course Outcomes (CO)	**By the end of this course, students will be able to** 1. To know about the differentorgan systems present in vertebrates. 2. To know about the receptors and evolution of organs in vertebrates. 3. To know about the comparative development among vertebrates.

UNIT-I

Integumentary System: Derivatives of integument w.r.t. glands and digital tips
Digestive System: Brief account of alimentary canal and digestive glands
Respiratory System: Brief account of Gills, lungs, air sacs and swim bladder
Circulatory System: Evolution of heart

UNIT-II

Nervous System: Comparative account of brain
Sense Organs: Types of receptors
Urinogenital System: Succession of kidney, Evolution of urinogenital ducts

UNIT-III

Early Embryonic Development: Gametogenesis: Spermatogenesis and oogenesis w.r.t. mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula); types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.

UNIT-IV

Late Embryonic Development: Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation.
Control of Development: Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death.

Text and Reference Books:

Sr No.	Title	Author(s)	Publisher
1	Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition	K.V. Kardong	McGraw-Hill
2	Comparative Anatomy of the Vertebrates. IX Edition	G.C. Kent and R.K Carr	McGraw-Hill
3	Analysis of Vertebrate Structure	M. Hilderbrand and G.E. Gaslow	John Wiley and Sons
4	Biology of Vertebrates	H.E. Walter and L.P. Sayles	Khosla Publishing House

BOTANY II: PRACTICAL COURSE ON FUNDAMENTALS OF PLANT ECOLOGY AND SYSTEMATICS

Semester	**II**
Course Code	**BOT164**
Course Title	**Botany II: Practical course on fundamentals of plant ecology and systematics**
Type of course	Practical
L T P	0 0 2
Credits	1
Course prerequisite	10+2 Medical
Course Objective (CO)	The aim of this course is to enable the students to 1. Give practical knowledge about the various parameters in ecology, its measurements and ecosystem components 2. Understanding by observing the plants flowers and floral description of important angiosperm families.
Course Outcomes (CO)	Student will able to understand 1. The principle and use various instruments used in the study of the ecology 2. The analysis of various physic chemical parameters of soil 3. The morphological adaptation of some special plants in different habitat 4. About the quantitative analysis of plant species diversity by using quadrat methods. 5. The classification of angiosperms and some families by observing the common members available for the experiment.

LIST OF EXPERIMENTS

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):
   a. Ranunculaceae - *Ranunculus, Delphinium*
   b. Brassicaceae - *Brassica, Alyssum / Iberis*
   c. Myrtaceae - *Eucalyptus, Callistemon*
   d. Apiaceae (Umbelliferae) - *Coriandrum /Anethum / Foeniculum*
   e. Asteraceae - *Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax*
   f. Solanaceae - *Solanum nigrum/Withania*
   g. Lamiaceae - *Salvia/Ocimum*
   h. Euphorbiaceae - *Euphorbia hirta/E.milii, Jatropha*
   i. Liliaceae - *Asphodelus/Lilium/Allium*
   j. Poaceae - *Triticum/Hordeum/Avena*
2. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
3. Determination of pH, and analysis of soil samples.
4. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the campus
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency
7. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).
8. Field visit (local) – Subject to grant of funds.

Text and Reference Books:

S. No.	Title	Author	Publisher
1	Concepts of Ecology	Kormondy, E.J	Prentice Hall, U.S.A. 4th edition.
2	Ecology and Environment	Sharma, P.D	Rastogi Publications, Meerut, India. 8th ed.
3	*Plant Systematics*	Simpson, M.G.	Academic Press, San Diego, CA, U.S.A.
4	*Plant Systematics:* Theory and Practice.	Singh, G.	Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
5	An Introduction to Plant Taxonomy	Jeffrey, C.	Cambridge University Press, London
6	Fundamental of Plant Systematics	Radford, A.E.,	Harper and Row, New York
7	Principles of Angiosperm Taxonomy	Davis, P.H. and Heywood, V.H	Oliver and Boyd, London.

CHEMICAL ANALYSIS II (PRACTICAL)

Course Code	**CHM164**
Course Title	**Chemical Analysis II (Practical)**
Type of Course	**Major (Practical)**
L T P	0:0:4
Credits	2
Course Prerequisite	10+2 with chemistry as core subject
Course Objective	The aim of this course is to provide practical knowledge about the preparation of organic compounds, Thermo-chemistry and Ionic equilibrium.
Course Outcome	**By the end of the course, students will be able to:** CO1 Know the importance of calibration of instruments, pipette, burette and volumetric flask CO2 Understand the significance of standardization of solutions and determination of the respective analytes CO3 Acquire coherent knowledge of thermochemistry, Analyse thermodynamic parameters of solutions and salt mixtures. CO4 Enthuse students to conduct experiments by arousing the curiosity which would help them in learning basics and advanced concepts through simulation-based lab CO2 Find out the acidity, Basicity and pKa Value on pH meter. CO3 Accurately evaluate physical properties of solutions, and perform analysis, separation and purification of mixture applying these properties.

Section A: Inorganic
Chemistry TITRIMETRY

1. Determination of carbonate and hydroxide present in a mixture.
2. Determination of oxalic acid and sodium oxalate in a given mixture using standard KMnO4/NaOH solution
3. Standardization of potassium permanganate solution and determination of nitrite in a water sample
4. Determination of alkali content in antacids
5. Determination of chlorine in bleaching powder using iodometric method

Section B: Physical Chemistry
Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO3, NH4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Solution Chemistry:

1. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald's viscometer (ethylacetate, toluene, chlorobenzene or any other non-hazardous liquids)
2. Study of the variation of viscosity of sucrose solution with the concentration of a solute
3. Determination of the density using specific gravity bottle and surface tension of liquids using Stalagmometer (ethylacetate, toluene, chlorobenzene or any other non-hazardous liquids)
4. Study of variation of surface tension of detergent solution with concentration.
5. Determination of molar mass of non-electrolyte by Walker-Lumsden method
6. Determination of partition/distribution coefficient of Benzoic acid in water and toluene
7. Determination of composition of liquid mixtures by refractometry. (toluene and alcohol, water and sucrose)
8. Determination of specific and molar refraction by Abbes refractometer (ethyl acetate, methyl acetate, ethylenedichloride)

Virtual Experiments

9. Determination of molar mass of a non-volatile solute by cryoscopic method
10. Determination of viscosity by average molecular weight of a polymer
11. Determination of partition co-efficient of Iodine between water and carbon tetrachloride

Perform any four experiments from each section

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1	Vogel's Qualitative Inorganic Analysis (7th Edition)	G Svehla	Prentice Hall
2	Laboratory Manual in OrganicChemistry	R.K. Bansal,	Wiley Eastern
3	Advanced Experimental Chemistry.Vol. I	J.N. Gurtu and R.Kapoor	S. Chand & CO.
4	Vogel's Qualitative Inorganic Analysis	Svehla	Orient Longman
5	Vogel's Textbook of QuantitativeInorganic Analysis (revised),	J. Basseff, R.C. Dennery, G.H.Jeffery and J. Mendham	ELBS
6	Experimental Physical Chemistry	C. Das, B. Behera	Tata McGraw Hill Publishing Company

ZOOLOGY II: COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES PRACTICAL

Semester	**II**
Course Code	**ZOO164**
Course Title	**Zoology II: Comparative Anatomy and Developmental Biology of Vertebrates practical**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	10+2 Medical
Course Objective	**The aim of this course is to enable the students to** 1. Study skeletons of different vertebrates, different developmental stages of frog and development of human. 2. Impart knowledge about histology of gonads.
Course Outcomes (CO)	**By the end of this course, students will be able to** 1. Know about osteology of animals like fowl, rabbit, tortoise and mammals. 2. Study the developmental stages of frogs and placental development in humans. 3. Study the sperm and ovum and the histology of gonads.

LIST OF EXPERIMENTS

1. **Osteology**:
   a) Disarticulated skeleton of fowl and rabbit
   b) Carapace and plastron of turtle /tortoise
   c) Mammalian skulls: One herbivorous and one carnivorous animal.

2. Study of developmental stages of frogs, metamorphosis from tadpole to adult though permanent slides.

3. **Study of the different types of placenta-**
   Histological sections through permanent slides or photomicrographs.

4. Study of placental development in humans by ultrasound scans.

5. **Examination of gametes - frog/rat**
   Sperm and ova through permanent slides or photomicrographs.
   Study of histological section of testis and ovary through permanent slides.

Text and Reference Books:

S. No.	Title	Author(s)	Publisher
1	Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition.	K.V. Kardong	McGraw-Hill
2	Comparative Anatomy of the Vertebrates. IX Edition	G.C. Kent and R.K Carr	McGraw-Hill
3	Analysis of Vertebrate Structure	M. Hilderbrand and G.E. Gaslow	John Wiley and Sons
4	Biology of Vertebrates	H.E. Walter and L.P. Sayles	Khosla Publishing House

SEMESTER-III

BOTANY III: PLANT ANATOMY

Semester	**III**
Course Code	**BOT261**
Course Title	**Botany III: Plant Anatomy**
Type of course	Major: Theory
L T P	4 0 0
Credits	4
Course prerequisite	B. Sc Ist year
Course Objective	The aim of this course is to enable the students to understand the basic body plan of flowering plant, various tissue systems in higher plants, their structure, development and function.
Course Outcomes (CO)	Student will able to understand 1. The basic body and its parts. 2. Understand basic concepts and terminology in plant anatomy and various structures of seed plants. 3. Be familiar with common research methods and techniques in plant Anatomy. 4. To instill in students an appreciation for the complexity of tissue organization that exists within plant bodies that allow plants to develop and live as integrated organisms in diverse environments.

Syllabus
(Theory Course)

UNIT-I

The basic body plan of a flowering plant. Basic plant morphology and review of the cell.
Plant Cell: Plant Cells, Tissues and Tissue systems. Introduction, objectives and scope of Plant Anatomy; General structure of plant cells - structure of plant cell wall. **Cell types**: parenchyma, collenchyma, sclerenchyma.

UNIT-II

Tissue and tissue systems - Definitions, structure and functions of Meristematic tissues and permanent tissues (Simple and Complex). A brief account of plant secretary tissues/cells. Concept of tissue systems - Ground tissues, Dermal tissues and Vascular tissues. **Classification of meristem**s: Based on location (apical, intercalary and lateral), Origin (promeristem, primary and secondary meristem) and function (protoderm, procambium and ground meristem). Apical meristems.

UNIT-III

Generalised structure of shoot apex, theories on organization of Shoot Apical Meristem (SAM) - Apical cell theory, Tunica-Corpus theory and Histogen theory. **Generalised structure of root apex**, theories on organisation of Root Apical Meristem (RAM) – Apical Cell Theory, Histogen theory, Quiescent centre theory and Korper – Kappe theory.

UNIT-IV

Primary and Secondary anatomy of Angiosperms: Primary anatomy of root: Dicot (Tridax/Sunflower), monocot (Maize). Primary anatomy of stem: Dicot (*Tridax*/Sunflower), Monocot (Maize), Nodal anatomy.
Anatomy of leaf: Dicot (*Tridax*/Sunflower), Monocot (Maize). Types of trichomes and stomata. Secondary Growth: Normal Secondary growth in stem and root (*Tridax*/Sunflower). Anomalous secondary growth in *Aristolochia* and *Boerhaavia* (dicot stem), *Dracaena* (monocot stem).
Applications of anatomy in Plant systematics, forensics and Pharmacognosy.

Text and reference books:

S. No.	Title	Author	Publisher
1	Plant Anatomy – Part I Cells and Tissues	Coutler E. G. , 1969	Edward Arnold, London.
2	Integrative Plant Anatomy	Dickison, W.C.	Harcourt Academic Press, USA
3	Plant Anatomy	J D Mauseth	Benjamin/Cummings Publishing Company Inc., California, USA
4	Anatomy of Seed Plants	K Peau	John Wiley & Sons, New York
5	Esau's Plant Anatomy: Meristem, Cells, and Tissues of the Plant Body: Their Structure, Function and Development.	Evert, R.F.	John Wiley and Sons, Inc

CHEMISTRY III: PHYSICAL CHEMISTRY (SOLUTIONS, PHASE & IONIC EQUILIBRIUM, CONDUCTANCE & ELECTROCHEMISTRY)

Semester	**III**
Course Code	**CHM261**
Course Title	**Chemistry III: Physical Chemistry (Solutions, Phase & Ionic Equilibrium, Conductance & Electrochemistry)**
Type of course	Major
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. 1st with chemistry as core subject
Course Objective (CO)	The aim of this course is to impart knowledge to the students about basic knowledge of solution chemistry, phase, ionic equillibria and Electrochemistry,
Course outcome	CO1 Derive mathematical expressions for different properties of gas, liquid and solids and understand their physical significance. CO2 Explain the concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt. CO3 Acquire coherent knowledge of solutions, phase equilibrium and conductance CO4 Learn the working of electrochemical cells, EMF & pH determination.

UNIT I

Solutions: Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications

UNIT II

Phase Equilibria: Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, FeCl3-H2O and Na-K only). Applications of phase equillibria. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions. Three component systems, water-chloroform-acetic acid system, triangular plots.

Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.

UNIT III

Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment). Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

UNIT IV

Conductance: Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt.

Electrochemistry: Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data. pH determination using hydrogen electrode and quinhydrone electrode.

Text and References Books:

S. No.	Name/Title	Author	Publisher
1	Principles of Physical Chemistry	B. R. Puri , Madan S. Pathania L.R. Sharma	Vishal Publishing Company (2020)
2	Atkins' Physical Chemistry, Thermodynamics and Kinetics	Peter Atkins, Julio dePaula	Oxford University Press, (2014)
3	A Textbook of Physical Chemistry, Thermodynamics and Chemical Equilibrium (volume Two)	K. L. Kapoor	McGraw Hill Education (2019)
4	A Textbook of Physical Chemistry(Vol. Five)	K. L. Kapoor	Macmillan Indian Press 2009
5	An introduction to Chemical Kinetics	Claire Vallance	Morgan & Claypool Publishers, US, 7017

ZOOLOGY III: STRUCTURE AND FUNCTION OF INVERTEBRATES

Semester	**III**
Course Code	**ZOO261**
Course Title	**Zoology III: Structure and Function of Invertebrates**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	**The aim of this course is to enable the students to** 1. Aware about the functions of different body systems of lower animals and their way of living. 2. Understand the evolutionary significance of larval forms of invertebrates.
Course Outcomes (CO)	**By the end of this course, students will be able to** 1. Describe different physiological body processes of invertebrates. 2. Understand the larval forms of the invertebrates. 3. Learn the colonial and social life in invertebrates.

UNIT-I

Locomotion: Flagellar and cilliary movement in Protozoa; Theories of origin of metazoa: Colonial theory, Syncytial theory, Polyphyletic theory; Porifera: Canal system, skeleton and reproduction, Coelenterata: Nematocytes, Polymorphism in hydra

UNIT-II

Organization of coelom: Acoelomates, Pseudocoelomates and coelomates; **Polychaeta:** Filter feeding and Adaptive radiations; **Organs of respiration**: Gills,lungs and trachea; Respiratory pigments and their functions; Mechanism of respiration and transport of gases

UNIT-III

Organs of excretion: Coelom, coelomoducts, nephridia and Malphigian tubules; Mechanism of excretion in invertebrates; **Primitive nervous system:** Coelenterates and Echinoderms; **Advanced nervous system:** Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda)

UNIT-IV

Larval forms: Crustacean, Mollusca and Echinodermata; Larval forms of invertebrate parasites; Evolutionary significance of larval forms; **General characters and organization of minor phyla**: Rotifera, Acanthocephala, Ectoprocta, Endoprocta, Phoronida

Text and Reference Books:

S. No	Name/Title	Author	Publisher
1	Invertebrate Zoology	Barnes R.D	W.B. Saunders Co., Philadelphia
2	Life of Invertebrates	Hunter	Collier Macmillan
4	Modern Text Book of Invertebrates	R.L. Kotpal	Rastogi Publications (2015-2016)
5	The Invertebrates. Vol-I	Hyman, L.H.	McGraw Hill Co., New York.
6	The Invertebrates. Vol-II	Hyman, L.H.	McGraw Hill Co., New York.
7	The Invertebrates. Vol-III	Hyman, L.H.	McGraw Hill Co., New York.
8	Invertebrate Structure and Function	Barrington E.J.W	Thomas Nelson and Sons Ltd., London

IKS: ETHNOZOOLOGY – II

Semester	**III**
Course Code	**ZOO269**
Course Title	**IKS: Ethnozoology-II**
Type of course	Major Course (DSE)
L T P	4 0 0
Credits	4
Course Objective	To study about Indian Knowledge System, its history and contribution.
Course Outcomes (CO)	CO1. Learn about the history of India from its formation. CO2. Learn about ayurveda, yoga and triguna system. CO3. Learn about the forest management and urban planning in ancient India.

UNIT I

Importance of Indian Knowledge System. The IKS classification. Unique features of IKS. Broad overview of disciplines included in the Indian Knowledge System (IKS), and historical developments.

UNIT II

Splendid geographical isolation of India and its unique faunal diversity. History of animal keeping and veterinary science in India. Ancient Indian texts on animals. Cultural significance of animals highlighted by traditional arts and festivals.

UNIT III

Health, Wellness and Psychology, Ayurveda Sleep and Food, Role of water in wellbeing Yoga way of life Indian approach to Psychology, the Triguṇa System Body-Mind-Intellect Consciousness Complex.

UNIT IV

Ecology and Environment: *Nakshatrara Gyaan* and Agriculture, Vernacular Architecture, Forest Management and Urban Planning, Agroforestry, Tank, Lakes, and Stepwells. India and the World**:** Influence of IKS on the world, knowledge exchanges with other classical civilizations, and inter-civilizational exchanges, India's Contribution to the World.

Text & References:

S. No.	Name of Book	Authors/Editors	Publisher
1.	Pride of India: A Glimpse into India's Scientific Heritage'	R.M. Pujari, Pradeep Kolhe, N. R. Kumar	Samskrita Bharati Publication
2.	Indian Contribution to science	Vijnana Bharati	Vijnana Bharati
3.	Knowledge traditions and practices of India	Kapil Kapoor, Michel Danino	CBSE, India
4.	India's Contribution to World Culture	Sudheer Birodkar	
5.	Animal Husbandry in Ancient Indian Literature	Aruna Tomar Kumar, Rajbir Singh, Vir Singh,	LAP Lambert Academic Publishing (2013)

BOTANY III: PRACTICAL COURSE ON PLANT ANATOMY

Semester	**III**
Course Code	**BOT263**
Course Title	**Botany III: Practical Course on Plant Anatomy**
Type of course	Major: Practical
L T P	0 0 2
Credits	1
Course prerequisite	B. Sc Ist year
Course Objective(CO)	The aim of this course is to demonstrate a general familiarity with basic plant structures and organs.
Course Outcomes (CO)	Student will able to understand 1. Describe in detail the basic cell types found in plants 2. Demonstrate their understanding of tissue types including the epidermis, xylem and phloem 3. Identify the basic structure of meristems found in shoots and roots 4. Discuss the detailed structure of roots, stems, and leaves of plants

LIST OF EXPERIMENTS

1. Study of various tools and techniques used in plant anatomy
2. Study of Types of Tissues
3. Structure of Vascular tissues: Structure of secondary phloem and xylem.
4. Normal and Anomalous growth.
5. L.S. Shoot tip to study the cytohistological zonation and origion of leaf primordia.
2. Anatomy of primary and secondary growth in monocots and dicots.
3. Growth rings in wood, Microscopic study of wood in T.S., T.L.S. and R.L.S.
4. Structure and development of stomata (using epidermal peels of leaf).
5. Anatomy of the root. Primary and secondary structure.
6. Study of meristem (Permanent slides/ Photographs).
7. Study of Simple Tissues: Parenchyma, Collenchyma and Sclerenchyma
8. Complex Tissues - xylem and phloem; Maceration technique to study elements of xylem and phloem
9. Study of primary structure of dicot and monocot stem
10. Study of primary structure of dicot and monocot root and leaf
11. Study of Normal secondary growth structure in dicot stem and root (Sunflower) and Anomalous secondary growth: *Aristolochia*, *Boerhaavia* (dicot stem) *Dracaena* (monocot stem)
12. Study of trichomes with the help of locally available plant materials

Text and reference books:

S. No.	Title	Author	Publisher
1	Plant Anatomy – Part I Cells and Tissues	Coutler E. G. , 1969	Edward Arnold, London.
2	Integrative Plant Anatomy	Dickison, W.C.	Harcourt Academic Press, USA
3	Plant Anatomy	J D Mauseth	Benjamin/Cummings Publishing Company Inc., California, USA
4	Anatomy of Seed Plants	K Peau	John Wiley & Sons, New York
5	Esau's Plant Anatomy: Meristem, Cells, and Tissues of the Plant Body: Their Structure, Function and Development.	Evert, R.F.	John Wiley and Sons, Inc

BASICS OF ORGANIC CHEMISTRY AND PHYSICAL CHEMISTRY - I (PRACTICAL)

Semester	**III**
Course Code	**CHM 263**
Course Title	**Basics of Organic Chemistry and Physical Chemistry - I (Practical)**
Type of course	Core (Practical)
L T P	0:0:2
Credits	1
Course prerequisite	B.Sc. 1st with chemistry as core subject
Course Objective	**The aim of this course is to** 1. Provide practical knowledge about conductometry, potentiometry. 2. Perform qualitative organic analysis.
Course outcome	**By the end of the course, students will be able to:** CO1demonstrate and calculate various parameters ofdistribution& phase equilibria CO2Calculate molar and normal solution of various concentrations. CO3perform and evaluate outcomes of conductometric & potentiometric titrations. CO4Study qualitative Organic Analysis & biochemical analysis of amino acids & carbohydrates.

Section A: Physical Chemistry

Distribution:

1. Study of the equilibrium of one of the following reactions by the distribution method:
2. $I_2(aq) + I^-(aq)$ $I_3^-(aq)$ $Cu^{2+}(aq) + xNH_2(aq)$ $[Cu(NH_3)x]^{2+}$
3. Distribution of acetic/ benzoic acid between water and chloroform or cyclohexane.
4. To find EMF of the cell. To calculate the Gibbs free energy change of the cell reaction.
5. To calculate the equilibrium constant.

Phase equilibria

1. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
2. Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
3. Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Conductance

Determination of cell constant

1. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
2. Perform the following conductometric titrations: Strong acid vs. strong base ; Weak acid vs. strong base

Potentiometry

1. Perform the following potentiometric titrations:

Strong acid vs. strong base;
Weak acid vs. strong base;
Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

1. Systematic Qualitative Organic Analysis of Organic Compounds possessingmonofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.
2. Determination of the concentration of glycine solution by formylation method.
3. Titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. Differentiation between a reducing and a non reducing sugar.
7. Organic and inorganic synthesis

**Perform any four experiments from each section*

Text and Reference Books

S. No.	Name	Author(S)	Publisher
01	Vogel's Qualitative Inorganic Analysis	Svehla	Orient Longman
02	Laboratory Experiments on Organic Chemistry	R. Edemas, J.R. Johnson and C.F. Wilcox	The Macmillan Limited, London,
03	Laboratory Manual in Organic Chemistry	R.K. Bansal,	Wiley Eastern
04	Experimental Physical Chemistry	C. Das, B. Behera	Tata McGraw Hill Publishing Company Limited.

ZOOLOGY III: STRUCTURE AND FUNCTION OF INVERTEBRATES PRACTICAL

Semester	**III**
Course Code	**ZOO164**
Course Title	**Zoology III: Structure and Function of Invertebrates Practical**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	10+2 Medical
Course Objective (CO)	**The aim of this course is to enable the students to** 1. Inculcate the knowledge of different organ systems of animals (both non-chordates and chordates). 2. Learn dissection techniques and preparation of permanent slides and observe special features.
Course Outcomes (CO)	**By the end of this course, students will be able to** 1. Learn the classification and external morphology of Protozoa, Cnidaria, Arthropoda, Mollusca 2. Observe the physiological systems of insects. 3. Distinguish poisonous & non-poisonous snakes and their biting apparatus.

List of Experiments

Preparation of permanent slides:

Protozoa: *Paramaecium* (whole mount) and demonstration of food vacuoles, **Cnidaria:** *Bougainvillea, Sertularia etc*.; **Arthropoda:** Cyclops, Megalopa/Zoea, spiracles of cockroach, *etc*.; **Mollusca:** Glochidium larva, *etc*.; **Echinodermata:** Spheredium, pedicellaria, tubefeet.

Dissections: Alimentary canal of cockroach/grasshopper; Arthopoda: Salivary gland of cockroach, Nervous system of Prawn; Mollusca: Nervous system of Mytilus and Aplysia/Sepia.

Study of museum pecimens: Porifera, Cnidaria, Annelida, Arthopoda, Mollusca, Echinodermata,

Study of external morphology of honey bee and dissection of sting apparatus

Text and Reference Books:

S. No.	Name/Title	Author	Publisher
1	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
2	Practical Zoology Invertebrates	S.S. Lal	Rastogi Publications
3	A Manual of Practical Zoology Vertebrates	P.S. Verma	S. Chand Publications
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications

SEMESTER IV

BOTANY IV: ESSENTIALS OF PLANT PHYSIOLOGY AND BIOCHEMISTRY

Semester	**IV**
Course Code	**BOT262**
Course Title	**Botany IV: Essentials of Plant Physiology and Biochemistry**
Type of course	Major: Theory
L T P	4 0 0
Credits	4
Course prerequisite	B. Sc Ist year
Course Objective (CO)	The aim of this course is to enable the students to 1. Study underlying mechanism of basic photosynthesis, plant metabolic and physiological processes. 2. Study the concepts of carbohydrate, nitrogen, enzymes metabolism in plants.
Course Outcomes (CO)	Student will able to understand 1. Plant water relation and mineral nutrition absorption process 2. Translocation of sap and Photosynthesis process in different types of plants 3. Carbohydrate and Nitrogen metabolism in Plants 4. Enzymes and various phases of plant development such as seed dormancy, germination and plant movement. 5. Plant response to light and its effect in the devepopment of plants

Syllabus
(Theory Course)

UNIT-I

Plant-water relations: Importance of water, physical properties of water, imbibitions, diffusion and osmosis, absorption, transport of water, Ascent of sap, water potential and its components; **Transpiration and its significance**; Factors affecting transpiration; Root pressure and guttation. **Mineral nutrition:** Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps, Hydroponics.

UNIT-II

Translocation in phloem: Composition of phloem sap, Phloem loading and unloading.

Photosynthesis: Photosynthetic Pigments; Photosystem I and II, reaction center, antenna molecules; z-scheme, photophosphorylation, **Electron transport chain and ATP synthesis**, redox potential; C3, C4 and CAM pathways of carbon fixation; Photorespiration.

UNIT-III

Carbohydrate metabolism: Carbohydrates - classification, occurrence, structure and functions. Carbohydrate breakdown-Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate cycle, Oxidative Pentose Phosphate Pathway. **Lipid metabolism**: classification, occurrence, structure and functions. Fatty acid biosynthesis, β-oxidation. **Nitrogen metabolism:** Protein and amino acid: classification, occurrence, structure and functions. Biology of nitrogen fixation, importance of nitrate reductase and its regulation, ammonium assimilation.

UNIT-IV

Enzymes: Discovery, nomenclature, structure, characteristics and properties; Basic concepts of holoenzyme, apoenzyme, coenzymes and cofactors regulation of enzyme activity. Enzyme catalysis and enzyme inhibition. **Plant response to light and temperature:** Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization, plant movements. **Photomorphogenesis and its application Plant growth regulators:** Discovery, physiological roles and applications of auxins, gibberellins, cytokinins, ABA, ethylene, salicylic acid, jamonates, and brassinosteroids. **Physiology of senescence, and fruit ripening.**

Text and reference books:

S. No.	Title	Author	Publisher
1	Plant Physiology	H N Srivastava	Pradeep Publishers
2	A Textbook of Plant Physiology, Biochemistry and Biotechnology	Dr S K Verma and Mohit Verma	S. Chand Publishing
3	Lehninger Principles of Biochemistry	Nelson, D., and Cox, M.	W.H. Freeman and Company, New York
4	Plant Physiology	S N Pandey and B K Sinha	Vikas Publishing House
5	Biochemistry and Molecular biology of Plants	Bob B Buchanan, Wilhelm Grissem and Russell L Jones	Wiley International
6	Plant Physiology	Lincoln Taiz, Eduardo Zeiger	Sinauer Associates

CHEMISTRY IV: TRANSITION METALS & COORDINATION CHEMISTRY, ORGANIC FUNCTIONAL GROUPS - II

Semester	**IV**
Course Code	**CHM 262**
Course Title	**Chemistry IV: Transition Metals & Coordination Chemistry, Organic Functional Groups-II**
Type of course	CORE (Theory)
L T P	3:0:0
Credits	3
Course prerequisite	BSc. 1st with chemistry as core subject
Course Objective	**The aim of this course is to** 1. Impart knowledge to the students about basic of transition elements 2. Provide knowledge of bonding of transition elements. 3. Impart knowledge of states of matter and chemical kinetics.
Course Outcome	**By the end of the course, the students will be able to:** CO1 Understand the terms, ligand, and denticity of ligands, chelate, coordination number and use standard rules to name coordination compounds. CO2 Explain the meaning of the terms Δo., Δt, pairing energy, CFSE, high spin and low spin and magnetic properties and colour of complexes on basis of Crystal Field Theory CO3 Derive mathematical expressions for different properties of gas, liquid and solids and understand their physical significance. CO4 Have understanding of rate law and rate of reaction, theories of reaction rates and catalysts

Unit-I

Transition Elements (3d series): General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu. **Lanthanoids and Actinoids:** Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

Coordination Chemistry: Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6.Drawbacks of VBT. IUPAC system of nomenclature.

Unit-II

Crystal Field Theory: Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for *Oh* and *Td* complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

Kinetic Theory of Gases: Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature. Critical phenomena, critical constants and their calculation from van der Waals equation.

Unit-III

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Liquids: Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

Solids: Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals.

Unit-IV

Chemical Kinetics: The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Concise Inorganic Chemistry	1.D. Lee	ELBS
2	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Introduction to Ligand Field	B.N. Figgis	Wiley Eastern.
4	Introduction to Liquid State	P.A. Eglestaff	Academic Press.
5	The Elements of Physical Chemistry	P.w.Aikins	Oxford
6	Physical Chemistry, A Molecular Approach	MacQuarrie and Simon	University Science Books,
7	Principles of Inorganic Chemistry	Puri, Sharma and Kalia	Vishal publishers

ZOOLOGY-IV: BIOSYSTEMATICS, TAXONOMY AND EVOLUTION

Course Code	**ZOO262**
Course Title	**Zoology IV: Biosystematics, Taxonomy & Evolution**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Life Sciences I year
Course Objective	To provide students' knowledge of biosystematics and evolution.
Course Outcomes	1. To know about taxonomy and its history. 2. To know about ICZN and different types of keys used for identification. 3. To know about various theories of organic evolution. 4. To know about cause of speciation and isolating mechanisms.

UNIT-I

Definition, scope, and objectives of taxonomy. Importance of biosystematics in biodiversity conservation. Taxonomy vs systematics vs biosystematics, History of classification, Artificial, natural, and phylogenetic systems, Contributions of early taxonomists, Aristotle, Linnaeus, Bentham & Hooker (brief overview)

UNIT-II

Binomial nomenclature, Principles and rules of nomenclature, International Codes of Nomenclature, ICZN (animals), Type concept, Holotype, paratype, lectotype, neotype. Taxonomic keys, Artificial and natural keys, Dichotomous keys and its types, Identification, description, and classification, Role of museums, Numerical taxonomy (phenetics) – basic concepts

UNIT-III

Meaning and scope of evolution, Concepts of evolution, **Theories of organic evolution:** Lamarckism (Theory of Inheritance of Acquired Characters), Darwin and Wallace, Darwinism, Neo-Darwinism (Modern Synthetic Theory); **Types of natural selection:** Stabilizing, Directional, Disruptive.

UNIT-IV

Miller–Urey experiment, Origin of prokaryotes and eukaryotes, Endosymbiotic theory, Homologous, Analogous, and Vestigial organs. Fossil evidence and geological time scale, Biogeographical distribution of organisms. Concept of species, Types of speciation, **Isolating mechanisms:** Prezygotic and Postzygotic, Adaptive Radiation, Microevolution vs Macroevolution, Human Evolution (brief overview)

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	The Biology of Biodiversity	Kato, M	Springer
2	Biodiversity	Wilson, E.O.	Academic Press
3	Principles of Animal Taxonomy	Simpson, G.G	Oxford IBH Pb Co.
4	Elements of Taxonomy	Mayor, E	
5	Threatened Animals of India	Tikadar, B.K	ZSI Publ. Calcutta
6.	Genes and Evolution	Jha, A.P.	John Publ., ND

IKS: VRIKSHAYURVEDA

Course Code	**BOT270**
Course Title	**IKS: Vrikshayurveda**
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	10+2 Medical
Course Objective (CO)	To carry out awareness of the traditional practices of Vrikshayurveda.
Course Outcomes	CO1 Understanding about the history and ancient background of Vrikshayurveda CO2 Understanding about the different practices such as seed storage, preservation, propagation and nutrition CO3 Understanding about the different types of practices of plant nourishment and irrigation procedure as per ancient science CO4 Understanding about the identification of plant disease and treatment of these disease though traditional remedies CO5 Understanding about the establishment of Upavanakriya, Upvana and conservation of diversity as per ancient science

Unit I

Introduction and History: Definition of Vrikshayurveda, historical background from Vedic periods (Atharva Veda), Land and Soil (Bhumi-nirupana): Classification of soil types (Anupa, Jangala, Samanya), land profile analysis, and soil selection for specific crops. Seed Science (Bijoptivithi): Collection, examination, preservation, and treatment (germination) of seeds.

UNIT II

Plantation and Propagation (Ropana vidhana): Ancient way of nomenclature of plants Digging of planting pits, methods of transplantation, and timing for sowing based on seasonal and astrological factors. Nutrition and Fertilizers (Posana vidhi): Principles of plant nourishment, including the preparation and use of Kunapajala (fermented liquid manure) and Panchagavya. Irrigation (Nisecanavidhi): Methods and frequency of watering based on soil type and seasonal requirements.

UNIT III

Pathology and Treatment (Taru-Chikitsa): Diagnosis of plant diseases (Vata, Pitta, Kapha imbalances in plants) and their traditional remedies.

UNIT IV

Horticulture and Gardening (Upavanakriya): Layout of gardens (Upavana), botanical wonders (Kautuka), and planting near residential complexes. Conservation and Resources: Underground water resources (Dakargala), land productivity, and protection of endangered medicinal plants.

Text and Reference books:

S. No.	Book Title	Author	Publisher
1	Charaka Samhita	Agnivesha	
2	Sushruta Samh	Sushruta	
3	Vrikshayurveda	Surapala,	AAHF, Secunderabad
4	Kashyapiya KrishiSukti, 2002	Kashyap	AAHF, Secunderabad
5	A text book on Ancient History of Indian Agricuylture	Saxena R C, Chaudhary SL, Nene YL	AAHF, Secunderabad
6	Glimpses of the Agricultural Heritage of India	Nene YL,	AAHF, Secunderabad

BOTANY IV: PRACTICAL COURSE ON ESSENTIALS OF PLANT PHYSIOLOGY AND BIOCHEMISTRY

Semester	**IV**
Course Code	**BOT264**
Course Title	**Botany IV: Practical Course on Essentials of Plant Physiology and Biochemistry**
Type of course	Major: Practical
L T P	0 0 2
Credits	1
Course prerequisite	B. Sc Ist year
Course Objective	The aim of this course is to enable the students to 1. Impart knowledge about plant functions through simple physiological experiments 2. Demonstration of many physiological processes
Course Outcomes (CO)	Student will able to understand 1. Various plants physiological processes with the help of experiments. 2. Study and calculation of stomatal index. 3. Impact of light on chlorophyll and phytochrome pigment 4. Demonstration of various physiological and biochemical processes to understand properly.

LIST OF EXPERIMENTS

1. Preparatation of buffers and solutions.
2. Determination of osmotic potential of plant cell sap by plasmolytic method.
3. To study the rate of transpiration from foliar surfaces.
4. Plant sampling for leaf area and biomass estimation.
5. Analysis of growth and yield parameters.
6. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
7. Demonstration of Hill reaction.
8. Determination of Chlorophyll content.
9. To obtain the action spectrum of chlorophyll pigment.
10. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
11. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
12. Comparison of the rate of respiration in any two parts of a plant.
13. Separation of amino acids by paper chromatography.
14. Study of Mineral nutrition Deficiency.
15. Demonstration experiments (any two):
    - Bolting.
    - Effect of auxins on rooting.
    - Suction due to transpiration.
    - R.Q.

Text and reference books:

S. No.	Title	Author	Publisher
1.	Plant Physiology	H N Srivastava	Pradeep Publishers
2.	A Textbook of Plant Physiology, Biochemistry and Biotechnology	Dr S K Verma and Mohit Verma	S. Chand Publishing
3.	Plant Physiology	Lincoln Taiz, Eduardo Zeiger	Sinauer Associates
4.	Fundamentals of Plant Physiology	V K Jain	S. Chand Publishing
5.	Lehninger Principles of Biochemistry	Nelson, D., and Cox, M.	W.H. Freeman and Company, New York
6.	Principles and Techniques of Practical Biochemistry	Wilson K and Walker J. (Eds.).	Cambridge Univ. Press.
7.	Experiments in Plant Physiology- A Laboratory Manual.	D Bajracharya	Narosa Publishing House

CHEMISTRY IV: TRANSITION METALS & COORDINATION CHEMISTRY, ORGANIC FUNCTIONAL GROUPS-II (PRACTICAL)

Semester	**IV**
Course Code	**CHM264**
Course Title	**Chemistry IV: Transition Metals & Coordination Chemistry, Organic Functional Groups - II (Practical)**
Type of course	Core (Practical)
L T P	0:0:4
Credits	2
Course prerequisite	BSc. 1st with chemistry as core subject
Course Objective	**The aim of this course is to** 1.Impart practical knowledge to the students about semi micro qualitative analysis. 2. To study practically physical properties of solutions.
Course Outcome	**By the end of the course, students will be able to:** CO1Analyse and estimate Qualitative analysis of inorganic cations & anions. CO2Calculate viscosity and surface tension of different liquids and solutions. CO3 Understand and apply gravimetric analysis and complexometric titrations. CO4 Derive mathematical expressions of chemical kinetics methods.

Section A: Inorganic Chemistry

1. **Semi-micro qualitative analysis** (using H_2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:
2. Cations : NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+
3. Anions : CO_3^{2-} , S^{2-}, SO^{2-}, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_4^{3-},BO_3^{3-}, $C_2O_4^{2-}$, F^-*(Spot tests should be carried out wherever feasible)*
4. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximato) nickel(II) or aluminium as oximate in a given solution gravimetrically.
5. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
6. Estimation of total hardness of a given sample of water by omplexometric titration.

Section B: Physical Chemistry

Surface tension measurement (use of organic solvents excluded).

Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

Study of the variation of surface tension of a detergent solution with concentration.

Viscosity measurement (use of organic solvents excluded).

Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

Study of the variation of viscosity of an aqueous solution with concentration of solute.

Chemical Kinetics

Study the kinetics of the following reactions.

Initial rate method: Iodide-persulphate reaction

Integrated rate method:

Acid hydrolysis of methyl acetate with hydrochloric acid.

Saponification of ethyl acetate.

Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

**Perform any four experiments from each section*

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1	Vogel's Qualitative Inorganic Analysis	Svehla	Orient Longman
2	Vogel's Textbook of Quantitative Inorganic Analysis (revised),	J. Basseff, R.C. Dennery, G.H. Jeffery and J. Mendham	ELBS
3	Advanced Practical Physical Chemistry	J.B. Yadav	KRISHNA Prakashan Media (P) Ltd

ZOOLOGY IV: BIOSYSTEMATICS, TAXONOMY AND EVOLUTION PRACTICAL

Course Code	**ZOO264**
Course Title	**Zoology IV: Biosystematics, Taxonomy and Evolution Practical**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Life Sciences 1st Year
Course Objective (CO)	To give students knowledge about naming of animals and some evolutionary processes.
Course Outcome (CO)	

List of Experiments

1. Study of Homologous and Analogous Organs (Using charts/models/specimens)
2. Study of Vestigial Organs (Examples in humans and other animals)
3. Fossil Study (Types of fossils and fossilization (models/charts))
4. Comparative Anatomy (Vertebrate forelimbs (basic comparison))
5. Evolutionary history of horse (charts)
6. Evolutionary history of Rhino (charts)
7. Evolutionary history of man (charts)
8. Study of Museums
9. Study of ICZN and ICN principles (basic rules of nomenclature)
10. Identification of diagnostic characters
11. Study of basic of taxonomic keys

Text and Reference Books:

S. No.	Name/Title	Author	Publisher
1	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications
2	A Manual of Practical Zoology Invertebrates	P.S. Verma	S. Chand Publications
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications

IKS: PRACTICAL COURSE ON VRIKSHAYURVEDA

Course Code	**BOT272**
Course Title	**IKS: Practical Course on Vrikshayurveda**
Type of course	Theory
L T P	0 0 1
Credits	1
Course prerequisite	10+2 Medical
Course Objective (CO)	To carry out awareness of the traditional practices of Vrikshayurveda.
Course outcomes	CO1 Understanding about classification of Soil types CO2 Understanding about the transplantation methods of plants as per season and astrological factors CO3 Understanding about the preparation of plant nourishment and irrigation procedure as per ancient science CO4 Understanding about the identification of plant disease and treatment of these disease though traditional remedies CO5 Understanding about the establishment of Upavanakriya, Upvana and conservation of diversity as per ancient science

Practicals:

1. Classification of soil types (Anupa, Jangala, Samanya), land profile analysis, and soil selection for specific crops

2. Digging of planting pits, methods of transplantation, and timing for sowing based on seasonal and astrological factors.

3. Preparation and use of Kunapajala (fermented liquid manure) and Panchagavya. Irrigation (Nisecanavidh.

4. Diagnosis of plant diseases (Vata, Pitta, Kapha imbalances in plants) and their traditional remedies.

5. Layout of gardens (Upavana), botanical wonders (Kautuka), and planting near residential complexes.

6. Conservation and Resources: Underground water resources (Dakargala), land productivity, and protection of endangered medicinal plants.

Text and Reference books:

Sr No.	Book Title	Author	Publisher
1	Charaka Samhita	Agnivesha	
2	Sushruta Samh	Sushruta	
3	Vrikshayurveda	Surapala,	AAHF, Secunderabad
4	Kashyapiya KrishiSukti, 2002	Kashyap	AAHF, Secunderabad
5	A text book on Ancient History of Indian Agricuylture	Saxena R C, Chaudhary SL, Nene YL	AAHF, Secunderabad
6	Glimpses of the Agricultural Heritage of India	Nene YL,	AAHF, Secunderabad.

Minor Courses

SERICULTURE

Semester	**III**
Course Code	**ZOO265**
Course Title	**Sericulture**
Type of course	**Minor Course 1**
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc Ist year with zoology as core subject
Course Objective (CO)	**The aim of this course is to enable the students to** 1. To gain basic knowledge about reaing of silkworms for commercial production of silk. 2. Understand about various pests and diseases of silkworm.
Course Outcome (CO)	**By the end of this course, students will be able to:** 1. Gain knowledge about silkworm rearing and their products. 2. Know about life cycle of silkworm. 3. Start their own business i.e employbility.

UNIT-I

Introduction & Biology of Silkworm: Sericulture: Definition, history and present status, Mulberry and non-mulberry Sericulture. Life cycle of *Bombyx mori,* Structure of silk gland and secretion of silk

UNIT-II

Rearing of Silkworms: Rearing house and rearing appliances; Disinfectants: Formalin, bleaching powder, Silkworm rearing technology: Early age and Late age rearing. Types of mountages Spinning, harvesting and storage of cocoons

UNIT-III

Pests of silkworm: Uzi fly, dermestid beetles and vertebrates. P**athogenesis of silkworm diseases:** Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases.

UNIT-IV

Entrepreneurship in Sericulture: Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Visit to various sericulture centres.

Text and Reference Books

S. No.	Author(s)	Title	Publisher
1	Handbook of Practical Sericulture	S.R. Ullal and M.N. Narasimhanna	CSB,Bangalore
2	Handbook of Silkworm Rearing	Agriculture and Technical Manual-1	Fuzi Pub. Co. Ltd., Tokyo, Japan
3	Manual of Silkworm Egg Production	M. N. Narasimhanna	CSB,Bangalore

FLORICULTURE

Semester	**III**
Course Code	**BOT267**
Course Title	**Floriculture**
Type of course	Minor Course 2
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc 1st year
Course Objective (CO)	**The aim of this course is to enable the students to** 1. Know about the different types of gardens and their management 2. Learn about various nursery techniques and growth and cultivation of flower
Course Outcome	**By the end of this course, students will be able to understand:** 1. The history, importance and scope of gardening in India 2. Nursery management and routine gardening operation 3. Various types of ornamental plants and their propagation in different gardens area 4. Various types of gardens in the world and landscaping design in public areas 5. Cultivation of commercial flowering plants

UNIT-I

Introduction: History of gardening; Importance and scope of floriculture and landscape gardening.

Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.

UNIT-II

Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai.

UNIT-III

Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India.

Landscaping Places of Public Importance: Landscaping highways and Educational institutions.

UNIT-IV

Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold,Rose, Lilium, Orchids).

Diseases and Pests of Ornamental Plants.

Text and reference books:

S. No.	Title	Author	Publisher
1	Floriculture in India	Randhawa, G.S. and Mukhopadhyay, A	Allied Publishers.

ETHNOBOTANY

Semester	**IV**
Course Code	**BOT266**
Course Title	**Ethnobotany**
Type of course	Minor Course 3
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Life Sciences 1st Year
Course Objective	**The aim of this course is to enable the students to** 1. Impart knowledge various plants used in ethnobotany 2. Learn about various medicinal plants used by tribal people
Course Outcome	**By the end of this course, students will be able to understand:** 1. Concept, scope and importance of ethnobotany 2.Various ethnic tribals groups and use of plants in their daily life style 3. Filed work, collection of plants and herbarium preparation, 4. About plant sources of various modern drug and their conservation by ethnic tribal people 5. Legal aspects of ethnobotany, Biopiracy, IPR and Traditional Knowledge.

Unit 1: Ethnobotany

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 and miscellaneous uses.

Unit 2: Methodology of Ethnobotanical Studies

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

Unit 3: Role of Ethnobotany in Modern Medicine

Medico-ethnobotanical sources in India;Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiractha indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*. Role of ethnobotany in modern medicine with special example *Rauvolfia sepentina, Trichopus zeylanicus, Artemisia, Withania*. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

Unit 4: Ethnobotany and Legal Aspects

Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

Text and Reference books:

S. No.	Title	Author	Publisher
1	Manual of Ethnobotany,	S.K. Jain	Scientific Publishers, Jodhpur, 1995
2	Glimpses of Indian Ethnobotany	S.K. Jain (ed.)	Oxford and I B H, New Delhi – 1981
3	Ethnobotany – Principles and applications	Colton C.M. 1997	John Wiley and sons – Chichester
4	The Ethnobotany of Eastern Ghats in Andhra Pradesh, India.	Rama Ro, N and A.N. Henry (1996)	Botanical Survey of India. Howrah

AQUARIUM FISH KEEPING

Semester	**IV**
Course Code	**ZOO268**
Course Title	**Aquarium Fish Keeping**
Type of course	**Minor Course 4**
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Ist year with zoology as a core subject
Course Objective	**The aim of this course is to enable the students to** 1. Learn about basic principles, themes and steps to set up and maintain an aquarium. 2. Understand the classification of fish based on their characteristic features.
Course Outcome (CO)	**By the end of this course, students will be able to:** 1. Understand the key skills needed to set an aquarium. 2. Know about different aquarium/ornamental fishes. 3. Know about fish feed formulation. 4. Understand about fish transportation, handling , packing etc.

Unit1: Introduction to Aquarium Fish Keeping
The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes

Unit 2: Biology of Aquarium Fishes
Common characters and sexual dimorphism of Fresh water and Marine Aquariumfishessuch as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish andButterfly fish

Unit 3: Food and feeding of Aquarium fishes
Use of live fish feed organisms. Preparation and composition of formulated fish feeds

Unit 4: Fish Transportation
Live fish transport - Fish handling, packing and forwarding techniques.

Unit 5: Maintenance of Aquarium
General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as aCottage Industry.

Text and Reference books:

S. no.	Title	Author	Publisher
1	A textbook of Aquarium fish keeping	Dr. Hem Raj	S. Vinesh & Co.
2	Concept of Aquarium fish keeping	Dr. Sanjib Saha	Techno World
3	An introduction to fishes	S.S. Khanna	Surjeet Publication

Ability Enhancement Courses Semester-I to IV

COMMUNICATION SKILLS IN ENGLISH - I

Semester	**I**
Course Code	**AEC0010**
Course Title	**Communication Skills in English - I**
Type of course	Theory
L T P	2 0 0
Credits	2
Course prerequisite	+2 with any stream
Course Objective (CO)	Objectives of the course is to: 1. Equip the learner with proficiency in reading comprehension.. 2. Enable the learner with improved writing skills and command over official/ corporate communication. 3. Enhance the learners' range of vocabulary and knowledge of the essentials of grammar.
Course Outcome	At the conclusion of the course the learner will be able to: 1. Have fairly good proficiency in reading comprehension. 2. Have enhanced writing skills and command in official/ corporate communication. 3. Develop confidence in making presentation: oral or documentary.

UNIT-I

Basics of Communication Skills: Communication, Process of Communication, Types of Communication- Verbal and Non-verbal communication, Channels of Communication- Upward, Downward, Horizontal, Barriers to Communication, Role of Communication in society.

UNIT-II

Listening Skills: Listening Process, Hearing and Listening, Types of Listening, Effective Listening, Barriers to Effective Listening, Note Taking.

Reading Skills: Purpose of reading, Process of reading, Reading skills Models and strategies, scanning, skimming, SQ3R, Approaches of Reading, Comprehension passages for practice.

UNIT III

Writing Skills: Purpose of writing, Effective writing, Types of writing, Business Correspondence, Precis writing, Memo writing, Minutes of meeting.

UNIT-IV

Speaking Skills: Speech process, Skills for effective speaking, Role of audience, Feedback Skill, Oral Presentation.

Recommended Books:

Sr No	Author(s)	Title	Publisher
1.	Bhupender Kour	Effectual Communication Skills	S.K. Kataria and Sons
2.	R. Datta Roy and K.K. Dheer	Communications Skills	Vishal Publishing Company
3	The Essence of Effective Communication	Ludlow and Panton	Prentice Hall of India
4	Essentials of Business Communication	Pal and Korlahalli	S. Chand and Sons. New Delhi

COMMUNICATION SKILLS IN ENGLISH – II

Semester	**II**
Course Code	**AEC0011**
Course Title	**Communication Skills in English – II**
Type of Course	Theory
LTP	2 0 0
Credits	2
Course pre-requisite	NA
Course Objectives (CO)	Objectives of the course is to: 1. Equip the learner with proficiency in reading comprehension.. 2. Enable the learner with improved writing skills and command over official/ corporate communication. 3. Enhance the learners' range of vocabulary and knowledge of the essentials of grammar.
Course Outcome	At the conclusion of the course the learner will be able to: 1. Have fairly good proficiency in reading comprehension. 2. Have enhanced writing skills and have command in official/ corporate communication. 3. Develop confidence in making presentation; oral or documentary.

UNIT-I

Grammar: Parts of Speech, Use of appropriate tense, Voice , Reported Speech, Sentence Structure; Simple, Compound, Complex, Vocabulary-One word substitution.

UNIT-II

Writing Skills: Application for employment , Resume Writing ,Paragraph Writing Construction-Kinds of Paragraphs, Preparing of Matter for meeting : Notice, agenda, Conference

UNIT-III

Speaking Skills: Effective oral Presentation, Slide making, Use of audio-visual aids.

UNIT-IV

Oral Communication and its Application:

Group Discussion, Customer Care Relations (PR Skills), Interview Skills (Conducting and appearing for interviews), and Telephone handling manners.

Recommended Books

S.no	Name	Author(s)	Publisher
1	Business Communication	K. K. Sinha	Galgotia Publishing Company,
2	Media and Communication Management	C. S. Rayudu	- Himalaya Publishing House,
3	Essentials of Business Communication	Rajendra Pal and J. S. Korlahalli	Sultan Chand & Sons, New Delhi

COMMUNICATION SKILLS IN ENGLISH - III

Semester	**III**
Course Code	**AEC0012**
Course Title	**Communication Skills in English - III**
Type of Course	Theory
LTP	2 0 0
Credits	2
Course pre-requisite	NA
Course Objectives(CO)	After completion of this course students will be able to: 1. formulate an effective communication strategy for any message,in any medium, and in any situation. 2. write clearly, concisely, and convincingly. 3. develop skills of effective communication - both written and oral. acquaint themselves with application of these skills in outside world.

UNIT-I

Grammar: Parts of Speech, Clause, Phrase Use of appropriate tense, Voice , Reported Speech, Sentence Structure; Simple, Compound, Complex, Vocabulary-One word substitution.

UNIT-II

Writing Skills: Application for employment , Resume Writing ,Paragraph Writing Construction- Kinds of Paragraphs, Preparing of Matter for meeting : Notice, agenda, Conference

UNIT-III

Speaking Skills: Effective oral Presentation, Slide making, Use of audio-visual aids.

UNIT-IV

Oral Communication and its Application:
Group Discussion, Customer Care Relations (PR Skills), Interview Skills (Conducting and appearing for interviews), and Telephone handling manners.

Recommended Books

S. No.	Name	Author(s)	Publisher
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3	Essentials of Business Communication	Rajendra Pal and J. S. Korlahalli	Sultan Chand & Sons, New Delhi

COMMUNICATION SKILLS IN ENGLISH - IV

Semester	**IV**
Course Code	**AEC0013**
Course Title	**Communication Skills in English - IV**
Type of Course	Theory
LTP	2 0 0
Credits	2
Course prerequisite	NA
Course Objectives (CO)	After completion of this course students will be able to: 1. Formulate an effective communication strategy for any message, in any medium, and in any situation. 2. Write clearly, concisely, and convincingly. 3. Develop skills of effective communication - both written and oral. 4. Acquaint themselves with application of these skills in outside world.

UNIT I

Social Communication Skills Conversational English, Appropriateness, Building rapport

UNIT II

Context Based Speaking In general situations, In specific professional situations, Discussion and associated vocabulary, Simulations/Role Play

UNIT III

Non-Verbal Communication Relevance and effective usage, Paralanguage, Chronemics, Haptics, Proxemics, Body language, Object language

UNIT IV

Business Presentation Audience Analysis, Preparing effective Power Point presentation, Delivering of presentation, Handling questions

Recommended Books

S. No.	Name	Author(s)	Publisher
1	Business Communication	Anjanee Sethi & Bhavana Adhikari	Tata McGraw Hill
2	Speaking Effectively	Jeremy Comfort	CUP
3	Business Communication	Raman Prakash	OUP
4	Working in English	Leo Jones	CUP

Value Added Courses
Semester-I & II

ENVIRONMENT EDUCATION

Course Code	EVS200
Course Name	**Environment Education**
Course Type	Theory (Compulsory for undergraduate students)
Contact Hours (L:T:P)	4 0 0
Credits (L:T:P)	4
Course pre requisite	10+2
Course Objective (CO)	To connect and sensitize the students towards the environment and prevailing Environmental issues (natural, physical, social and cultural).
Course Outcomes (CO)	The student will able to: 1. Appreciate the historical context of human interactions with the environment. 2. Develop an understanding of pollution and its types 3. Learn about the concept of Ecosystem, Ecosystem services 4. Learn about climate change and biodiversity conservation 5. Understand the relation between social issues and environment. 6. Learn about the major international treaties and our country's stand on and responses to the major international agreements.

UNIT I

Historical Prospective: Brief introduction of Humans as hunter-gatherers; Mastery of fire; Origin of agriculture, Emergence of city-states; Indic Knowledge and Culture of sustainability, Industrial revolution and its impact on the environment; Population growth and natural resource exploitation

Environment Definition and scope and importance. Environmental Ethics and emergence of environmentalism: World Commission on Environment and Development and the concept of sustainable development; Rio Summit and subsequent international efforts.

Natural Resources: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources, soil and mineral resources. Sustainable Development Goals (SDGs)-targets and indicators, challenges and strategies for SDGs.

UNIT II

Environmental Pollution: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes.

Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Biodiversity loss: past and current trends, impact

Global change: Ozone layer depletion; Climate change. Disasters–Natural and Man-made (Anthropogenic).

Biodiversity and its distribution: Biodiversity as a natural resource. Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories.

Ecosystemsinbrief:forests,wetlands,grasslands,agriculture,coastalandmarine.

Ecosystemservices-classificationandtheirSignificance,Threatstobiodiversityandecosystems Biodiversity Conservation: Major conservation policies: in-situ and ex-situ conservation approaches therole of traditional knowledge, community-based conservation.

UNIT III

Understanding climate change: Anthropogenic climatechange from greenhouse gas emissions, Climate change impact on global warminganditseffect on Indian Subcontinent, rise ofsealevel, Changesin marineand coastal ecosystems, Impacts on animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment. Mitigation of climate change, National climate action plan.

Introductiontoenvironmentallawsandregulation:Constitutionalprovisions-Article48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest,wildlife and

pollution control. Environmental management system: ISO 14001ConceptofCircularEconomy,Lifecycleanalysis;Cost-benefitanalysis.Environmentalaudit andimpactassessment;WasteManagement-Conceptof3R(Reduce,RecycleandReuse)and sustainability; Eco labeling /Eco mark scheme.

UNIT IV

Social Issues and the Environment: Unsustainable to Sustainable development, urban problems related to energy, Water conservation, rain water harvesting, and watershed management. Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Major InternationalEnvironmentalAgreements andNationalActs: CBD, Cartagena Protocol on Biosafety; Nagoya Protocol on Access and Benefit-sharing, (CITES);RamseurConventiononWetlandsof InternationalImportance;EnvironmentProtection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation Public awareness.

Case Studies and Field Work (Any two): Discussion on onenational and oneinternationalcase study related to the environment and sustainable development. Or Field visits to identify local/regional environmental issues, make observations including data collection and prepare a brief report. Or Participation in plantation drive and nature camps. Or Documentation of campus biodiversity

Text and reference books:

S. No	Name	Author(S)	Publisher
1	Environmental Biology	Agarwal,K.C.2001	Nidi Publ. Ltd. Bikaner.
2	Environmental Science	Miller T.G. Jr.	Wadsworth
3	Perspectives in Environmental Studies	AnubhaKaushikand Gaurav Garg	New Age International Publishers
4	A Handbook on International Environment Conventions & Programmes	2019	Ministry of Environment, Forest and Climate Change
5	Introduction to Environmental Management 2nd Edition	Theodore,M.K.and Theodore, Louis (2021)	CRCPress.
6	Climate Change: The Science, Impacts and Solutions. 2nd Edition	Pittock,Barrie(2009)	Routledge.
7	Textbook of Biodiversity	Krishnamurthy,K.V. (2003)	Science Publishers, Plymouth, U

Vocational Courses (VOC)
Semester - II

Vocational Course/Summer Internship

Course Code	**VOC002**	
Course Title	**Landscaping and Nursery Management**	
Type of course	Vocational Course (VOC)	
L T P	Practicum	
Credits	0:0:16	
Course prerequisite	10+2	
Course Objective	To generate awareness about Plants, Gardening and Landscaping activity as a self-employment occupation and its significance for remaing physically fit..	
Course Outcome	CO1	Student will gain knowledge of all round knowledge of landscaping as an agri-business enterprise rather than as a community profession
	CO2	Student will gain knowledge of characteristics of plant material, their use, care and maintenance and suitable areas for landscaping.
	CO3	Students will learn about effective management of landscaping.
	CO4	Students will learn about landscaping activity as an agri- business enterprise by liaising with different stake holders

1. To study about salient Features of Gardening In India, Aryan's Period, Buddhist Period, Kanishka And Gupta Period, Mughal Period, Rajput King Period, Britishers Period, Post Independence Period.
2. To study about important and Famous Botanical and Pleasure Gardens of India.
3. Hedges and Edge plants.
4. Lawn and its importance.
5. Landscaping as a business.
6. Introduction to Entrepreneurship.
7. Introduction to Plant-based or Agri-Business Mangment and Startups.
8. Site analysis for Landscaping.
9. Plant selection for landscaping.
10. Raising nursery beds, sowing seeds, raising nurseries
11. Propagations of plants through cuttings
12. Weed management in the nurseries and nutrient addition
13. On hand practice of landscaping
14. Visit to a hi-tech nursery.
15. Visit to different landscape gardens.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Introductory Ornamental Horticulture	Arora, J.S	Kalyani Publishers, Ludhiana
2	Flowers and Trees	Randhawa, M.S.,	National book trust-New Delhi
3	Home gardening	Trivedy . P.P. 1987.	ECA Publication
4	Gardening in India,	Bose T K and Mukerjee D	Oxford Book House
5	Hi Tech Horticulture	S Parsad, Dharam Singh and B L Bhardwaj	Agro Bios
6	Greenhouse Management for Horticulture Crops	S Prasad and U Kumar	Agro Bios

VERMI-TECHNOLOGY

Course Code	**VOOC005**
Course Title	**Vermi-technology**
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. Non-Medical or B. Sc. Medical with Zoology as main subject
Course Objective	This course describes about economic importance of earthworms and vermicomposting and value of vermicompost
Course Outcomes	The students will able to: 1. On successful completion of this course, students should acquire the detailed knowledge of: 2. Knowledge about earthworms 3. Economic importance of vermicompost and its role in organic farming

Syllabus

Theory Course

UNIT–I

Vermitechnology- Definition, history, growth and development in other countries & India, significance. Vermiculture – definition, scope and importance; common species for culture; Environmental parmeters; culture methods – wormery – breeding techniques; indoor and out door cultures - monoculture and polyculture – merits and demerits.

UNIT – II

Vermicomposting of wastes in field pits, ground heaps, tank method, roof shed method, static pile windrows, top fed windrows, wedges & bin method, harvesting the compost, storage, Vermiwash-Preparation and application.

UNIT – III

Applications of vermiculture – Vermiculture Bio-technology, vermi-composting, use of vermicastings in organic farming/horticulture, earthworms for management of municipal/selected biomedical solid wastes; as feed/bait for capture/culture fisheries; forest regeneration.

UNIT – IV

Future perspectives – Predator / pathogen control in wormeries; Potentials and constraints for vermiculture in India. Marketing the products of vermiculture – quality control, market research, marketing techniques – creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing. Visit to relevant Labs/Field Visits

Text Books

S. No.	Name/Title	Author	Publisher
1	Earthworm vermiculture and vermin-composting	Sultan Ahmed Ismail	Kalyani Publishers, New Delhi
2	Vermitechnology	Mary Violet Christy	MJP Publishers, Chennai
3	Verms & Vermitechnology	Aravind Kumar	A.P.H. Publishing Corporation, New Delhi.